An Annotated Bibliography of Camera Trap Literature: 1991-2013

Dr. Timothy O'Brien

We Stand for Wildlife

WCS envisions a world where wildlife thrives in healthy lands and seas, valued by societies that embrace and benefit from the diversity and integrity of life on earth.

WCS uses science to discover and understand the natural world. This knowledge helps us engage and inspire decision-makers, communities and millions of supporters to take action with us to protect the wildlife and wild places we all care about.

SAVING WILDLIFE

WCS scientists study what wildlife need to thrive. With this knowledge we invest in abating threats to wildlife within their most important strongholds and the corridors that connect them. We target large, iconic, wide-ranging wildlife because they are vital to ecosystem health and, by saving them, we protect all other biodiversity that shelters under their conservation canopy.

SAVING WILD PLACES

Over the past century, WCS has established long-term conservation presence in the last wild places across the Americas, Africa, Asia and Oceania, built strong and trusting partnerships, and acquired a depth of knowledge that ensures effective conservation action. We protect these last wild places because they are intact, biodiverse, most resilient to climate change, and bastions for large, iconic wildlife.

An Annotated Bibliography of Camera Trap Literature: 1991-2013

By Tim O'Brien

Dr. Timothy O'Brien
Wildlife Conservation Society
Conservation Measures
Email: tobrien@wcs.org

Suggested citation:
O'Brien, T., 2015. An Annotated Bibliography of Camera Trap Literature: 1991-2013. WCS Working Paper No. 46 New York: Wildlife Conservation Society.

Cover photograph: Common leopard (Panthera pardus), Lion (P. leo) and tiger (P. tigris) © T.G. O'Brien and M.F. Kinnaird.

Table of Contents

INTRODUCTION

The growth of camera trapping as a tool for monitoring and ecological studies has been exponential in the past 15 years. To help interested people find information on camera trap studies, I have prepared a bibliography on camera trap publications in journals that are tracked by the Web of Science (accessed 5 November 2013 and 27 January 2014). The bibliography is extensive but not exhaustive. Many articles may simply be missed by Web of Science. Unfortunately, I have not mastered the art of searching books edited volumeson Web of Science, so the numerous articles in edited volumes such as *Camera Traps in Animal Ecology: Methods and Analyses* (O'Connell, Nichols and Karanth, 2011) and other edited volumes, proceedings, and grey literature are not covered.

The organization of the bibliography is alphabetical within year. The format is similar to the downloaded information from Web of Science and includes the abstract for each article that had an associated abstract. This is to help make it easier to update over time. If you would like to make a contribution, please contact me by email (tobrien@wcs.org) and include your information in a format similar to that used in this document.

1 January 2013 to 31 December 20013

Ahumada, JA, Hurtado, J, Lizcano, D. 2013. Monitoring the Status and Trends of Tropical Forest Terrestrial Vertebrate Communities from Camera Trap Data: A Tool for Conservation. PLOS ONE 8(9): e73707

Reducing the loss of biodiversity is key to ensure the future well being of the planet. Indicators to measure the state of biodiversity should come from primary data that are collected using consistent field methods across several sites, longitudinal, and derived using sound statistical methods that correct for observation/detection bias. In this paper we analyze camera trap data

collected between 2008 and 2012 at a site in Costa Rica (Volcan Barva transect) as part of an ongoing tropical forest global monitoring network (Tropical Ecology Assessment and Monitoring Network). We estimated occupancy dynamics for 13 species of mammals, using a hierarchical modeling approach. We calculated detection-corrected species richness and the Wildlife Picture Index, a promising new indicator derived from camera trap data that measures changes in biodiversity from the occupancy estimates of individual species. Our results show that 3 out of 13 species showed significant declines in occupancy over 5 years (lowland paca, Central American agouti, nine-banded armadillo). We hypothesize that hunting, competition and/or increased predation for paca and agouti might explain these patterns. Species richness and the Wildlife Picture Index are relatively stable at the site, but small herbivores that are hunted showed a decline in diversity of about 25%. We demonstrate the usefulness of longitudinal camera trap deployments coupled with modern statistical methods and advocate for the use of this approach in monitoring and developing global and national indicators for biodiversity change.

Ambarli, H, Bilgin, CC. 2013. First record of a melanistic golden jackal (*Canis aureus*, Canidae) from Turkey. MAMMALIA 77(2):219-222.

The golden jackal is a locally common mammal species widely distributed along the Black Sea and other coastal regions of Turkey. Between February 2009 and April 2010, we conducted a camera trap study in Artvin, northeastern Turkey that revealed the presence of ten medium or large mammal species. We report here the first ever photographic evidence of a melanistic golden jackal, along with its normal-colored probable mate. Dark fur color in wolves has been shown to be historically transferred from domestic dogs, and interbreeding among wolves, coyotes and dogs is well documented. However, we consider this an unlikely mechanism for the present observation, and instead suggest independent mutation as the source of this possibly adaptive trait.

Bellan, SE, Gimenez, O, Choquet, R, Getz, WM. 2013. A hierarchical distance sampling approach to estimating mortality rates from opportunistic carcass surveillance data. METHODS IN ECOLOGY AND EVOLUTION 4(4):361-369.

Distance sampling is widely used to estimate the abundance or density of wildlife populations. Methods to estimate wildlife mortality rates have developed largely independently from distance sampling, despite the conceptual similarities between estimation of cumulative mortality and the population density of living animals. Conventional distance sampling analyses rely on the assumption that animals are distributed uniformly with respect to transects and thus require randomised placement of transects during survey design. Because mortality events are rare, however, it is often not possible to obtain precise estimates in this way without infeasible levels of effort. A great deal of wildlife data, including mortality data, are available via road-based surveys. Interpreting these data in a distance sampling framework requires accounting for the non-uniformity of sampling. In addition, analyses of opportunistic mortality data must account for the decline in carcass detectability through time. We develop several extensions to distance sampling theory to address these problems. We build mortality estimators in a hierarchical framework that integrates animal movement data, surveillance effort data and motion-sensor camera trap data, respectively, to relax the uniformity assumption, account for spatiotemporal variation in surveillance effort and explicitly model carcass detection and disappearance as competing ongoing processes. Analysis of simulated data showed that our estimators were unbiased and that their confidence intervals had good coverage. We also illustrate our approach on opportunistic carcass surveillance data acquired in 2010 during an anthrax outbreak in the plains zebra of Etosha National Park, Namibia. The methods developed here will allow researchers and managers to infer mortality rates from opportunistic surveillance data.

Bernard, H, Ahmad, AH, Brodie, J, Giordano, AJ, Lakim, M, Amat, R, Hue, SKP, Khee, LS, Tuuga, A, Malim, PT, Lim-Hasegawa, D, Wai, YS, Sinun,

W. 2103. Camera-trapping survey of mammals in and around Imbak Canyon Conservation Area in Sabah, Malaysian Borneo. RAFFLES BULLETIN OF ZOOLOGY 61(2)861-870.

As part of an effort to develop a comprehensive management plan for the Imbak Canyon Conservation Area in central Sabah, Malaysian Borneo, we conducted a rapid but extensive mammal survey using camera-trapping techniques. We gathered baseline data on mammal species richness and community composition, as well as information on activity patterns for some mammal species. Eighty motion-triggered digital camera-traps were set in the primary and logged forests in and around the Imbak Canyon. The total accumulated camera-trapping effort of 1,436 camera trap-nights yielded 1,641 digital photographs of mammals represented by 27 species in 14 families and five orders. The species photo-captured included common species, as well as rare and elusive species and species that are of high conservation value, such as the Sunda clouded leopard, *Neofelis diardi* and orang utan, *Pongo pygmaeus*. Our results indicated that the primary forest of the Imbak Canyon and its surrounding disturbed forests are important habitats for mammal conservation. Of particular importance are the carnivores, with 13 species recorded. Game animals, such as bearded pig, *Sus barbatus*, muntjac, *Muntiacus* spp., and mousedeer, *Tragulus* spp., were found to be among the most frequently photo-captured and the most widespread species. The activity patterns of mammals investigated did not show that they were affected by human activities. Even so, we found substantial evidence of poaching and illegal collection of the aromatic gaharu tree resin (*Aquilaria* spp.) in the surveyed areas, raising management concerns and highlighting the urgent need for law enforcement activities in the area.

Blake, JG, Mosquera, D, Salvador, J. 2013. Use of mineral licks by mammals and birds in hunted and non-hunted areas of Yasuni National Park, Ecuador. ANIMAL CONSERVATION 16(4):430-437.

Mineral licks are sites where a diverse array of mammals and birds consume soil or drink water, likely for mineral supplementation. Many of those same animals are targets of hunters. Camera traps triggered by heat and motion were used to document use of mineral licks by birds and mammals over approximately 2 months at two lowland forest sites in eastern Ecuador, one that has experienced considerable hunting by indigenous Waorani (four mineral licks) and one that is largely unaffected by hunting (five licks). We obtained 264 photographs representing nine mammal species and one photograph of a bird at the hunted site; 1123 photographs of 12 mammal species and 73 of three bird species were obtained at the site without hunting. Photographs were counted if at least 30min elapsed between photographs of the same species at the same camera location. Activity (photographs/100 trap-days) was higher at all licks at the site without hunting (mean=436; range 276-665/100 trap-days) than at the hunted site (mean=123; range 89-151/100 trap-days). Diurnal activity was, overall, lower at the hunted site, particularly during the middle of the day. Species not recorded at the hunted site included two primates (white-bellied spider monkey *Ateles belzebuth*; Venezuelan red howler monkey *Alouatta seniculus*), white-lipped peccary, *Tayassu pecari* and two large-bodied birds (common piping-guan, *Pipile pipile*; Salvin's curassow, *Mitu salvini*); all are common prey of local hunters. Red brocket deer, *Mazama americana* was the most frequently photographed species at both sites, but was less active during the day at the hunted site.

Blanc, L, Marboutin, E, Gatti, S, Gimenez, O. 2013. Abundance of rare and elusive species: Empirical investigation of closed versus spatially explicit capture-recapture models with lynx as a case study. JOURNAL OF WILDLIFE MANAGEMENT 77(2):372-378.

Effective conservation and management require reliable monitoring methods and estimates of abundance to prioritize human and financial investments. Camera trapping is a non-invasive sampling method allowing the use of capture-recapture (CR) models to estimate abundance while accounting for the difficulty of detecting individuals in the wild. We investigated the

relative performance of standard closed CR models and spatially explicit CR models (SECR) that incorporate spatial information in the data. Using simulations, we considered 4 scenarios comparing low versus high detection probability and small versus large populations and contrasted abundance estimates obtained from both approaches. Standard CR and SECR models both provided minimally biased abundance estimates, but precision was improved when using SECR models. The associated confidence intervals also provided better coverage than their non-spatial counterpart. We concluded SECR models exhibit better statistical performance than standard closed CR models and allow for sound management strategies based on density maps of activity centers. To illustrate the comparison, we considered the Eurasian lynx (*Lynx lynx*) as a case study that provided the first abundance estimates of a local population in France.

Borchard, P. 2013. Using camera-trap data to model habitat use by wombats and cattle in Australian riparian ecosystems. APPLIED ECOLOGY AND ENVIRONMENTAL RESEARCH 11(1):21-33.

Common Wombats (*Vombatus ursinus*) are an enigmatic south east Australian agricultural riparian species which may improve riparian landscape heterogeneity via their burrowing activity. At the same time they are often accused of causing soil erosion. As populations of wombats in other landscapes are under threat due to habitat disturbance, road mortality and disease, knowledge of the factors determining their distribution and abundance are important for their conservation and management. Since the European colonization of Australia, riparian areas have been utilized by domestic cattle (*Bos taurus*) usually resulting in a decline in biodiversity. Camera trap data was used to investigate the habitat use by wombats and cattle in Eastern Riverine Forests. The relationship between camera trapping and ecological and meteorological variables was investigated using logistic regression modelling. Wombats and cattle were the most common mammals recorded across all sites with 468 photographs of wombats and 106 of cattle recorded. The meteorological and ecological variables that

had a significant effect on the observation of a wombat or a cow were time of day, humidity, lower storey canopy cover and the summer season. This study highlights the usefulness of camera trapping as a tool of conservation and management in an agricultural riparian landscape.

Brodie, JF, Giordano, A. 2013. Lack of trophic release with large mammal predators and prey in Borneo. BIOLOGICAL CONSERVATION 163(SI):58-67

When humans reduce top carnivore abundance in insular systems, herbivore populations may increase, with cascading impacts on the community. But the prevalence of such "trophic release" effects in non-insular ecosystems remains little known, particularly in tropical ecosystems. We assessed whether areas with low top carnivore abundance were associated with greater abundance of herbivores across seven rainforest study areas in Malaysian Borneo. We deployed 134 camera-trap stations and analyzed the resulting photographic detections from 16,608 trap-days using multi-species occupancy models that estimate abundance while accounting for imperfect detectability. Estimated local abundance of Sunda clouded leopards (*Neofelis diardi*), the apex mammalian predator, varied from 0.0 to 3.5 individuals per camera location. Clouded leopard abundance was not negatively correlated with the abundance of any of the four prey species that we analyzed. Rather, sites with few or no clouded leopards also had the lowest estimated abundance of pig-tailed macaques (*Macaca nemestrina*). Estimated abundance of muntjac (*Muntiacus* spp.) and mousedeer (*Tragulus* spp.) was statistically unrelated to estimated clouded leopard abundance. Bearded pig (*Sus barbatus*) abundance was likewise unaffected by predator abundance, but pigs appear to live in larger groups when clouded leopards are common, possibly to better defend their young. We found no evidence of trophic release, an important conservation threat in other areas, in this ecosystem, particularly relative to the massive impacts of agricultural conversion, habitat degradation, and unsustainable wildlife exploitation.

Carter, NH, Gurung, B, Vina, A, Campa, H, Karki, JB, Liu, JG. 2013. Assessing spatiotemporal changes in tiger habitat across different land management regimes. ECOSPHERE 4(10): DI 10.1890/ES13-00191.1

Human-induced habitat loss and degradation are increasing the extinction probability of many wildlife species worldwide, thus protecting habitat is crucial. The habitat of thousands of imperiled wildlife species occurs in a variety of land management regimes (e.g., protected areas, multiple-use areas), each exerting differing effects. We used the globally endangered tiger (*Panthera tigris*) to examine the relationships between habitat change and land management in Nepal's Chitwan district, a global biodiversity hotspot. We evaluated the effects of environmental and human factors on tiger habitat based on data acquired by motion-detecting cameras and space-borne imaging sensors. Spatiotemporal habitat dynamics in Chitwan National Park and a multiple-use area outside the park were then evaluated in three time periods (1989, 1999, and 2009). Our results indicate that tigers preferred areas with more grasslands and higher landscape connectivity. The area of highly suitable habitat decreased inside the park over the entire 20 year interval, while outside the park habitat suitability increased, especially from 1999 to 2009. The loss of highly suitable habitat inside the park may be associated with an increasing trend of unauthorized resource extraction by a rapidly growing human population, coupled with natural processes such as flooding and forest succession. In contrast, community-based management of natural resources and the prohibition of livestock grazing since the late 1990s likely improved tiger habitat suitability outside the park. Results of this study are useful for evaluating habitat change and guiding conservation actions across the tiger range, which spans 13 countries. Moreover, quantitatively assessing habitat change across different land management regimes in human-dominated areas provides insights for conserving habitat of other

Carter, NH, Gurung, B, Vina, A, Campa, H, Karki, JB, Liu, JG. 2013. Assessing spatiotemporal changes in tiger habitat across different land management regimes. ECOSPHERE 4(10): DI 10.1890/ES13-00191.1

Human-induced habitat loss and degradation are increasing the extinction probability of many wildlife species worldwide, thus protecting habitat is crucial. The habitat of thousands of imperiled wildlife species occurs in a variety of land management regimes (e.g., protected areas, multiple-use areas), each exerting differing effects. We used the globally endangered tiger (*Panthera tigris*) to examine the relationships between habitat change and land management in Nepal's Chitwan district, a global biodiversity hotspot. We evaluated the effects of environmental and human factors on tiger habitat based on data acquired by motion-detecting cameras and space-borne imaging sensors. Spatiotemporal habitat dynamics in Chitwan National Park and a multiple-use area outside the park were then evaluated in three time periods (1989, 1999, and 2009). Our results indicate that tigers preferred areas with more grasslands and higher landscape connectivity. The area of highly suitable habitat decreased inside the park over the entire 20 year interval, while outside the park habitat suitability increased, especially from 1999 to 2009. The loss of highly suitable habitat inside the park may be associated with an increasing trend of unauthorized resource extraction by a rapidly growing human population, coupled with natural processes such as flooding and forest succession. In contrast, community-based management of natural resources and the prohibition of livestock grazing since the late 1990s likely improved tiger habitat suitability outside the park. Results of this study are useful for evaluating habitat change and guiding conservation actions across the tiger range, which spans 13 countries. Moreover, quantitatively assessing habitat change across different land management regimes in human-dominated areas provides insights for conserving habitat of other imperiled wildlife species around the world.

Cid, B, Oliveira-Santos, LGR, Mourao, G. 2013. Seasonal Habitat Use of Agoutis (*Dasyprocta azarae*) is Driven by the Palm *Attalea phalerata* in Brazilian Pantanal. BIOTROPICA 45(3):380-385.

Resource availability can influence animal movement causing changes in home-range size and arrangement between seasons. We investigated the influence of acuri palm (*Attalea phalerata*) on the occupancy of agouti *Dasyprocta azare* during both the dry and rainy seasons, as well as the abandonment probabilities in the transition between seasons in the Brazilian Pantanal. The agoutis occupied a high proportion of the forested areas in the rainy season (0.83), but the occupancy decreased in the dry season (0.39). In the rainy season, occupancy by agoutis was not correlated with acuri palm availability, while in the dry season, it was positively correlated with the palm's availability. The acuri palm availability also drove the agoutis' probability of site abandonment from the rainy to the dry season, with higher abandonment probability in sites with low acuri palm availability. These findings show that this large-seeded palm can be an important resource for the agoutis' populations during the fruit-scarcity period. The acuri palm seeds may be particularly important for agoutis using fragmented forests, given that the large-seeded palms are able to persist even in small fragments, which is untrue for other important resource.

Cozzi, G, Broekhuis, F, McNutt, JW, Schmid, B. 2013. Density and habitat use of lions and spotted hyenas in northern Botswana and the influence of survey and ecological variables on call-in survey estimation. BIODIVERSITY AND CONSERVATION 22(12):2937-2956.

Top predators significantly impact ecosystem dynamics and act as important indicator species for ecosystem health. However, reliable density estimates for top predators, considered necessary for the development of management plans and ecosystem monitoring, are challenging to obtain. This study aims to establish baseline density estimates for two top predators,

spotted hyena and lion, in the Okavango Delta in northern Botswana. Using calling stations, we surveyed free-ranging populations of the two species and investigated methodological variables that might influence results about distributions and densities, including habitat type, seasonality, and different types of playback sounds. Calling stations were distributed over a survey area of approximately 1,800 km^2 characterized by three major habitat types: mopane woodland, floodplain and mixed acacia sandveld. Results indicate spotted hyenas were evenly distributed independent of habitat type and season throughout the survey area with an overall density estimate of 14.4 adults/100 km^2. In contrast, lion distribution and density varied significantly with habitat and season. Lion density in the prey-poor mopane woodland was near zero, while in the comparatively prey-rich floodplains it was estimated at 23.1 individuals/100 km^2 resulting in a weighted average density of 5.8 individuals/100 km^2 across the entire study area. In testing the effect of varying playback sounds we found that both species were significantly more likely to respond to calls of conspecifics. Our results show how several methodological variables may influence density estimates and emphasize the importance of standardized calling-station survey methods to allow consistent replication of surveys and comparison of results that can be used for landscape-scale monitoring of large predator species.

Crook, N, Cairns, SC, Vernes, K. 2013. Bare-nosed wombats (*Vombatus ursinus*) use drainage culverts to cross roads. AUSTRALIAN MAMMALOGY 35(1):23-29.

Despite drainage culverts being numerous along highways, there is a scarcity of data evaluating their use as roadway underpasses by wildlife, including the bare-nosed wombat (*Vombatus ursinus*), a large marsupial that is involved in substantial numbers of vehicle collisions in New South Wales. Culvert use was measured with camera traps positioned at 19 drainage culverts along an 8-km stretch of 'Thunderbolt's Way' near Nowendoc on the Northern Tableland, north-eastern New South Wales. The estimated probability of the occupancy/use of a culvert by a wombat was 0.46 ± 0.10. Culvert use was related to structural variables (e.g.

diameter and length) and both the distance to the next adjacent culvert and to forest cover. This suggests that wombats readily use drainage culverts to cross under roads and that these structures could be modified (e.g. by maintaining proximate forest cover) to increase the likelihood that wombats would use them, thus reducing vehicle collisions and road mortality of wombats.

Di Bitetti, MS, Albanesi, SA, Foguet, MJ, De Angelo, C, Brown, AD. 2013. The effect of anthropic pressures and elevation on the large and medium-sized terrestrial mammals of the subtropical mountain forests (Yungas) of NW Argentina. MAMMALIAN BIOLOGY 78(1)21-27.

We conducted a 55-day long camera-trap survey in the Yungas subtropical forest in NW Argentina, to assess the effect of human accessibility, conservation status of the area, domestic animals and elevation on the diversity and composition of the large and medium-sized native terrestrial mammal assemblage. We deployed 24 camera-trap stations at distances of similar to 2 km from each other. The study area is covered by continuous forest and has its center in the small community of Acambuco, in the Acambuco Provincial Reserve. The main economic activity in the area is oil/gas exploitation. Local residents raise cattle, hunt and use timber and non-timber forest products. The human impact was indirectly measured with an accessibility cost model. We used a multiple regression ANCOVA to assess the effect of elevation (range: 628-1170 masl), accessibility, protection status (reserve vs not) and frequency of records of domestic animals on the native mammal species richness and on a nonmetric multidimensional scaling (NMDS) ordination based on the frequency of records of the native mammals recorded at >3 camera-trap stations. We recorded 15 species of native mammals. Native mammal species richness decreased with elevation. Elevation was correlated with NMDS axes. Other predictive variables had no effect on species richness or the NMDS ordination, probably as a result of the relatively narrow range of conditions assessed in this study. The effect of elevation on mammal assemblages

should be considered in landscape planning processes aimed at promoting biodiversity conservation.

Engeman, RM, Massei, G, Sage, M, Gentle, MN. 2013. Monitoring wild pig populations: a review of methods. ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH 20(11):8077-8091.

Wild pigs (*Sus scrofa*) are widespread across many landscapes throughout the world and are considered to be an invasive pest to agriculture and the environment, or conversely a native or desired game species and resource for hunting. Wild pig population monitoring is often required for a variety of management or research objectives, and many methods and analyses for monitoring abundance are available. Here, we describe monitoring methods that have proven or potential applications to wild pig management. We describe the advantages and disadvantages of methods so that potential users can efficiently consider and identify the option(s) best suited to their combination of objectives, circumstances, and resources. This paper offers guidance to wildlife managers, researchers, and stakeholders considering population monitoring of wild pigs and will help ensure that they can fulfill their monitoring objectives while optimizing their use of resources.

Foster, VC, Sarmento, P, Sollmann, R, Torres, N, Jacomo, ATA, Negroes, N, Fonseca, C, Silveira, L. 2013. Jaguar and Puma Activity Patterns and Predator-Prey Interactions in Four Brazilian Biomes. BIOTROPICA 45(3):373-379.

Jaguars (*Panthera onca*) and pumas (*Puma concolor*) coexist throughout the Neotropics. Using camera trapping in four Brazilian biomes, we compare the daily activity patterns of the jaguar and puma, and their relationships with their main prey species. We used a kernel density method to quantify

daily activity patterns and to investigate overlap between these predators and their main prey. Both cats showed intensive nocturnal and crepuscular activity (0.69 and 0.14 kernel density, respectively, for jaguars; 0.68 and 0.19 kernel density, respectively, for pumas). Only in the Pantanal did we observe a pattern of concentrated diurnal activity for both species. We found little temporal segregation between jaguars and pumas, as they showed similar activity patterns with high coefficients of overlapping (average 1=0.86; SE=0.15). We also observed a significant overlap between the activity patterns of the predators and their main prey species, suggesting that both predators adjust their activity to reduce their foraging energy expenditure. Our findings suggest that temporal partitioning is probably not a generalized mechanism of coexistence between jaguars and pumas; instead, the partitioning of habitat/space use and food resources may play a larger role in mediating top predator coexistence. Knowledge about these behavior aspects is crucial to elucidating the factors that enable coexistence of jaguars and pumas. Furthermore, an understanding of their respective activity periods is relevant to management and associated research efforts.

Fusco-Costa, R, Ingberman, B. 2103. Records of the bush dog *Speothos venaticus* in a continuous remnant of coastal Atlantic Forest in southern Brazil. ORYX *47*(1):105-108.

The bush dog *Speothos venaticus*, a rarely seen Neotropical canid categorized as Near Threatened globally, is categorized as Vulnerable in Brazil. In the Atlantic Forest occurrence data of this species are extremely rare. Here we document new records of the bush dog in four reserves in a large remnant of continuous coastal Atlantic Forest in Parana state, southern Brazil. From a total of 4,112 trap days in two camera-trap surveys in 2009 and 2011 we obtained one opportunistic sighting and three independent photographic records of the bush dog. Additionally, park guards reported previous sightings (> 4 years earlier) in three of these reserves, including the reserve where we did not record the species. Our results indicate that the remnant coastal Atlantic Forest of Parana state is an important region

for the conservation of the bush dog in southern Brazil. Given the rarity of this species in its natural habitat we suggest that conservation efforts in this region should focus on minimizing the potential threats (prey depletion from poaching and disease transmission from domestic dog) to the species.

Galvez, N, Hernandez, F, Laker, J, Gilabert, H, Petitpas, R, Bonacic, C, Gimona, A, Hester, A, Macdonald, DW. 2013. Forest cover outside protected areas plays an important role in the conservation of the Vulnerable guina *Leopardus guigna*. ORYX 47(2):251-258.

Habitat loss and fragmentation are affecting populations of forest dwelling mammalian carnivores worldwide. In southern Chile, a biodiversity hotspot, anthropogenic activities have resulted in high loss of native forest cover. The guina, or kodkod cat, *Leopardus guigna* is a small forest-dwelling felid with a narrow range in the temperate forest of southern Chile. The few existing studies of the species have suggested that it is almost exclusively restricted to large tracts of native forest. This paper reports a study in the temperate forest within a fragmented Andean piedmont landscape which demonstrates that smaller forest fragments in the farmland matrix are playing a key role in the persistence of the guina. We estimated occupancy in both continuous native forest and remnant forest fragments and, with single-species/single-season models, evaluated the extent to which forest cover, habitat type and proximity to protected areas have a modulating effect on occupancy. A continuous survey during 2008-2009, in three seasons of 90-100 days each, accumulated 6,200 camera trap days and returned 47 photographs of guina. Total detection in fragments was higher than in continuous forests, with detection confirmed in almost 70% of studied fragments. We found that probability of a site being occupied significantly increased with forest cover (adult/secondary forest, scrubland) and probability was low (< 0.2) in sites with <50% of surrounding forest cover. Our study highlights the importance of remnant forest fragments in the mosaic of extensive agriculture for the spatial dynamics of a guina population and hence for the future conservation of the species.

Glen, AS, Cockburn, S, Nichols, M, Ekanayake, J, Warburton, B. 2013. Optimising Camera Traps for Monitoring Small Mammals. PLOS ONE 8(6):e67940

Practical techniques are required to monitor invasive animals, which are often cryptic and occur at low density. Camera traps have potential for this purpose, but may have problems detecting and identifying small species. A further challenge is how to standardise the size of each camera's field of view so capture rates are comparable between different places and times. We investigated the optimal specifications for a low-cost camera trap for small mammals. The factors tested were 1) trigger speed, 2) passive infrared vs. microwave sensor, 3) white vs. infrared flash, and 4) still photographs vs. video. We also tested a new approach to standardise each camera's field of view. We compared the success rates of four camera trap designs in detecting and taking recognisable photographs of captive stoats (*Mustela erminea*), feral cats (*Felis catus*) and hedgehogs (*Erinaceus europaeus*). Trigger speeds of 0.2-2.1 s captured photographs of all three target species unless the animal was running at high speed. The camera with a microwave sensor was prone to false triggers, and often failed to trigger when an animal moved in front of it. A white flash produced photographs that were more readily identified to species than those obtained under infrared light. However, a white flash may be more likely to frighten target animals, potentially affecting detection probabilities. Video footage achieved similar success rates to still cameras but required more processing time and computer memory. Placing two camera traps side by side achieved a higher success rate than using a single camera. Camera traps show considerable promise for monitoring invasive mammal control operations. Further research should address how best to standardise the size of each camera's field of view, maximise the probability that an animal encountering a camera trap will be detected, and eliminate visible or audible cues emitted by camera traps.

Goldingay, RL, Rohweder, D, Taylor, BD. 2013. Will arboreal mammals use rope-bridges across a highway in eastern Australia? AUSTRALIAN MAMMALOGY 35(1):30-38.

Artificial structures designed to promote road-crossing by arboreal mammals are increasingly being installed in Australia but there is a limited understanding of their usefulness. We studied five 50-70-m-long rope-bridges (encompassing three designs) erected across the Pacific Highway, a major freeway in eastern Australia. Native arboreal mammals showed a willingness to explore these structures, being detected by camera traps on four rope-bridges. The vulnerable squirrel glider (*Petaurus norfolcensis*) crossed on one rope-bridge at least once every 4.5 weeks over a 32-week period. The feathertail glider (*Acrobates pygmaeus*), common ringtail possum (*Pseudocheirus peregrinus*) and the common brushtail possum (*Trichosurus vulpecula*) were detected on one of two rope-bridges that extended under the freeway at creek crossings. The feathertail glider was detected on all three rope-bridge designs. Our results suggest that rope-bridges have the potential to restore habitat connectivity disrupted by roads for some arboreal mammals. Further research is needed to refine the design and placement of rope-bridges as well as to determine whether these structures promote gene flow.

Hamel, S, Killengreen, ST, Henden, JA, Eide, NE, Roed-Eriksen, L, Ims, RA, Yoccoz, NG. 2013. Towards good practice guidance in using camera-traps in ecology: influence of sampling design on validity of ecological inferences. METHODS IN ECOLOGY AND EVOLUTION 4(2):105-113.

The development of camera-traps has provided an opportunity to study ecological relationships and population dynamics of species that are rare, difficult to observe or capture. Their use has seen a major increase recently, particularly with the recent progress in methods adapted to species for which individuals cannot be identified. We took advantage of extensive

camera-trap data sets from large spatiotemporal-scale studies of a diverse assemblage of avian and mammalian scavengers in subarctic/arctic tundra to determine sampling designs that minimize detection errors (false-negative) and to evaluate the influence of sampling design on estimation of site occupancy. Results showed that raw error rates in daily presence varied between 5 and 30% among species when using time-triggered cameras with a 5-min interval. Using movement-triggered cameras resulted in larger raw error rates, between 30 and 70%, as well as a lower number of daily presences detected. Increasing the time interval from 5 to 20min greatly increased the raw error rate in daily presence, but it had negligible impacts on estimates and precision of occupancy and detection probability. Occupancy estimates were mostly influenced by variation in the number of days included during the sampling period. For most species, a threshold of between 20 and 30 problem-free days (i.e. without camera-related technical problems) was required to stabilize occupancy and detection probability, as well as to maximize their precision. Based on the results, we discuss guidelines for establishing sampling designs according to the different ecological questions researchers might want to answer. To our knowledge, our study is the first to directly test the influence of sampling design in camera-trap studies, providing guidelines that are likely to be directly applicable to a large range of species and ecosystems.

Hearn, AJ, Ross, J, Pamin, D, Bernard, H, Hunter, L, Macdonald, DW. 2013. Insights into the spatial and temporal ecology of the Sunda clouded leopard *Neofelis diardi*. RAFFLES BULLETIN OF ZOOLOGY 61(2):871-875.

The Sunda clouded leopard *Neofelis diardi* is an extremely challenging species to study and as such remains one of the least known of the world's larger (> 10 kg) cats. We used a combination of radio-tracking and camera-trap surveys to provide some of the first insights into the spatial and temporal ecology of this elusive felid. A female clouded leopard, radio-tagged and tracked over 109 days in Sabah, Malaysian Borneo, occupied a home-range of 16.1 km^2 and a core-range of 5.4 km^2 (95% and 50%

fixed-kernel estimators, respectively). Photographic records of this species from three intensive camera-trap surveys, amounting to 135 independent capture events of at least 22 individuals, were pooled and used to investigate patterns of activity. Sunda clouded leopards were found to be primarily, although not exclusively, nocturnal. We compare our results with those from two field studies of the mainland clouded leopard, *N. nebulosa*, in Thailand. Although preliminary, our data serve to underscore the need for more intensive research of this elusive wild cat.

Higashide, D, Miura, S, Miguchi, H. 2013. Evaluation of camera-trap designs for photographing chest marks of the free-ranging Asiatic black bear, *Ursus thibetanus*. MAMMAL STUDY. 38(1):35-39.

NO ABSTRACT

Ikeda, T, Takahashi, H, Yoshida, T, Igota, H, Kaji, K. 2013. Evaluation of camera trap surveys for estimation of sika deer herd composition. MAMMAL STUDY 38(1):29-33.

Camera trap method has been developed for monitoring wildlife, however, most studies using camera trap depend on baited camera sites to attract target wildlife. This is likely to bias estimates of population structure. We evaluated the use of non-baited camera trap for the estimation of herd composition of sika deer (*Cervus nippon*). Camera trap showed a distinct seasonal pattern in sex ratios (males/100 female), which remained lowest between May and October but increased in November. Sex ratios were influenced by the number of observed males, because the ratios were positively correlated with the number of males but not females. The number of males increased in autumn during rutting season. Fawns/100 female ratios showed a distinct seasonal pattern. Highest and lowest fawns/100 female ratios were obtained in November and May, respectively. The

decrease of fawns/100 female ratios in May comparing with that in November may be because of the overwinter mortality of fawns. Camera trap method is superior in term of continuously conduct in long-term, collect reasonable seasonal patterns, automatically record large numbers of sample sizes and useful in all weather conditions.

Kalle, R, Ramesh, T, Qureshi, Q, Sankar, K. 2013. Predicting the Distribution Pattern of Small Carnivores in Response to Environmental Factors in the Western Ghats. PLOS ONE 8(11):e79295.

Due to their secretive habits, predicting the pattern of spatial distribution of small carnivores has been typically challenging, yet for conservation management it is essential to understand the association between this group of animals and environmental factors. We applied maximum entropy modeling (MaxEnt) to build distribution models and identify environmental predictors including bioclimatic variables, forest and land cover type, topography, vegetation index and anthropogenic variables for six small carnivore species in Mudumalai Tiger Reserve. Species occurrence records were collated from camera-traps and vehicle transects during the years 2010 and 2011. We used the average training gain from forty model runs for each species to select the best set of predictors. The area under the curve (AUC) of the receiver operating characteristic plot (ROC) ranged from 0.81 to 0.93 for the training data and 0.72 to 0.87 for the test data. In habitat models for *F. chaus*, *P. hermaphroditus*, and *H. smithii* "distance to village" and precipitation of the warmest quarter emerged as some of the most important variables. "Distance to village" and aspect were important for *V. indica* while "distance to village" and precipitation of the coldest quarter were significant for *H. vitticollis*. "Distance to village", precipitation of the warmest quarter and land cover were influential variables in the distribution of *H. edwardsii*. The map of predicted probabilities of occurrence showed potentially suitable habitats accounting for 46 km^2 of the reserve for *F. chaus*, 62 km^2 for *V. indica*, 30 km^2 for *P. hermaphroditus*, 63 km^2 for *H. vitticollis*, 45 km^2 for *H. smithii* and 28 km^2 for *H. edwardsii*. Habitat heterogeneity driven by the east-west climatic

gradient was correlated with the spatial distribution of small carnivores. This study exemplifies the usefulness of modeling small carnivore distribution to prioritize and direct conservation planning for habitat specialists in southern India.

Kawanishi, K, Clements, GR, Gumal, M, Goldthorpe, G, Yasak, MN, Sharma, DSK. 2013. Using BAD for good: how best available data facilitated a precautionary policy change to improve protection of the prey of the tiger *Panthera tigris* in Malaysia. ORYX 47(3):420-426.

Tiger *Panthera tigris* populations are under threat from poaching and depletion of their prey populations. The National Tiger Action Plan for Malaysia contains several actions addressing the threat of legal and illegal hunting of tiger prey species. One action in this plan required an investigation of whether urgent policy changes were needed to improve the protection of the prey of tigers, based on existing data. As the lack of reliable baseline data prevented us from determining population trends accurately, we compiled camera-trapping data from 23 studies conducted between 1997 and 2008 on four principal tiger prey species (sambar *Rusa unicolor*, barking deer *Muntiacus muntjac*, wild boar *Sus scrofa* and bearded pig *S. barbatus*) and two potential prey species (gaur *Bos gaurus* and Malayan tapir *Tapirus indicus*) and compared their distributions and relative abundances. From 10,145 wildlife photographs spanning 40,303 trap-nights, sambar, bearded pig and gaur appeared to be most threatened given their restricted distribution and low relative abundance. Among these, the gaur has full legal protection and has received more conservation attention than the other two species. Following our assessment and advocacy a 6-year moratorium on hunting both sambar and barking deer was imposed by the Malaysian government and the highest protection status possible was afforded the bearded pig. This case study illustrates how best available data (BAD), in this case from camera-trapping studies, can be harnessed to effect precautionary policy changes to curb the impacts of hunting on threatened predator and prey populations that could

crash well before resources would otherwise be available for rigorous scientific assessments.

Kent, VT, Hill, RA. 2013. The importance of farmland for the conservation of the brown hyaena *Parahyaena brunnea*. ORYX 47(3):431-440.

The conservation of wide-ranging, territorial carnivores presents many challenges, not least the inadequacy of many protected areas in providing sufficient space to allow such species to maintain viable populations. As a result populations occurring outside protected areas may be of considerable importance for the conservation of some species, although the significance of these areas is poorly understood. Brown hyaenas *Parahyaena brunnea* are categorized as Near Threatened on the IUCN Red List and recent research suggests the species may be particularly vulnerable to habitat loss and the conversion of land to agriculture. Here we report on the population density and abundance of brown hyaenas in an area of commercial farmland in western Botswana. Mean brown hyaena density estimated from camera-trap surveys was 2.3 per 100 km^2 and from spoor surveys 2.88 per 100 km^2, which are comparable to estimates reported for protected areas. Estimated densities were higher on farms used for livestock production than on those used for game farming, suggesting that the species can tolerate land-use change where reliable alternative food resources exist. Our results indicate that populations of brown hyaenas in non-protected areas comprise a significant proportion of the global population and that such areas may be of critical importance for their conservation.

Kukielka, E, Barasona, JA, Cowie, CE, Drewe, JA, Gortazar, C, Cotarelo, I, Vicente, J. 2013. Spatial and temporal interactions between livestock and wildlife in South Central Spain assessed by camera traps. PREVENTIVE VETERINARY MEDICINE 112(3-4):213-221.

The diversification of livestock farms into hunting estates in South Central Spain (SCS) may impede the success of *Mycobacterium bovis* eradication programmes by facilitating transmission between wildlife and livestock. In this observational study we aimed to provide information of relevance about the nature and frequency of interactions (observed visits to study points) between livestock (cattle and domestic pigs) and wildlife (wild boar and red deer). The study was conducted in an extensive cattle farm in SCS where the land is also used for game hunting. During a period of one year, camera traps (n=16) were placed at a priori risk points for interspecies interactions: water (natural and artificial troughs), food placed on the ground for baiting wildlife, and pasture. To define indirect interspecies interactions, a critical time window for *M. bovis* to survive in the environment was selected based on the literature. Results suggest that wildlife frequented food and pasture points more often than water points, and that the number of visits increased through the dry season, peaking during the acorn season (October-January) and the deer breeding season (June-July). Direct interactions were rare (n=10), as opposed to indirect interactions (n = 8992). Wildlife-followed-by-livestock interactions (n = 7714) occurred much more often than livestock-followed-by-wildlife (n = 1278) and were frequent at water points (66% water points, 17% food, 17% pasture). Results also suggest that water points are a hotspot for indirect interactions and might therefore be a source of infection at the wildlife-livestock interface in the territory covered, particularly for *M. bovis*, as it is around water where the bacteria seem to survive the longest. Preventing aggregation and therefore reducing contact rates between domestic and wild animals especially at water points may be valuable for disease control in South Central Spain.

Kuprewicz, EK. 2013. Mammal Abundances and Seed Traits Control the Seed Dispersal and Predation Roles of Terrestrial Mammals in a Costa Rican Forest. BIOTROPICA 45(3):333-342.

In Neotropical forests, mammals act as seed dispersers and predators. To prevent seed predation and promote dispersal, seeds exhibit physical or

chemical defenses. Collared peccaries (*Pecari tajacu*) cannot eat some hard seeds, but can digest chemically defended seeds. Central American agoutis (*Dasyprocta punctata*) gnaw through hard-walled seeds, but cannot consume chemically defended seeds. The objectives of this study were to determine relative peccary and agouti abundances within a lowland forest in Costa Rica and to assess how these two mammals affect the survival of large seeds that have no defenses (*Iriartea deltoidea*, *Socratea exorrhiza*), physical defenses (*Astrocaryum alatum*, *Dipteryx panamensis*), or chemical defenses (*Mucuna holtonii*) against seed predators. Mammal abundances were determined over 3yrs from open-access motion-detecting camera trap photos. Using semi-permeable mammal exclosures and thread-marked seeds, predation and dispersal by mammals for each seed species were quantified. Abundances of peccaries were up to six times higher than those of agoutis over 3yrs, but neither peccary nor agouti abundances differed across years. Seeds of *A. alatum* were predominantly dispersed by peccaries, which did not eat *A.alatum* seeds, whereas non-defended and chemically defended seeds suffered high levels of predation, mostly by peccaries. Agoutis did not eat *M.holtonii* seeds. Peccaries and agoutis did not differ in the distances they dispersed seeds. This study shows that seed fates are contingent upon many factors such as seed defenses, frugivoregranivore abundances, and seed-handling capabilities. Mammalseed interactions are complex; the outcomes of these interactions depend on the inherent characteristics of seeds and their potential dispersers.

Lantschner, MV, Rusch, V, Hayes, JP. 2013. Do exotic pine plantations favour the spread of invasive herbivorous mammals in Patagonia? AUSTRAL ECOLOGY 38(3):228-345.

Changes in land use patterns and vegetation can trigger ecological change in occupancy and community composition. Among the potential ecological consequences of land use change is altered susceptibility to occupancy by invasive species. We investigated the responses of three introduced mammals (red deer, *Cervus elaphus*; wild boar, *Sus scrofa*; and European

hare, *Lepus europaeus*) to replacement of native vegetation by exotic pine plantations in the Patagonian forest-steppe ecotone using camera-trap surveys (8633 trap-days). We used logistic regression models to relate species presence with habitat variables at stand and landscape scales. Red deer and wild boar used pine plantations significantly more frequently than native vegetation. In contrast, occurrence of European hares did not differ between pine plantations and native vegetation, although hares were recorded more frequently in firebreaks than in plantations or native vegetation. Presence of red deer and wild boar was positively associated with cover of pine plantations at the landscape scale, and negatively associated with mid-storey cover and diversity at the stand scale. European hares preferred sites with low arboreal and mid-storey cover. Our results suggest that pine plantations promote increased abundances of invasive species whose original distributions are associated with woodlands (red deer and wild boar), and could act as source or pathways for invasive species to new areas.

LaPoint, S, Gallery, P, Wikelski, M, Kays, R. 2013. Animal behavior, cost-based corridor models, and real corridors. LANDSCAPE ECOLOGY 28(8):1615-1630.

Corridors are popular conservation tools because they are thought to allow animals to safely move between habitat fragments, thereby maintaining landscape connectivity. Nonetheless, few studies show that mammals actually use corridors as predicted. Further, the assumptions underlying corridor models are rarely validated with field data. We categorized corridor use as a behavior, to identify animal-defined corridors, using movement data from fishers (*Martes pennanti*) tracked near Albany, New York, USA. We then used least-cost path analysis and circuit theory to predict fisher corridors and validated the performance of all three corridor models with data from camera traps. Six of eight fishers tracked used corridors to connect the forest patches that constitute their home ranges, however the locations of these corridors were not well predicted by the two cost-based models, which together identified only 5 of the 23 used

corridors. Further, camera trap data suggest the cost-based corridor models performed poorly, often detecting fewer fishers and mammals than nearby habitat cores, whereas camera traps within animal-defined corridors recorded more passes made by fishers, carnivores, and all other non-target mammal groups. Our results suggest that (1) fishers use corridors to connect disjunct habitat fragments, (2) animal movement data can be used to identify corridors at local scales, (3) camera traps are useful tools for testing corridor model predictions, and (4) that corridor models can be improved by incorporating animal behavior data. Given the conservation importance and monetary costs of corridors, improving and validating corridor model predictions is vital.

Leeb, C, Hodl, W, Ringler, M. 2013. A high-quality, self-assembled camera trapping system for the study of terrestrial poikilotherms tested on the Fire Salamander. HERPETOZOA. 25(3-4):164-171.

NO ABSTRACT

Linkie, M, Guillera-Arroita, G, Smith, J, Ario, A, Bertagnolio, G, Cheong, F, Clements, GR, Dinata, Y, Duangchantrasiri, S, Fredriksson, G, Gumal, MT, Horng, LS, Kawanishi, K, Khakim, FR, Kinnaird, MF, Kiswayadi, D, Lubis, AH, Lynam, AJ, Maryati, Maung, M, Ngoprasert, D, Novarino, W, O'Brien, TG, Parakkasi, K, Peters, H, Priatna, D, Rayan, DM, Seuaturien, N. Shwe, NM, Steinmetz, R, Sugesti, AM, Sunarto, Sunquist, ME, Umponjan, M, Wibisono, HT, Wong, CCT, Zulfahmi. 2013. Cryptic mammals caught on camera: Assessing the utility of range wide camera trap data for conserving the endangered Asian tapir. BIOLOGICAL CONSERVATION 162:107-115.

The loss and fragmentation of substantial areas of forest habitat, in combination with rampant hunting, has pushed many of Southeast Asia's

megafauna species to the verge of extinction. However, the extent of these declines is rarely quantified, thereby weakening lessons learned and species-based management. This need not be the case as a proliferation of camera trap surveys for large-bodied mammals across Southeast Asia, which use a standardized sampling technique, presents a rich yet under-utilized wildlife data set. Furthermore, advances in statistical techniques for assessing species distribution provide new opportunities for conducting comparative regional analyses. Here, we focus on one of Southeast Asia's least known species of megafauna, the Endangered Asian tapir (*Tapirus indicus*), to investigate the performance of a camera trap-based spatial modeling approach in conducting a range-wide species assessment. Detection data were collectively collated from 52,904 trap days and 1,128 camera traps located across 19 study areas drawn from the Asian tapir's entire range. Considerable variation in tapir occurrence was found between study areas in: Malaysia (0.52-0.77); Sumatra, Indonesia (0.12-0.90); Thailand (0.00-0.65); and, Myanmar (0.00-0.26), with generally good levels of estimate precision. Although tapirs were widespread (recorded in 17 of the 19 study areas), their occurrence was significantly and negatively correlated with human disturbance. Thus, this study extends the previously known applicability of camera traps to include a threatened and cryptic species by identifying where and how tapirs persist (including new records of occurrence), where future surveys should be conducted and providing a benchmark for measuring future conservation management efforts.

Liu, XH, Wu, PF, Songer, M, Cai, Q, He, XB, Zhu, Y, Shao, XM. 2013. Monitoring wildlife abundance and diversity with infra-red camera traps in Guanyinshan Nature Reserve of Shaanxi Province, China. ECOLOGICAL INDICATORS 33:121-128.

Ecological indicators or indices have been widely used to simplify and measure complex ecosystems. It is critical to identify suitable indicators or indices to improve monitoring and understanding of complex natural systems. Camera trapping is an objective technique that can provide a large amount of information on wildlife. The purpose of our study is to

explore the effective ecological indices for wildlife diversity analysis and monitoring in Guanyinshan Nature Reserve of Shaanxi Province, China. Since July 2009, a total of 18 cameras were installed in the reserve from August 2009 to July 2011, collecting 2115 photo captures during these 24 months. We developed five abundance indices, including relative abundance index (RAI), monthly relative abundance index (MRAI), time-period relative abundance index (TRAI), night-time relative abundance index (NRAI) and species abundance index (N) to integrate the information derived from captures. Results are: (1) 27 species were detected and 6 species had high RAI values of over 79.3%, including takin (*Budorcas taxicolor*), common goral (*Naemorhedus goral*), tufted deer (*Elaphodus cephalophus*), golden pheasant (*Chtysolophus pictus*), wild boar (*Sus scrofa*), and mainland serow (*Capricornis sumatraensis*). (2) MRAI shows a consistent monthly activity pattern of all animals being active in June and July and inactive in February. (3) TRAIs of the most abundant six species show that takin, tufted deer and common goral have the similar daily activity pattern with one peak at dawn and one peak at dusk. The daily activity patterns of golden pheasant and wild boar show that they are most active during the day time, with wild boar being particularly active at noon. NRAIs of mainland serow show the highest nocturnality and of golden pheasant the lowest nocturnality. (4) We estimated abundance of takin, tufted deer and wild boar by using our developed index. The abundance for the three species shows an increasing trend during the 2-year study period, particularly for wild boar. Our results provided an interesting comparison of species diversity and their activity patterns. As trapping continues we will have a consistent source of monitoring data to evaluate changes in species abundance and activities. Therefore, the conclusion is that the methods we used and the indices we developed are capable to estimate species activity patterns and abundance dynamics which are useful for future wildlife management in Guanyinshan Nature Reserve and elsewhere.

Loken, B, Spehar, S, Rayadin, Y. 2013. Terrestriality in the Bornean Orangutan (*Pongo pygmaeus morio*) and Implications for Their Ecology and Conservation. AMERICAN JOURNAL OF PRIMATOLOGY 75(11):1129-1138.

Aside from anecdotal evidence, terrestriality in orangutans (*Pongo* spp.) has not been quantified or subject to careful study and important questions remain about the extent and contexts of terrestrial behavior. Understanding the factors that influence orangutan terrestriality also has significant implications for their conservation. Here we report on a camera trapping study of terrestrial behavior in the northeastern Bornean orangutan, *Pongo pygmaeus morio*, in Wehea Forest, East Kalimantan, Indonesia. We used 78 non-baited camera traps set in 43 stations along roads, trails, and at mineral licks (sepans) to document the frequency of orangutan terrestriality. Habitat assessments were used to determine how terrestrial behavior was influenced by canopy connectivity. We compared camera trapping results for *P. p. morio* to those for a known terrestrial primate (*Macaca nemestrina*), and another largely arboreal species (*Presbytis rubicunda*) to assess the relative frequency of terrestrial behavior by *P. p. morio*. A combined sampling effort of 14,446 trap days resulted in photographs of at least 15 individual orangutans, with females being the most frequently recorded age sex class (N=32) followed by flanged males (N=26 records). *P. p. morio* represented the second most recorded primate (N=110 total records) of seven primate species recorded. Capture scores for *M. nemestrina* (0.270) and *P. p. morio* (0.237) were similar and almost seven times higher than for the next most recorded primate, *P. rubicunda* (0.035). In addition, our results indicate that for orangutans, there was no clear relationship between canopy connectivity and terrestriality. Overall, our data suggest that terrestriality is relatively common for the orangutans in Wehea Forest and represents a regular strategy employed by individuals of all age-sex classes. As Borneo and Sumatra increasingly become characterized by mixed-use habitats, understanding the ecological requirements and resilience in orangutans is necessary for designing optimal conservation strategies.

Lynam, AJ, Jenks, KE, Tantipisanuh, N, Chutipong, W, Ngoprasert, D, Gale, GA, Steinmetz, R, Sukmasuang, R, Bhumpakphan, N, Grassman, LI, Cutter, P, Kitamura, S, Reed, DH, Baker, MC, McShea, W, Songsasen, N,

Leimgruber, P. 2013. Terrestrial activity patterns of wild cats from camera-trapping. RAFFLES BULLETIN OF ZOOLOGY 61(1):407-415.

The behaviour of wild cats is poorly understood. Using camera-trapping, we quantified temporal overlap among seven species of Asian wild cats, including tiger *Panthera tigris* and leopard *Panthera pardus*. Based on time stamp data from 780 camera-traps and 24 study sites from 14 protected areas across Thailand, we assessed terrestrial activity patterns and temporal overlap in habitat use. For quantifying overlap, we used a coefficient estimator (Delta) over cap (1) that allows for calculation of confidence intervals. Our study provided insight into temporal interactions among species of wild cats, particularly between small cats and their larger cat relatives. We found temporal habitat segregation in several small cats with some species being strongly nocturnal (>= 85% records between 1800 and 0600 hours - leopard cat *Prionailurus bengalensis*), mostly (>50%) nocturnal (clouded leopard *Neofelis nebulosa*), mostly diurnal (>50% records between 0600 and 1800 hours - Asiatic golden cat *Catopuma temminckii*), or strongly (>= 85%) diurnal (marbled cat *Pardofelis marmorata*). We found high temporal overlap ((Delta) over cap >= 0.80) between leopard cat and clouded leopard (95% CI = 0.77-0.91), Asiatic golden cat and leopard (95% CI = 0.69-0.87), Asiatic golden cat and tiger (95% CI = 0.72-0.90), and clouded leopard and tiger (95% CI = 0.69-0.85). Our research demonstrates that temporal habitat or niche segregation may be an important process in maintaining the functioning of diverse predator guilds in tropical forests. We developed several avoidance or overlap hypotheses that can explain the patterns observed in our study and that should be further tested.

Maputla, NW, Chimimba, CT, Ferreira, SM. 2013. Calibrating a camera trap-based biased mark-recapture sampling design to survey the leopard population in the N'wanetsi concession, Kruger National Park, South Africa. AFRICAN JOURNAL OF ECOLOGY 51(3):422-430.

Estimating large carnivore abundance can be challenging. A biased leopard (*Panthera pardus*) population survey was conducted in the N'wanetsi concession in the Kruger National Park (KNP), South Africa, using motion-sensitive camera traps from April to August 2008. Survey effort included 88 trapping occasions and 586 trap days. The survey yielded 24 leopard photographs, comprising fourteen adults of eleven males and three females. The capture rate was determined to be 24.4 trap days per leopard. Estimates of population abundance stabilized at approximately 500 trap days. Precision of population estimates began to stabilize after 378 trap days. We estimated that there were nineteen leopards in an area of 150 KM^2. Leopard density was estimated at 12.7 leopards per 100 KM^2. We explore the possibility of employing the methods used in this study to survey the leopard population in the KNP and surrounding areas.

Martins, Q, Harris, S. 2013. Movement, activity and hunting behaviour of leopards in the Cederberg mountains, South Africa. AFRICAN JOURNAL OF ECOLOGY 51(4):571-579.

Few data are available on the behaviour of leopards in the absence of competing large predators and human impact, both of which are believed to influence leopard activity and movements. Remote camera traps and global positioning system (GPS) collars were used to quantify leopard activity in the Cederberg Mountains, seasonal and sexual differences in their movements, and determine whether nocturnal hunting success was related to lunar activity. Seventy-seven per cent of camera-trap photographs were at night, with a strong male bias (69%) in captures. Daily displacement using one location per day suggested that males moved significantly further than females. However, multiple locations (6 per day) showed no difference because males moved in a more linear fashion, but not further each day, than females. In the Cederberg Mountains, an open rocky habitat with low human impact and no competing predators, leopards were predominantly nocturnal, mainly hunting diurnal prey

species. Hunting success was low: leopards travelled long distances between kills, with nocturnal hunting success higher on darker nights.

Mccallum, J. 2013. Changing use of camera traps in mammalian field research: habitats, taxa and study types. MAMMAL REVIEW 43(3):196-206.

Camera traps are automated cameras, triggered by movements, used to collect photographic evidence of the presence of animals in field research. I asked whether the use of camera traps in mammalian field research is distributed evenly and increasing equally in a range of habitats, taxa and study types. I aimed to understand where camera traps are used and for what purposes. I identified the population of papers published since 1994 in which camera trap methodology was used. I then explored the population for defined habitats, taxa and study types. I tested the derived data for growth and distribution. Over 96% of the population of camera trap papers identified were focused on mammalian species. Between 1994 and 2011, the use of camera traps for mammalian research increased: 73% of 414 studies were published after 2005. Over time, equipment has become more sophisticated, reliable, flexible, cost-effective and easy to deploy, and there have been other methodological advances. Growth in the number of mammal-related camera trap studies was matched by an expansion in the taxa studied and in study types. The most studied taxon is the order Carnivora; forests are the most studied habitat. No single study type dominates, although there are more population density studies than any other. Camera trap studies are focused on a limited number of habitats and taxa due to their particular strengths and the characteristics of the species that they are used to investigate. Developments such as infrared illumination and triggering, greater battery life, improved lenses, digital storage capacity, miniaturization, video and real-time links will enable camera traps to be used for an increasing range of habitats, taxa and study types and will reinforce their growing value in the areas in which they currently predominate.

Meek, PD, Ballard, GA, Fleming, PJS. 2013. A permanent security post for camera trapping. AUSTRALIAN MAMMALOGY 35(1):123-127.

As the use of camera traps in wildlife management in Australia rapidly increases, government agencies, private enterprises, universities and individuals are investing considerable amounts of money in camera trap technology for research, monitoring and recreation. Often camera traps need to be placed along vehicle tracks or in obvious locations to detect animal activity. Consequently, units are frequently highly visible and therefore easily located by would-be thieves. We describe a field-tested security post design that increases security for both camera traps and data, whilst also offering a means of standardising placement.

Nakashima, Y, Iwata, Y, Ando, C, Nkoguee, CN, Inoue, E, Akomo, EFO, Nguema, PM, Bineni, TD, Banak, LN, Takenoshita, Y, Ngomanda, A, Yamagiwa, J. 2013. Assessment of Landscape-Scale Distribution of Sympatric Great Apes in African Rainforests: Concurrent Use of Nest and Camera-Trap Surveys. AMERICAN JOURNAL OF PRIMATOLOGY 75(12):1220-1230.

Information on the distribution and abundance of sympatric great apes (*Pan troglodytes troglodytes* and Gorilla *gorilla gorilla*) are important for effective conservation and management. Although much research has been done to improve the precision of nest-surveys, trade-offs between data-reliability and research-efficiency have not been solved. In this study, we used different approaches to assess the landscape-scale distribution patterns of great apes. We conducted a conventional nest survey and a camera-trap survey concurrently, and checked the consistency of the estimates. We divided the study area (ca. 500 km^2), containing various types of vegetation and topography, into thirty 16-km(2) grids (4kmx4km) and performed both methods along 2-km transects centered in each grid. We

determined the nest creator species according to the definitions by Tutin & Fernandez [Tutin & Fernandez, 1984, Am J Primatol 6:313-336] and estimated nest-site densities of each species by using the conventional distance-sampling approach. We calculated the mean capture rate of 3 camera traps left for 3 months at each grid as the abundance index. Our analyses showed that both methods provided roughly consistent results for the distribution patterns of the species; chimpanzee groups (parties) were more abundant in the montane forest, and gorilla groups were relatively homogeneously distributed across vegetation types. The line-transect survey also showed that the number of nests per nest site did not vary among vegetation types for either species. These spatial patterns seemed to reflect the ecological and sociological features of each species. Although the consistent results may be largely dependent on site-specific conditions (e.g., high density of each species, distinct distribution pattern between the two species), conventional nest-surveys and a subsequent check of their consistency with independent estimates may be a reasonable approach to obtain certain information on the species distribution patterns. Further analytical improvement is necessary for camera-traps to be considered a stand-alone method.

Oliveira-Santos, LGR, Zucco, CA, Agostinelli, C. 2013. Using conditional circular kernel density functions to test hypotheses on animal circadian activity. ANIMAL BEHAVIOUR 85(1):269-280.

NO ABSTRACT

Mohd-Azlan, J, Engkamat, L. 2013. Camera trapping and conservation in Lanjak Entimau Wildlife Sanctuary, Sarawak, Borneo. RAFFLES BULLETIN OF ZOOLOGY 61(1):397-405.

AB Information on the distribution of species is important in prescribing sound management practices for a protected area. In view of this, we conducted a series of camera trapping surveys in Lanjak Entimau Wildlife Sanctuary, Sarawak, Malaysian Borneo. A total of 20 camera traps was deployed primarily in riverine forests over two sampling periods (2003 and 2006) spanning 10 months altogether. A total of 1945 camera trap days yielded 537 of photographs of at least 21 species of mammals and five species of birds. Of these, four mammalian species are endemic to Borneo and two species are listed as endangered by the IUCN. In addition, our camera trapping survey has provided more detailed information on activity patterns of some cryptic mammal species. Finally, we discuss potential threats to selected mammal species in this area and suggest possible mitigation measures. We emphasize that regular monitoring of wildlife in protected areas should not be neglected, especially when biodiversity in this region is experiencing accelerated and unprecedented rates of extinction.

Mohamed, A, Sollmann, R, Bernard, H, Ambu, LN, Lagan, P, Mannan, S, Hofer, H, Wilting, A. 2013. Density and habitat use of the leopard cat (*Prionailurus bengalensis*) in three commercial forest reserves in Sabah, Malaysian Borneo. JOURNAL OF MAMMALOGY 94(1):82-89.

The small (2- to 7-kg) leopard cat (*Prionailurus bengalensis*) is the most common cat species in Asia. Although it occurs in a wide range of habitats and seems to adapt well to anthropogenic habitat changes, surprisingly little is known about this species in the wild. All studies have focused on protected areas, although a large proportion of Southeast Asian forests are timber concessions. During this study, we used large camera-trapping data sets (783 records of 124 individuals) from 3 commercially used forests to investigate consequences of different logging regimes on density and habitat associations of the leopard cat. We applied spatial capture recapture models accounting for the location of camera-traps (on or off road) to obtain estimates of leopard cat density. Density was higher in the 2 more disturbed forest reserves ((X) over bar = 12.4 individuals/100 KM^2 ±

1.6 SE and 16.5 ± 2 individuals/100 KM^2) than in the sustainably managed forest (9.6 ± 1.7 individuals/100 KM^2). Encounter rates with off-road traps were only 3.6-9.1% of those for on-road traps. Occupancy models, which accounted for spatial autocorrelation between sampling sites by using a conditional autoregressive model, revealed that canopy closure and ratio of climax to pioneer trees had a significantly negative impact on leopard cat occurrence. Our results confirm that the leopard cat is doing well in modified landscapes and even seems to benefit from the opening of forests. With such flexibility the leopard cat is an exception among tropical rain-forest carnivores.

Mugerwa, B, Sheil, D, Ssekiranda, P, van Heist, M, Ezuma, P. 2013. A camera trap assessment of terrestrial vertebrates in Bwindi Impenetrable National Park, Uganda. AFRICAN JOURNAL OF ECOLOGY 51(1):21-31.

We placed camera traps for a month at sixty locations in Bwindi Impenetrable National Park to determine the species composition and distribution of medium-to-large terrestrial vertebrates. A total of 15912 images were recorded from 1800 camera trap days. These provided a total of 625 and 338 camera events when filtered by hour and day, respectively. Twenty mammal species were recorded from 594 and 314 camera events by hour and day, respectively. Four bird species were recorded from 31 and 24 camera events by hour and day, respectively. The African golden cat *Profelis aurata* Temminck was recorded from 27 and nineteen camera events by hour and day, respectively. The black-fronted duiker *Cephalophus nigrifrons* Gray was most frequently photographed with 179 and 65 camera events by hour and day, respectively. Analyses reveal two species possessed a significantly interior-biased distribution. One species showed an edge-biased pattern. Five species were detected to have significantly biased altitudinal distributions with higher elevations. Distance to park edge and elevation can significantly influence species distribution. The selective use of the park limits the area that each species utilizes, with implications for maximum population sizes and viability. Our observations provide a baseline for long-term terrestrial vertebrate monitoring in Bwindi.

Ohashi, H, Saito, M, Horie, R, Tsunoda, H, Noba, H, Ishii, H, Kuwabara, T, Hiroshige, Y, Koike, S, Hoshino, Y, Toda, H, Kaji, K. 2013. Differences in the activity pattern of the wild boar *Sus scrofa* related to human disturbance. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 59(2):167-177.

Over the last century, human activity has caused significant changes to the activity patterns of many wildlife species. The wild boar is one species known to change its activity pattern with the intensity of human disturbance. We conducted camera trap surveys in two study sites, Shingo and Himuro, in Tochigi, central Japan. We investigated effects of two types of human disturbance on the activity pattern of a wild boar population: 'direct' disturbance related to hunting activity and 'indirect' disturbance related to daily human activity. In the hunting season, relative abundance indices (RAI) of wild boars significantly decreased, and the proportion of activity at night increased compared with the nonhunting season. RAI of wild boars at night decreased with increasing distance from the settlement, while RAI of wild boars during the day did not. Relative proportion of activity at night was higher in cameras at 0-200 m from the settlements, while no significant pattern was found in cameras far from settlements. Both direct and indirect effects of human activity had a significant effect on the activity pattern of wild boars. A decrease in human activity may result in the rapid expansion of wild boar populations, and re-evaluation of the human factor is important for more intelligent management of wild boar populations and to solve the human-wildlife conflict.

Pender, RJ, Shiels, AB, Bialic-Murphy, L, Mosher, SM. 2013. Large-scale rodent control reduces pre- and post-dispersal seed predation of the endangered Hawaiian lobeliad, Cyanea superba subsp superba (Campanulaceae). BIOLOGICAL INVASIONS 15(1):213-223.

Large-scale rodent control can help to manage endangered species that are vulnerable to invasive rodent consumption. A 26 ha rodent snap-trap grid was installed in montane forest on Oahu Island, Hawaii, in order to protect endangered snails and plants. To assess the effectiveness of this trapping operation in reducing fruit consumption and seed predation of the endangered Hawaiian lobeliad, *Cyanea superba* subsp. *superba*, pre- and post-dispersal *C. superba* fruit consumption were monitored for 36 plants at the site with rodent control (Kahanahaiki) and 42 plants at an adjacent site without rodent control (Pahole). Over 47 % of all monitored fruit were eaten on the plants at Pahole compared to 4 % at Kahanahaiki. Images captured using motion-sensing cameras suggest that black rats (*Rattus rattus*) were the only pre-dispersal fruit consumers. To quantify post-dispersal fruit consumption, and to identify the culprit frugivore(s), mature fruit were placed in tracking tunnels positioned on the forest floor and checked daily. At Pahole, all of the fruit were consumed by rats compared to 29 % at Kahanahaiki. Lastly, to determine if rodents from the sites were predators or dispersers of *C. superba* seed, fruit were fed to captive black rats and house mice (*Mus musculus*). Black rats consumed entire fruit, killing all the seed, while mice did little damage to the fruit and seed. Therefore, large-scale rat trapping can directly benefit the reproduction of *C. superba* subsp. *superba*. Controlling black rats at restoration sites appears integral to the successful restoration of this endangered plant species.

Pesenti, E, Zimmermann, F. 2013. Density estimations of the Eurasian lynx (*Lynx lynx*) in the Swiss Alps. JOURNAL OF MAMMALOGY 94(1):73-81.

Use of photographic capture recapture analyses to estimate abundance of species with distinctive natural marks has become an important tool for monitoring rare or cryptic species, or both. Two different methods are available to estimate density: nonspatial capture recapture models where the trap polygon is buffered with the half or full mean maximum distance moved by animals captured at more than 1 trap (1/2 MMDM or MMDM, respectively); or spatial capture recapture (SCR) models that explicitly incorporate movement into the model. We used data from radiotracked

Eurasian lynx (*Lynx lynx*) in the northwestern Swiss Alps (NWSA) during a low (1.0 lynx/100 KM^2) and a high (1.9-2.1 lynx/100 KM^2) lynx population density to test if lynx space use was density dependent. Second, we compared lynx density estimates resulting from these 2 different methods using camera-trapping data collected during winters 2007-2008 and 2009-2010 in the NWSA. Our results indicated lynx space use was negatively correlated with density. Lynx density estimates in all habitats using MMDM (0.86 and 0.97 lynx/100 KM^2 in winters 2007-2008 and 2009-2010, respectively) were significantly lower than SCR model estimates, whereas there was no significant difference between SCR model (1.47 and 1.38) and 1/2 MMDM (1.37 and 1.51) density estimates. In the NWSA, which currently harbors the most abundant lynx population in Switzerland, 1/2 MMDM and SCR models provided more realistic lynx density estimates compared to the MMDM, which lies in the lower range of densities. Overall, the SCR model is preferable because it considers animal movements explicitly and is not biased by an informal estimation of the effective sampling area.

Ramesh, T, Downs, CT. 2013. Impact of farmland use on population density and activity patterns of serval in South Africa. JOURNAL OF MAMMALOGY 94(6):1460-1470.

The Drakensberg Midlands, South Africa are experiencing unprecedented levels of habitat change. Despite the serval (*Leptailurus serval*) being a near-threatened wetland specialist, no studies have investigated their response to land use. To assess their abundance, we used camera trapping at 3 sites differing in intensity of farmland use with capture recapture models. A total of 1,320 camera trap nights across the 3 sites yielded 26 and 28 servals. We detected no major difference in servals/100 km^2 among the 3 sites using spatially explicit maximum-likelihood (7.6 ± 2.3; 6.5 ± 2.7; 6.5 ± 2.6) and Bayesian (7.7 ± 1.6; 6.2 ± 1.9; 6.9 ± 2.1) methods in sites A, B, and C, respectively. Servals were mainly crepuscular and nocturnal. The Mardia-Watson-Wheeler test showed significant difference in activity in A and C compared with B, whereas it showed no difference between A and

C. Servals avoided activity during the day in the intensively farmed B. Abundance analysis at the broader habitat scale may not have detected variation among sites. Differences need to be tested at smaller spatial scales. The statistical approaches in this study provide the 1st robust estimation of serval population size. This estimation of a medium-sized felid with changing land use can assist their management and conservation.

Ramnanan, R, Swanepoel, LH, Somers, MJ. 2013. The diet and presence of African wild dogs (*Lycaon pictus*) on private land in the Waterberg region, South Africa. SOUTH AFRICAN JOURNAL OF WILDLIFE RESEARCH 43(1):68-73.

African wild dog (*Lycaon pictus*) populations and their geographic distributions have been greatly reduced due to direct human persecution and habitat reduction; however, remnant groups still manage to persist on private reserves and farmland. Farmland, especially game farming areas, can potentially be suitable for wild dog conservation. However, little is known about them in these areas. To increase our understanding regarding the presence and general ecology of wild dogs on private land we used a camera trapping picture database initially used to census leopards (*Panthera pardus*) to report on wild dog presence on private farmland and reserves within the Waterberg Biosphere, South Africa. We identified nine different wild dogs from the camera trap images and all wild dog signs were restricted to Lapalala. We further supplemented the data set with opportunistically collected scats to report on wild dog prey use. Only three species could be identified in the scats, namely bushbuck (*Tragelaphus scriptus*), impala (*Aepyceros melampus*) and greater kudu (*Tragetaphus strepsiceros*), with bushbuck the most important prey species. Our results show that some wild dogs still persist on private land in the Waterberg, confirming that private land can play an important role in wold dog conservation. We suggest that conservation efforts focussing on mitigation actions to improve local tolerance towards wild dogs would be the most efficient action to secure a viable wild dog population.

Rowcliffe, JM, Kays, R, Carbone, C, Jansen, PA. 2013. Clarifying assumptions behind the estimation of animal density from camera trap rates. JOURNAL OF WILDLIFE MANAGEMENT 77(5):876.

NO ABSTRACT

Sekar, N, Sukumar, R. 2013. Waiting for Gajah: an elephant mutualist's contingency plan for an endangered megafaunal disperser. JOURNAL OF ECOLOGY 101(6):1379-1388.

Large animals are disproportionately likely to go extinct, and the effects of this on ecosystem processes are unclear. Megaherbivores (weighing over 1000kg) are thought to be particularly effective seed dispersers, yet only a few plant species solely or predominantly adapted for dispersal by megaherbivores have been identified. The reasons for this paradox may be elucidated by examining the ecology of so-called megafaunal fruiting species in Asia, where large-fruited species have been only sparsely researched. We conducted focal tree watches, camera trapping, fruit ageing trials, dung seed counts and germination trials to understand the ecology of *Dillenia indica*, a large-fruited species thought to be elephant-dispersed, in a tropical moist forest (Buxa Tiger Reserve, India). We find that the initial hardness of the fruit of *D.indica* ensures that its small (6mm) seeds will primarily be consumed and dispersed by elephants and perhaps other megaherbivores. Elephants removed 63.3% of camera trap-monitored fruits taken by frugivores. If the fruit of *D.indica* is not removed by a large animal, the seeds of *D.indica* become available to successively smaller frugivores as its fruits soften. Seeds from both hard and soft fruits are able to germinate, meaning these smaller frugivores may provide a mechanism for dispersal without megaherbivores. Synthesis. *Dillenia indica's* strategy for dispersal allows it to realize the benefits of dispersal by megaherbivores without becoming fully reliant on these less abundant species. This risk-

spreading dispersal behaviour suggests *D.indica* will be able to persist even if its megafaunal disperser becomes extinct.

Shardlow, TF, Hyatt, KD. 2013. Quantifying associations of large vertebrates with salmon in riparian areas of British Columbia streams by means of camera-traps, bait stations, and hair samples. ECOLOGICAL INDICATORS 27:97-107

The importance of transfers of marine derived nutrients (MDN) in salmon between stream ecosystems and terrestrial riparian systems is a subject of much recent research which has established that MDN subsidies support populations of many animal species, affect riparian zone productivity and may control the biodiversity of riparian plant communities. Numerous biophysical processes are involved in the transfer of MDN between aquatic and riparian zones of streams but, the largest proportion of MDN transport across the aquatic-terrestrial interface appears to depend on the actions of a predator-scavenger complex (PSC) that in British Columbia includes at least 23 species of mammals and birds. Consequently, the role of salmon in maintaining riparian ecosystem integrity depends not only on spatial and temporal variations in salmon abundance but also on variations in the composition and strength of linkages between salmon and other PSC species. Measuring these linkages with traditional methods using direct observation would be prohibitively expensive and time consuming. In the current paper laser activated camera systems, salmon carcass manipulation and deoxyribonucleic acid (DNA) analysis of hair samples were employed to (1) identify large vertebrate members of the PSC of riparian zone ecosystems and (2) quantify the strength of linkages of these PSC vertebrates to spatial and temporal changes in salmon abundance. Techniques developed and applied here to gain insights into the salmon PSC have several advantages over traditional survey methods. These include semi-automated capture of large volumes of data, identification of diurnally and nocturnally active PSC members, ready inclusion of experiments in field survey design, reduced impacts of unintentional human interference on survey results, and greatly reduced cost relative to direct

observational studies. Results reported here confirm black bears (*Ursus americanus*), pine marten (*Martes americana*), cougar (*Felis concolor*), wolverine (*Gulo luscus*), eagles (*Haliaeetus leucocephalus*), ravens (*Corvus corox*), and vultures (*Cathartes aura*) as large vertebrate members of the regional salmon PSC. However, the composition and strength of linkages between salmon and these PSC members vary so much in space and time that most appear unsuitable as generally useful indicators of the potential magnitude of salmon-dependent, MDN-transport from aquatic to riparian-zone ecosystems. Black bears however, given their high relative abundance, broad geographic distribution, and strong linkages to salmon represent a superior candidate for further development in combination with salmon, as indicators of the maintenance of MDN transport potential in future assessments of riparian ecosystem integrity of salmon bearing streams.

Sheil, D, Mugerwa, B, Fegraus, EH. 2013. African golden cats, citizen science, and serendipity: tapping the camera trap revolution. SOUTH AFRICAN JOURNAL OF WILDLIFE RESEARCH 43(1):74-78.

The use of camera traps for wildlife research and monitoring is increasing and this is yielding significant observations at an accelerating pace. Yet many potentially valuable observations are overlooked, misinterpreted or withheld. Using our first-ever images of a wild African golden cat (*Caracal aurata*) catching prey, we consider practical challenges and opportunities for more effective image management systems. In particular we highlight the benefits of online image archives and assessments.

Singh, R, Majumder, A, Sankar, K, Qureshi, Q, Goyal, SP, Nigam, P. 2013. Interbirth interval and litter size of free-ranging Bengal tiger (*Panthera tigris tigris*) in dry tropical deciduous forests of India. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 59(5):629-636.

We studied the interbirth interval (IBI) and litter size of the population of free-ranging Bengal tigers (Panthera tigris tigris) in dry tropical deciduous forests in Ranthambhore Tiger Reserve (RTR), Rajasthan, and Pench Tiger Reserve (PTR), Madhya Pradesh, between April 2005 and June 2011. Data on 15 breeding females in RTR and nine breeding females in PTR were collected using camera trapping, direct observation and radio-telemetry. The mean ± standard error of IBI (months) in RTR was 33.4 ± 3.7 and in PTR was 25.2 ± 1.8. A significant difference was observed between the mean IBI of tigresses in RTR and those in PTR (df = 9, P = 0.04). The estimated mean litter size in RTR was 2.3 ± 0.1 and that in PTR was 2.9 ± 0.2. There was a significant difference between the litter size in RTR and that in PTR (chi^2 = 12.04, P = 0.017, df = 4). Since RTR and PTR are the important source populations of tigers in the Western and Central Indian landscapes, we propose that the tigers in these reserves be monitored, particularly for reproductive traits that are essential for understanding aspects of their population ecology.

Singh, R, Qureshi, Q, Sankar, K, Krausman, PR, Goyal, SP. 2013. Use of camera traps to determine dispersal of tigers in semi-arid landscape, western India. JOURNAL OF ARID ENVIRONMENTS. 98:105-108.

Dispersal is a life history trait that plays a key role in population dynamics. We used camera traps to estimate the distance male and female tigers (*Panthera tigris*) dispersed from Ranthambhore Tiger Reserve (RTR) in semi-arid habitats of western India from 2003 to 2010. We deployed camera traps whenever tiger tracks were found in places adjacent to protected areas where tigers had not been recently reported. We identified tigers by matching strip patterns by using their photographs with the database of camera-trapped tigers of RTR at the Wildlife Institute of India, Dehradun. We determined the aerial distance (straight line) between the last location of photo-capture in the natal area (in RTR) and the location of the most recent photo-capture. One female and three male tigers that dispersed from RTR were identified from photographs. The longest distance dispersed by a tiger was 148.4 km, and the average dispersed distance was 124.2 ±

23.7 km (n = 3) for male tigers and 78.4 km for the female tiger. The minimum age of the male tigers when they dispersed was 24 months. These data are important for making conservation and management decisions for restoration of potential connectivity between landscapes.

Smallwood, KS, Bell, DA, Karas, B, Snyder, SA. 2013. Response to Huso and Erickson's comments on novel scavenger removal trials. JOURNAL OF WILDLIFE MANAGEMENT 77(2):216-225.

Trials involving volitionally placed carcasses are often used to estimate the portion of the collision-caused fatality population that is undetected by periodic fatality searches at wind turbines. Huso and Erickson criticized our paper reporting on a comparison of carcass persistence rates between what we termed conventional versus novel approaches to these trials. In our novel approach, we measured carcass persistence rates by placing only 12 fresh carcasses per week, instead of the typical 10 or more carcasses at a time, often using found carcasses of unknown time since death. Huso and Erickson directed most of their critique to this novel aspect of our approach, although the novelty of our approach also included the use of event-triggered camera traps, which we used to record exact times of removals and to identify vertebrate scavenger species responsible for the removals. In our replies to Huso and Erickson's major criticisms, we acknowledge flaws in our field methods for arriving at fatality rate estimates, but we also point out the larger flaws in the methods used by Huso and Erickson, especially in their use of mean days to removal as a measure of carcass persistence. We conclude by introducing a more appropriate detection trial, which combines searcher detection and scavenger removal trials, and integrates this detection trial into periodic fatality monitoring.

Srbek-Araujo, AC, Chiarello, AG. 2013. Influence of camera-trap sampling design on mammal species capture rates and community structures in southeastern Brazil. BIOTA NEOTROPICA 13(2):51-62.

The distribution of species and population attributes are critical data for biodiversity conservation. As a tool for obtaining such data, camera traps have become increasingly common throughout the world. However, there are disagreements on how camera-trap records should be used due to imperfect species detectability and limitations regarding the use of capture rates as surrogates for abundance. We evaluated variations in the capture rates and community structures of mammals in camera-trap surveys using four different sampling designs. The camera traps were installed on internal roads (in the first and fourth years of the study), at 100-200 m from roads (internal edges; second year) and at 500 m from the nearest internal road (forest interior; third year). The mammal communities sampled in the internal edges and forest interior were similar to each other but differed significantly from those sampled on the roads. Furthermore, for most species, the number of records and the capture success varied widely among the four sampling designs. A further experiment showed that camera traps placed on the same tree trunk but facing in opposing directions also recorded few species in common. Our results demonstrated that presence or non-detection and capture rates vary among the different sampling designs. These differences resulted mostly from the habitat use and behavioral attributes of species in association with differences in sampling surveys, which resulted in differential detectability. We also recorded variations in the distribution of records per sampling point and at the same spot, evidencing the stochasticity associated with the camera-trap location and orientation. These findings reinforce that for species whose specimens cannot be individually identified, the capture rates should be best used as inputs for presence and detection analyses and for behavior inferences (regarding the preferential use of habitats and activity patterns, for example). Comparisons between capture rates or among relative abundance indices, even for the same species, should be made cautiously.

Sunarto, Sollmann, R, Mohamed, A, Kelly, MJ. 2013. Camera trapping for the study and conservation of tropical carnivores. RAFFLES BULLETIN OF ZOOLOGY 28:21-42.

Past studies on tropical carnivores and other secretive animals relied on indirect evidence of animal presence such as tracks, scats, or scrapes. While such evidence can be useful for basic studies, using remotely-triggered camera traps offer researchers more reliable evidence of animal presence and, with appropriate study design and analysis, provides an array of opportunities to investigate carnivore ecology. We present an overview on camera trap uses for the study and conservation of wildlife, with a particular focus on tropical carnivores. Our goals are to promote proper and effective application of camera trapping and related analyses. We highlight major research avenues, give relevant examples and lessons learned from published material and from our own experiences, and review available resources for implementation, from preparation and camera trap field set up, to data management, analysis, and presentation of results. Our review considers sampling design with respect to target species or groups of species, the state variable(s) of interest, what constitutes a sample, sample size needed, collection of supporting data (independent variables), reducing bias/ minimising error, and data collection schedule. We also highlight some available camera trap database management packages and available statistical packages to analyse camera trapping data. We discuss presenting findings to a wider audience so results become useful in the conservation and management of species. Finally, we discuss future development of camera trapping technology and related techniques for the study and conservation of carnivores in the tropics.

Tambling, CJ, Minnie, L, Adendorff, J, Kerley, GIH. 2013. Elephants facilitate impact of large predators on small ungulate prey species. BASIC AND APPLIED ECOLOGY 14(8):694-701.

Predators and megaherbivores have profound impacts on ecosystem structure and functioning. Following the reintroduction of apex predators (lion and spotted hyaena) into the Main Camp Section (Main Camp) of the Addo Elephant National Park (Addo Eastern Cape, South Africa)

populations of small (5-50 kg) prey species declined. Following the recent reintroduction of apex predators into the neighbouring Colchester Section, a similar decline in small prey species might have occurred. However, we predict that the dense nature of Thicket vegetation in Colchester has provided the small prey species a refuge from predation from the reintroduced apex predators. Using camera trap data collected over three years following the apex predator reintroduction into Colchester, we show that declines in small ungulate prey species have not taken place. The primary difference between these two sections at the time of the apex predator reintroduction was the state of the Thicket (dense vegetation type characteristic of both sections). Main Camp is characterized by fragmented Thicket that has been altered as a result of high elephant densities, whereas Colchester has intact Thicket following a long history of elephant absence. The fragmented Thicket in Main Camp allowed access to the Thicket habitats (as indicated by GPS collar data on lions), in which these small prey species reside, potentially increasing the predation on these species in Main Camp. The intact Thicket in Colchester, however, may provide a refuge away from the apex predators (and possibly meso-predators) for the small prey species. We suggest that the impact of predators on this prey community is conditional on the long history of ecosystem transformation by ecosystem engineers such as elephants.

Tan, CL, Yang, YQ, Niu, KF. 2013. Into the night: camera traps reveal nocturnal activity in a presumptive diurnal primate, *Rhinopithecus brelichi*. PRIMATES 54(1):1-6.

Most living primates exhibit a daytime or nighttime activity pattern. Strict diurnality is thought to be the rule among anthropoids except for owl monkeys. Here we report the diel activity pattern of an Asian colobine, the Guizhou snub-nosed monkey *Rhinopithecus brelichi*, based on a methodology that relied on using 24-h continuously operating camera traps. We conducted the study in Fanjingshan National Nature Reserve in Guizhou, China from March 22 to May 19 and from June 17 to October 14, 2011. After standardizing all time elements to a meridian-based time

according to the geographic coordinates of the study site, we showed unequivocally that the monkeys, though predominantly diurnal, exhibited activity beyond daylight hours throughout the study. Specifically, their activity at night and during twilight periods suggests a complex interplay of behavioral adaptations, among others, to living in a temperate environment where day length and food resources fluctuate substantially across seasons. We contend that, under prevailing ecological conditions, so-called strictly diurnal primates may adjust their activity schedule opportunistically in order to increase energy intake. We also discuss the advantages of using camera traps in primate studies, and how the standardized use of meridian-based time by researchers would benefit comparisons of diel activity patterns among primates.

Taylor, BD, Goldingay, RL. 2013. Squirrel gliders use roadside glide poles to cross a road gap. AUSTRALIAN MAMMALOGY. 35(1)119-122.

Tall wooden poles placed along roadsides may enable road crossing by gliding mammals. We investigated the use of 12-m-high roadside glide poles at one location in Brisbane. Camera traps on roadside poles detected squirrel gliders (*Petaurus norfolcensis*) on one or both poles on 60 of 310 operational nights including at least 16 confirmed crossings during 125 nights when both roadside cameras operated concurrently. This provides definitive evidence that squirrel gliders will readily use tall wooden poles to make glide-crossings of two-lane roads. This is consistent with other investigations of glide poles and suggests that poles should be installed more broadly to reconnect habitat for gliding mammals.

Tempa, T, Hebblewhite, M, Mills, LS, Wangchuk, TR, Norbu, N, Wangchuk, T, Nidup, T, Dendup, P, Wangchuk, D, Wangdi, Y, Dorji, T. 2013. Royal Manas National Park, Bhutan: a hot spot for wild felids. ORYX 47(2):207-210

The non-uniformity of the distribution of biodiversity makes allocation of the limited resources available for conservation of biodiversity a difficult task. Approaches such as biodiversity hotspot identification, endemic bird areas, crisis ecoregions, global 200 ecoregions, and the Last of the Wild are used by scientists and international conservation agencies to prioritize conservation efforts. As part of the biodiverse Eastern Himalayan region, Bhutan has been identified as a conservation priority area by all these different approaches, yet data validating these assessments are limited. To examine whether Bhutan is a biodiversity hot spot for a key taxonomic group, we conducted camera trapping in the lower foothills of Bhutan, in Royal Manas National Park, from November 2010 to February 2011. We recorded six species of wild felids of which five are listed on the IUCN Red List: tiger *Panthera tigris*, golden cat *Pardofelis temminckii*, marbled cat *Pardofelis marmorata*, leopard cat *Prionailurus bengalensis*, clouded leopard *Neofelis nebulosa* and common leopard *Panthera pardus*. Our study area of 74 KM^2 has c. 16% of felid species, confirming Bhutan as a biodiversity hot spot for this group.

Tobler, MW, Powell, GVN. 2013. Estimating jaguar densities with camera traps: Problems with current designs and recommendations for future studies. BIOLOGICAL CONSERVATION 159:109-118.

Camera traps have become the main method for estimating jaguar (*Panthera onca*) densities. Over 74 studies have been carried out throughout the species range following standard design recommendations. We reviewed the study designs used by these studies and the results obtained. Using simulated data we evaluated the performance of different statistical methods for estimating density from camera trap data including the closed-population capture-recapture models M-o and M-h with a buffer of 1/2 and the full mean maximum distance moved (MMDM) and spatially explicit capture-recapture (SECR) models under different study designs and scenarios. We found that for the studies reviewed density estimates were negatively correlated with camera polygon size and MMDM estimates were positively correlated. The simulations showed that for camera polygons that

were smaller than approximately one home range density estimates for all methods had a positive bias. For large polygons the Mh MMDM and SECR model produced the most accurate results and elongated polygons can improve estimates with the SECR model. When encounter rates and home range sizes varied by sex, estimates had a negative bias for models that did not include sex as a covariate. Based on the simulations we concluded that the majority of jaguar camera trap studies did not meet the requirements necessary to produce unbiased density estimates and likely overestimated true densities. We make clear recommendations for future study designs with respect to camera layout, number of cameras, study length, and camera placement. Our findings directly apply to camera trap studies of other large carnivores.

Tobler, MW, Carrillo-Percastegui, SE, Hartley, AZ, Powell, GVN. 2013. High jaguar densities and large population sizes in the core habitat of the southwestern Amazon. BIOLOGICAL CONSERVATION 159:375-381.

Over 80% of the currently occupied range of the jaguar (*Panthera onca*) lies in the Amazon. However, few density estimates exist for this habitat. Between 2005 and 2010 we carried out six camera trap surveys at three different sites in the department of Madre de Dios in the Peruvian Amazon. We analyzed our data using a Bayesian spatially explicit capture recapture model (SECR) with sex covariates to account for differences in home range size and detection probabilities of male and female jaguars. As several of our camera grids where too small for reliable density estimates, we used estimates for the sigma parameter from the largest camera grid to correct for the bias. Density estimates for our surveys were similar with an average density of 4.4 ± 0.7 jaguar 100 km^{-2}. Both home range size and encounter rates varied significantly between sexes with males having a larger home range and higher encounter rate than females. Our estimated sex ratio was 1:1.5 compared to an observed ratio of 1.9:1. Not accounting for sex would have resulted in an underestimation of the true density. The densities found in this study are among the highest documented and show that the Amazon is indeed a core habitat for the jaguar. We estimate that three

jaguar conservation units in our study region (areas defined by experts as having a high conservation priority) could harbor as many as 6000 jaguars (CI: 4278-8142).

Wearn, OR, Rowcliffe, JM, Carbone, C, Bernard, H, Ewers, RM. 2013. Assessing the Status of Wild Felids in a Highly-Disturbed Commercial Forest Reserve in Borneo and the Implications for Camera Trap Survey Design. PLOS ONE 8(11):e77598.

The proliferation of camera-trapping studies has led to a spate of extensions in the known distributions of many wild cat species, not least in Borneo. However, we still do not have a clear picture of the spatial patterns of felid abundance in Southeast Asia, particularly with respect to the large areas of highly-disturbed habitat. An important obstacle to increasing the usefulness of camera trap data is the widespread practice of setting cameras at non-random locations. Non-random deployment interacts with non-random space-use by animals, causing biases in our inferences about relative abundance from detection frequencies alone. This may be a particular problem if surveys do not adequately sample the full range of habitat features present in a study region. Using camera-trapping records and incidental sightings from the Kalabakan Forest Reserve, Sabah, Malaysian Borneo, we aimed to assess the relative abundance of felid species in highly-disturbed forest, as well as investigate felid space-use and the potential for biases resulting from non-random sampling. Although the area has been intensively logged over three decades, it was found to still retain the full complement of Bornean felids, including the bay cat *Pardofelis badia*, a poorly known Bornean endemic. Camera-trapping using strictly random locations detected four of the five Bornean felid species and revealed inter-and intra-specific differences in space-use. We compare our results with an extensive dataset of >1,200 felid records from previous camera-trapping studies and show that the relative abundance of the bay cat, in particular, may have previously been underestimated due to the use of non-random survey locations. Further surveys for this species using random locations will be crucial in determining its conservation status. We

advocate the more wide-spread use of random survey locations in future camera-trapping surveys in order to increase the robustness and generality of inferences that can be made.

Wong, WM, Leader-Williams, N, Linkie, M. 2013. Quantifying changes in sun bear distribution and their forest habitat in Sumatra. ANIMAL CONSERVATION 16(2):216-223.

High rates of deforestation are presumed to adversely affect large-bodied mammal populations across South-east Asia. Understanding how these species respond to deforestation is therefore important for their conservation, particularly for more cryptic species that have proved a challenge to enumerate. Here, we use an occupancy approach based on detection/non-detection data collected over two survey periods to conduct the first assessment of spatio-temporal changes in sun bear distribution. We measured sun bear population trends through repeat camera-trap surveys and assessed their response to varying levels of deforestation in four study areas located in and around the 13300km2 Kerinci Seblat National Park (KSNP), Sumatra, from 2004/06 to 2009/11. The crude results suggested a decline in sun bear distribution, from 0.683 [0.5190.810; 95% confidence intervals (CIs)] to 0.444 (0.2530.584), but there were considerable overlaps in temporal CIs. This overall change in occupancy was partially driven by the significant decline (9.4%year1) in one subpopulation living in the study area that underwent the highest rate of deforestation (0.96%year1). Meanwhile, sun bear subpopulations living in areas experiencing lower deforestation rates (i.e. <0.60%year1) appear to be less affected by forest clearance. Our study demonstrates that occupancy modelling is a useful and replicable tool for monitoring sun bear populations in KSNP and elsewhere. Our results confirm that KSNP is a stronghold for sun bears, while also forewarning of the detrimental effects of ongoing illegal deforestation on sun bear distributions.

Yu, XY, Wang, JP, Kays, R, Jansen, PA, Wang, TJ, Huang, T. 2013. Automated identification of animal species in camera trap images. EURASIP JOURNAL ON IMAGE AND VIDEO PROCESSING DI 10.1186/1687-5281-2013-52

Image sensors are increasingly being used in biodiversity monitoring, with each study generating many thousands or millions of pictures. Efficiently identifying the species captured by each image is a critical challenge for the advancement of this field. Here, we present an automated species identification method for wildlife pictures captured by remote camera traps. Our process starts with images that are cropped out of the background. We then use improved sparse coding spatial pyramid matching (ScSPM), which extracts dense SIFT descriptor and cell-structured LBP (cLBP) as the local features, that generates global feature via weighted sparse coding and max pooling using multi-scale pyramid kernel, and classifies the images by a linear support vector machine algorithm. Weighted sparse coding is used to enforce both sparsity and locality of encoding in feature space. We tested the method on a dataset with over 7,000 camera trap images of 18 species from two different field cites, and achieved an average classification accuracy of 82%. Our analysis demonstrates that the combination of SIFT and cLBP can serve as a useful technique for animal species recognition in real, complex scenarios.

Zero, VH, Sundaresan, SR, O'Brien, TG, Kinnaird, MF. 2013. Monitoring an Endangered savannah ungulate, Grevy's zebra *Equus grevyi*: choosing a method for estimating population densities. ORYX 47(3):410-419.

Methods that accurately estimate animal abundance or density are crucial for wildlife management. Although numerous techniques are available, there have been few comparisons of the precision and cost-effectiveness of different approaches. We assess the precision and cost of three methods for estimating densities of the Endangered Grevy's zebra *Equus grevyi*. We

compare distance sampling and photographic capture-recapture, and a new technique, the random encounter model (REM) that uses camera-trap encounter rates to estimate density. All three methods provide comparable density estimates for Grevy's zebra and are preferable to the common practice of raw counts. Photographic capture-recapture is the most precise and line-transect distance sampling the least precise. Line transects and photographic capture-recapture surveys are cost-effective in the first year and REM is most cost-effective in the long-term. The methods used here for Grevy's zebra may be applied to other rangeland ungulates. We suggest that for single species monitoring programmes in which individuals can be identified, photographic capture-recapture surveys may be the preferred method for estimating wildlife abundances. When encounter rates are low, distance sampling lacks the precision of the other methods but its cost advantage may make it appropriate for long-term or multi-species monitoring programmes. The REM is an efficient and precise method of estimating densities but has high initial equipment costs. We believe REM has the potential to work well for many species but it requires independent estimates of animal movements and group size.

Zimbres, B, Furtado, MM, Jacomo, ATA, Silveira, L, Sollmann, R, Torres, NM, Machado, RB, Marinho, J. 2013. The impact of habitat fragmentation on the ecology of xenarthrans (Mammalia) in the Brazilian Cerrado. LANDSCAPE ECOLOGY 28(2)259-269.

The impact of deforestation and fragmentation upon ecologically important and poorly known groups is currently an important issue for conservation biology. Herein we describe xenathran communities across the Brazilian Cerrado and study the effects of habitat fragmentation on occupancy and activity patterns on these assemblages. Our hypothesis was that larger and specialized species would be more ecologically sensitive, and likely to exhibit shifts in their activity patterns in more deforested areas as a way of dealing with the myriad of effects involved in the fragmentation process. The study was conducted by camera trapping in ten Cerrado sites. Five species were analyzed: *Priodontes maximus*, *Euphractus sexcinctus*,

Dasypus novemcintus (Order Cingulata), *Tamandua tetradactyla* and *Myrmecophaga tridactyla* (Order Pilosa). Fragmentation was quantified by landscape metrics, calculated on scales that matched the species' home ranges. Occupancy and detection probability analyses were conducted to test for shifts in occupancy under different fragmentation conditions. A mixed-effects model analysis was conducted to test for shifts in species' frequency of records related to time of day, controlling for spatial autocorrelation by means of eigenvector-based spatial filters for the models' residuals. There were no changes in activity pattern between more and less fragmented areas, so that our behavioural plasticity hypothesis was not corroborated for this group. The lack of changes in the patterns could be explained by a species' time-lag response, or by the lack of a wide enough fragmentation gradient in our study.

2012

Abi-Said, M, Amr, ZS. 2012. Camera trapping in assessing diversity of mammals in Jabal Moussa Biosphere Reserve, Lebanon. VERTEBRATE ZOOLOGY 62(1):145-152.

Thirteen species of mammals were documented using camera trapping in Jabal Moussa Biosphere Reserve in Lebanon. The presence of seven carnivores and most interestingly the Rock Hyrax, *Procavia capensis*, was confirmed. Data on annual activity were also included for all species reported.

Akbaba, B, Ayas, Z. 2012. Camera trap study on inventory and daily activity patterns of large mammals in a mixed forest in north-western Turkey. MAMMALIA 76(1):43-48.

This study aimed to detect the presence and the daily activity patterns of large mammals in a mixed forest in north-western Turkey. Field studies were carried out at 21 camera trap stations with a total sampling effort of 1046 camera trap days, covering an area of approximately 70 KM^2 between June 2009 and January 2010. Brown bear (*Ursus arctos*), wolf (*Canis lupus*), Eurasian lynx (*Lynx lynx*), red deer (*Cervus elaphus*), wild boar (*Sus scrofa*), red fox (*Vulpes vulpes*), European badger (*Meles meles*) and European hare (*Lepus europaeus*) were not known to be present in the area. European hare was the most captured species among the others and Eurasian lynx was the most captured carnivore. There was a positive relationship between spatial distributions and daily activity patterns of European hare and Eurasian lynx. European hare, Eurasian lynx and red fox were found to have nocturnal activity in the study area. The number of records between the activity classes (nocturnal and diurnal) did not differ for red deer and wolf. This study revealed the ecological importance of the

area by determining both the species present in this area and their activity patterns.

Albayrak, T, Giannatos, G, Kabasakal, B. 2012. Carnivore and ungulate populations in the Beydaglari Mountains (Antalya, Turkey): border region between Asia and Europe. POLISH JOURNAL OF ECOLOGY 60(2):419-428.

Turkey is being a bridge between Europe and Asia and it provides the natural pathway for the spread of species between these continents. The Beydaglari Mountains and its surroundings (Antalya) host many Asian, European and Mediterranean faunal and floral elements and the location, which is considered as one of the most important faunal areas in Turkey especially for larger mammals. The study is the first systematic survey of the carnivores in the region which is based on photo trapping. The cameras were set at 45 locations for 2055 trap days between 2005-2009 over the area 294 KM^2 at the altitude 1200-2000 m a.s.l. Most of the species and their individual abundance were recorded in maquis habitat type followed by red pine forest, mixed (red pine and maquis), and cedar forest respectively. The wild animals that were captured included five mammalian carnivore species (red fox *Vulpes vulpes*, badger *Meles meles*, stone marten *Martes foina*, gray wolf *Canis lupus* and caracal *Caracal caracal*) and also wild boar *Sus scrofa*, fallow deer *Dama dama* and hare *Lepus europaeus*. Photo trapping activity was mostly recorded between 21:00 and 03:00 hours. Wild terrestrial carnivores occur at low densities in the study area (1.73 for caracal and 0.9 for wolf ind.100 km^{-2}) while the most widespread larger mammal was the wild boar (188 ind.100 km^{-2}). The small fallow deer population was mainly confined in a large (4.2 KM^2) fenced enclosure and its size was accessed by direct drive count. The results support the hypothesis that Beydaglan Mountains having the Asian, European and Mediterranean mammals makes the Anatolian Peninsula being a bridge between Europe and Asia. Caracal density was lower than the Datca population in the southern part of Anatolia. This may be consequence of higher human activities in the Beydaglan Mts. Human activities in the

Beydaglan Mts. should be reduced for sensitive animals to human activities like caracal and wolf and the illegal hunting should be strictly prohibited in the area for viability of the large mammals of Beydaglan Mts.

Anile, S, Arrabito, C, Mazzamuto, MV, Scornavacca, D, Ragni, B. 2012. A non-invasive monitoring on European wildcat (*Felis silvestris silvestris* Schreber, 1777) in Sicily using hair trapping and camera trapping: does scented lure work? HYSTRIX-ITALIAN JOURNAL OF MAMMALOGY 23(2):44-49.

A hair trapping protocol, with camera trapping surveillance, was carried out on the south-western side of the Etna, inhabited by an abundant population of the European wildcat. We aimed to collect hair for genetic analysis on the base of a field study conducted in Switzerland, where valerian tincture had been used to attract wildcats to rub again wooden sticks and therefore leaving hairs. We placed 18 hair trapping stations, plus one camera trap per scented wooden stick, 1 km away from each other for 60 days (October 29 2010 to December 28 2010). The rate of "capture" success (1 capture / 24.5 trap-days) by camera trapping was substantially the same as those obtained during previous surveys performed in the same study area without the use of any attractants. No wildcats were photographed while rubbing against the wooden sticks, neither any wildcat was interested in the scent lure. We discuss limitations of the hair trapping, providing possible explanations on the failure of valerian tincture, while suggesting some field advices for future monitorings.

Andresen, L, Everatt, KT, Somers, MJ, Purchase, GK. 2012. Evidence for a resident population of cheetah in the Parque Nacional do Limpopo, Mozambique. SOUTH AFRICAN JOURNAL OF WILDLIFE RESEARCH 42(2):144-146.

Transboundary protected areas may be important for the conservation of large African carnivores because these species require large tracts of

habitat to maintain viable population numbers and gene flow. Cheetah (*Acinonyx jubatus* Schreber, 1775), is a species that may benefit from transboundary conservation agreements. It occurs at naturally low population densities, makes use of large home ranges, and disperses over long distances, thus requiring large tracts of suitable habitat to maintain viable population numbers. Here we present the first scientific evidence of a breeding population of cheetah in Parque Nacional do Limpopo (PNL), Mozambique. We obtained data from camera-traps deployed during occupancy surveys conducted from 9 September 2011 to 31 August 2012 over a 3400 KM^2 study area located within the central third of PNL. These results highlight the importance of the Greater Limpopo Transfrontier Park (GLTFP) to the overall conservation of cheetah in Africa, and the potential value of transboundary protected areas for the conservation of wide-roaming terrestrial mammals.

Aranda, M, Botello, F, Lopez-de Buen, L. 2012. Medium and large mammal diversity and reproductive data in the cloud forest, Biosphere Reserve of Sierra Manantlan, Jalisco-Colima, Mexico. REVISTA MEXICANA DE BIODIVERSIDAD 83(3):778-784.

The cloud forest (CF) is one of the ecosystems with less surface and the most threatened in Mexico. This paper presents information on the richness, relative abundance, activity and reproductive data of medium and large mammals in the CF located in the Sierra de Manantlan Biosphere Reserve. Between February 2008 and August 2009, we used camera-traps with which we obtained 372 independent records, corresponding to 17 species. We believe this data supports an appropriate choice of method and monitoring sites; but also data on richness, abundance and reproduction of the species indicate that the ecosystem is properly preserved in the area, which is consistent with recently reported Conabio. Therefore we recommend establishing monitoring activities in the medium and long term in multiple sites, which could complement the assessment that has been undertaken at national level in this ecosystem.

Arias-Del Razo, I, Hernandez, L, Laundre, JW, Velasco-Vazquez, L. 2012. The landscape of fear: habitat use by a predator (*Canis latrans*) and its main prey (*Lepus californicus* and *Sylvilagus audubonii*). CANADIAN JOURNAL OF ZOOLOGY 90(6):683-693.

We evaluated the degree of mutual exclusivity of distributions of coyotes (*Canis latrans* Say, 1823) and their main prey (two lagomorph species: the black-tailed jackrabbit, *Lepus californicus* Gray, 1837, and the desert cottontail rabbit, *Sylvilagus audubonii* (Baird, 1858)) within the landscape by testing two models. The first assumes that prey seek high resource patches and, subsequently, predators seek prey within these patches, and predicts a high degree of overlap in patch use by both. The second model assumes that predator and prey balance not only food resources but reciprocal levels of predation risk and predation success in making decisions on whether or not to use a patch. This model predicts discordance in patch use between predator and prey. We used a combination of GPS-telemetry and camera-trapping data to assess habitat use patterns of predator and prey. Results from this study support the second model regarding spatial use of the landscape by a predator and its prey. Where the use of the landscape by predators and prey seem to be mediated by environmental constraints, both will adjust their predatory or antipredatory strategies based on these constraints. This results in a partial spatial separation of predator and prey across the landscape, providing patches of relative safety for prey but sufficient areas of overlap for predators to be successful.

Berger, J. 2012. Estimation of Body-Size Traits by Photogrammetry in Large Mammals to Inform Conservation. CONSERVATION BIOLOGY 26(5):768-777).

Photography, including remote imagery and camera traps, has contributed substantially to conservation. However, the potential to use photography to understand demography and inform policy is limited. To have practical value, remote assessments must be reasonably accurate and widely deployable. Prior efforts to develop noninvasive methods of estimating trait size have been motivated by a desire to answer evolutionary questions, measure physiological growth, or, in the case of illegal trade, assess economics of horn sizes; but rarely have such methods been directed at conservation. Here I demonstrate a simple, noninvasive photographic technique and address how knowledge of values of individual-specific metrics bears on conservation policy. I used 10 years of data on juvenile moose (*Alces alces*) to examine whether body size and probability of survival are positively correlated in cold climates. I investigated whether the presence of mothers improved juvenile survival. The posited latter relation is relevant to policy because harvest of adult females has been permitted in some Canadian and American jurisdictions under the assumption that probability of survival of young is independent of maternal presence. The accuracy of estimates of head sizes made from photographs exceeded 98%. The estimates revealed that overwinter juvenile survival had no relation to the juvenile's estimated mass ($p < 0.64$) and was more strongly associated with maternal presence ($p < 0.02$) than winter snow depth ($p < 0.18$). These findings highlight the effects on survival of a social dynamic (the mother-young association) rather than body size and suggest a change in harvest policy will increase survival. Furthermore, photographic imaging of growth of individual juvenile muskoxen (*Ovibos moschatus*) over 3 Arctic winters revealed annual variability in size, which supports the idea that noninvasive monitoring may allow one to detect how some environmental conditions ultimately affect body growth.

Bhattacharya, T, Bashir, T, Poudyal, K, Sathyakumar, S, Saha, GK. 2012. Distribution, occupancy and activity patterns of goral (*Nemorhaedus goral*) and serow (*Capricornis thar*) in Khangchendzonga Biosphere Reserve, Sikkim, India. MAMMAL STUDY 37(3):173-181.

We assessed the distribution, occupancy, and activity patterns of two rupicaprids viz., Himalayan goral *Nemorhaedus goral* and Himalayan serow *Capricornis thar* in the western part of the Khangchendzonga Biosphere Reserve, Sikkim, using camera traps during 2009-2010. Goral had the highest photo-capture rate (# photo/100 days) of 6.37 ± 3.02 in temperate habitats (n = 169) followed by 1.82 ± 1.27 in subalpine habitats (n = 41). Serow had the highest photo-capture rate of 1.65 ± 0.88 in subalpine habitats (n = 53) followed by 0.58 ± 0.34 in temperate habitats (n = 19). The estimated detection probability was 0.57 for goral and 0.46 for serow. Detection probabilities were negatively related to human presence. Occupancy of goral (0.27) was slightly lesser than serow (0.30). Denser tree cover, warmer aspect and sites far away from tourist trails were the best predictors for the occupancy of goral. Denser tree cover, higher elevation and warmer aspect were the best predictors for the occupancy of serow. Spatial separation between these two species was not clear although different activity peaks were observed. To ensure the survival of these species, protection measures are required to keep their habitats free from anthropogenic activities.

Bischof, R, Swenson, JE. 2012. Linking noninvasive genetic sampling and traditional monitoring to aid management of a trans-border carnivore population. ECOLOGICAL APPLICATIONS 22(1):361-373.

Noninvasive genetic sampling has been embraced by wildlife managers and ecologists, especially those charged with monitoring rare and elusive species over large areas. Challenges arise when desired population measures are not directly attainable from genetic data and when monitoring targets trans-border populations. Norwegian management authorities count individual brown bears (*Ursus arctos*) using noninvasive genetic sampling but express management goals in the annual number of bear reproductions (females that produce cubs), a measure that is not directly available from genetic data. We combine noninvasive genetic sampling data with information obtained from a long-term intensive monitoring study in neighboring Sweden to estimate the number of annual

reproductions by females detected within Norway. Most female brown bears in Norway occur near the border with neighboring countries (Sweden, Finland, and Russia) and their potential reproduction can therefore only partially be credited to Norway. Our model includes a simulation-based method that corrects census data to account for this. We estimated that 4.3 and 5.7 reproductions can be credited to females detected with noninvasive genetic sampling in Norway in 2008 and 2009, respectively. These numbers fall substantially short of the national target (15 annual reproductions). Ignoring the potential for home ranges to extend beyond Norway's borders leads to an increase in the estimate of the number of reproductions by similar to 30%. Our study shows that combining noninvasive genetic sampling with information obtained from traditional intensive/invasive monitoring can help answer contemporary management questions in the currency desired by managers and policy makers. Furthermore, combining methodologies and thereby accounting for space use increases the accuracy of the information-on which decisions are based. It is important that the information derived from multiple approaches is applicable to the same focal population and that predictions are cross-validated. When monitoring and management are constrained to administrative units, census data should be adjusted by discounting portions of individual space utilization that extend beyond the focal jurisdiction. Our simulation-based approach for making such an adjustment may be useful in other situations where management, authorities target portions of transborder populations.

Braczkowski, A, Watson, L, Coulson, D, Randall, R. 2012. Diet of leopards in the southern Cape, South Africa. AFRICAN JOURNAL OF ECOLOGY 50(3):377-380.

NO ABSTRACT

Brocardo, CR, Rodarte, R, Bueno, RD, Culot, L, Galetti, M. 2012. Non-volant mammals of Carlos Botelho State Park, Paranapiacaba Forest Continuum. BIOTA NEOTROPICA 12(4):198-208.

The Atlantic Forest is one of the most studied Brazilian biomes in relation to its mammalian fauna. However, there is still a series of gaps of knowledge about the distribution and persistence of some of these species which prevents taking adequate conservation measures to better protect the mammals. In order to make the inventory of the non-volant mammalian fauna of the Carlos Botelho State Park (SP), we compiled data of camera trapping, diurnal census, track records, pitfall and live trapping collected over 8 years (2004-2012). We registered a total of 53 species, of which 12 are regionally threatened and one is an exotic species (*Lepus europaeus*), including the presence of most mammal.species expected for the Paranapiacaba Forest Continuum. The high non-volant mammals species richness allied to the presence of threatened species, strengthen the role of this protected area for mammal conservation in the Atlantic Forest. Although, the local extinction of one species, *Tayassu pecan*, alert to the need for effective measures of protection.

Brodie, J, Giordano, AJ. 2012. Density of the Vulnerable Sunda clouded leopard *Neofelis diardi* in a protected area in Sabah, Malaysian Borneo. ORYX 46(3):427-430.

Population density is an important parameter for monitoring and guiding conservation of small or threatened wildlife populations. Yet, despite the Vulnerable status of both species of clouded leopard *Neofelis* spp., and their disappearing tropical forest habitat, information on their population density is lacking from across their broad geographic ranges. Here we estimated population density of the Sunda clouded leopard *N. diardi* in the Maliau Basin Conservation Area in Sabah, Malaysian Borneo, one of the first such estimates for either species of clouded leopard. With 25 camera-

trap stations, each operated for at least 81 trap-nights, we obtained 59 detections of four individual Sunda clouded leopards in undisturbed primary rainforest but only a single detection in logged forest, despite similar sampling effort. Using spatially-explicit mark-recapture models, we estimated a density of 1.9 individuals per 100 KM^2 (95% confidence interval 0.7-5.4) for primary forest and 0.8 per 100 KM2 (0.2-2.6) for the entire study area (including logged forest). These results will contribute to a better understanding of clouded leopard status and serve as a reference for future assessments of the species.

Burton, AC, Sam, MK, Balangtaa, C, Brashares, JS. 2012. Hierarchical Multi-Species Modeling of Carnivore Responses to Hunting, Habitat and Prey in a West African Protected Area. PLOS ONE 7(5):e38007.

Protected areas (PAs) are a cornerstone of global efforts to shield wildlife from anthropogenic impacts, yet their effectiveness at protecting wide-ranging species prone to human conflict - notably mammalian carnivores - is increasingly in question. An understanding of carnivore responses to human-induced and natural changes in and around PAs is critical not only to the conservation of threatened carnivore populations, but also to the effective protection of ecosystems in which they play key functional roles. However, an important challenge to assessing carnivore communities is the often infrequent and imperfect nature of survey detections. We applied a novel hierarchical multi-species occupancy model that accounted for detectability and spatial autocorrelation to data from 224 camera trap stations (sampled between October 2006 and January 2009) in order to test hypotheses about extrinsic influences on carnivore community dynamics in a West African protected area (Mole National Park, Ghana). We developed spatially explicit indices of illegal hunting activity, law enforcement patrol effort, prey biomass, and habitat productivity across the park, and used a Bayesian model selection framework to identify predictors of site occurrence for individual species and the entire carnivore community. Contrary to our expectation, hunting pressure and edge proximity did not have consistent, negative effects on occurrence across the nine carnivore

species detected. Occurrence patterns for most species were positively associated with small prey biomass, and several species had either positive or negative associations with riverine forest (but not with other habitat descriptors). Influences of sampling design on carnivore detectability were also identified and addressed within our modeling framework (e. g., road and observer effects), and the multi-species approach facilitated inference on even the rarest carnivore species in the park. Our study provides insight for the conservation of these regionally significant carnivore populations, and our approach is broadly applicable to the robust assessment of communities of rare and elusive species subject to environmental change.

Burton, AC. 2012. Critical evaluation of a long-term, locally-based wildlife monitoring program in West Africa. BIODIVERSITY AND CONSERVATION 21(12):3079-3094.

Effective monitoring programs are required to understand and mitigate biodiversity declines, particularly in tropical ecosystems where conservation conflicts are severe yet ecological data are scarce. "Locally-based" monitoring has been advanced as an approach to improve biodiversity monitoring in developing countries, but the accuracy of data from many such programs has not been adequately assessed. I evaluated a long-term, patrol-based wildlife monitoring system in Mole National Park, Ghana, through comparison with camera trapping and an assessment of sampling error. I found that patrol observations underrepresented the park's mammal community, recording only two-thirds as many species as camera traps over a common sampling period (2006-2008). Agreement between methods was reasonable for larger, diurnal and social species (e.g., larger ungulates and primates), but camera traps were more effective at detecting smaller, solitary and nocturnal species (particularly carnivores). Data from patrols and cameras corresponded for some spatial patterns of management interest (e.g., community turnover, edge effect on abundance) but differed for others (e.g., richness, edge effect on diversity). Long-term patrol observations were influenced by uneven sampling effort and considerable variation in replicate counts. Despite potential benefits of

locally-based monitoring, these results suggest that data from this and similar programs may be subject to biases that complicate interpretation of wildlife population and community dynamics. Careful attention to monitoring objectives, methodological design and robust analysis is required if locally-based approaches are to satisfy an aim of reliable biodiversity monitoring, and there is a need for greater international support in the creation and maintenance of local monitoring capacity.

Campos, RC, Steiner, J, Zillikens, A. 2012. Bird and mammal frugivores of *Euterpe edulis* at Santa Catarina island monitored by camera traps. STUDIES ON NEOTROPICAL FAUNA AND ENVIRONMENT 47(2):105-110.

From July to October 2009, the frugivorous fauna associated with palmito palms (*Euterpe edulis*) was studied to identify possible seed dispersers in Atlantic forest remnants on Santa Catarina Island, southern Brazil. The animals approaching or feeding on fruits were recorded by camera traps directed towards infructescences bearing ripe fruits and towards fruit patches on the ground. In a total sampling effort of 165 trap-days, 48 feeding events were recorded. Three birds, the Channel-billed Toucan (*Ramphastos vitellinus*), Speckled Chachalaca (*Ortalis guttata*) and White-necked Thrush (*Turdus albicollis*), and four mammal species, the coa(*Nasua nasua*), russet rice rat (*Euryoryzomys russatus*), South American water rat (*Nectomys squamipes*) and the tayra (*Eira barbara*) were identified. The highest number of feeding events was recorded for *O. guttata*, followed by *R. vitellinus* and *E. russatus*. Although the number of detected species was low, seed dispersal of *E. edulis* fruits on Santa Catarina Island is likely still performed by birds and small mammals.

Carter, NH, Shrestha, BK, Karki, JB, Pradhan, NMB, Liu, JG. 2012. Coexistence between wildlife and humans at fine spatial scales.

Many wildlife species face imminent extinction because of human impacts, and therefore, a prevailing belief is that some wildlife species, particularly large carnivores and ungulates, cannot coexist with people at fine spatial scales (i.e., cannot regularly use the exact same point locations). This belief provides rationale for various conservation programs, such as resettling human communities outside protected areas. However, quantitative information on the capacity and mechanisms for wildlife to coexist with humans at fine spatial scales is scarce. Such information is vital, because the world is becoming increasingly crowded. Here, we provide empirical information about the capacity and mechanisms for tigers (a globally endangered species) to coexist with humans at fine spatial scales inside and outside Nepal's Chitwan National Park, a flagship protected area for imperiled wildlife. Information obtained from field cameras in 2010 and 2011 indicated that human presence (i.e., people on foot and vehicles) was ubiquitous and abundant throughout the study site; however, tiger density was also high. Surprisingly, even at a fine spatial scale (i.e., camera locations), tigers spatially overlapped with people on foot and vehicles in both years. However, in both years, tigers offset their temporal activity patterns to be much less active during the day when human activity peaked. In addition to temporal displacement, tiger-human coexistence was likely enhanced by abundant tiger prey and low levels of tiger poaching. Incorporating fine-scale spatial and temporal activity patterns into conservation plans can help address a major global challenge-meeting human needs while sustaining wildlife.

Caruso, N, Manfredi, C, Vidal, EML, Casanaveo, EB, Lucherinio, M. 2012. First density estimation of two sympatric small cats, *Leopardus colocolo* and *Leopardus geoffroyi*, in a shrubland area of central Argentina. ANNALES ZOOLOGICI FENNICI 49(3):181-191.

Geoffroy's and Pampas cats are small felids with large distribution ranges in South America. A camera trap survey was conducted in the Espinal of central Argentina to estimate abundance based on capture-recapture data. For density estimations we used both non-spatial methods and spatially explicit capture-recapture models (SECR). For Geoffroy's cat we also obtained density estimates from 8 radio-tracked individuals. Based on the data on 10 Geoffroy's cats and 7 Pampas cats, non-spatial methods produced density ranges of 16.21-21.94 indiv./100 KM^2 and 11.34-17.58 indiv./100 KM^2, respectively. The density estimated using SECR models was 45 animals/100 KM^2 for Geoffroy's cat, whereas we were unable to produce a reliable estimate for the Pampas cat. The SECR estimate for Geoffroy's cat is more similar to that obtained from telemetry data (58.82 cats/100 KM^2). In agreement with the hypothesis of its greater adaptability, Geoffroy's cat was more abundant than the Pampas cat.

Cassano, CR, Barlow, J, Pardini, R. 2012. Large Mammals in an Agroforestry Mosaic in the Brazilian Atlantic Forest. BIOTROPICA 44(6):818-825.

The forest-like characteristics of agroforestry systems create a unique opportunity to combine agricultural production with biodiversity conservation in human-modified tropical landscapes. The cacao-growing region in southern Bahia, Brazil, encompasses Atlantic forest remnants and large extensions of agroforests, locally known as cabrucas, and harbors several endemic large mammals. Based on the differences between cabrucas and forests, we hypothesized that: (1) non-native and non-arboreal mammals are more frequent, whereas exclusively arboreal and hunted mammals are less frequent in cabrucas than forests; (2) the two systems differ in mammal assemblage structure, but not in species richness; and (3) mammal assemblage structure is more variable among cabrucas than forests. We used camera-traps to sample mammals in nine pairs of cabruca-forest sites. The high conservation value of agroforests was supported by the presence of species of conservation concern in cabrucas, and similar species richness and composition between forests and

cabrucas. Arboreal species were less frequently recorded, however, and a non-native and a terrestrial species adapted to open environments (*Cerdocyon thous*) were more frequently recorded in cabrucas. Factors that may overestimate the conservation value of cabrucas are: the high proportion of total forest cover in the study landscape, the impoverishment of large mammal fauna in forest, and uncertainty about the long-term maintenance of agroforestry systems. Our results highlight the importance of agroforests and forest remnants for providing connectivity in human-modified tropical forest landscapes, and the importance of controlling hunting and dogs to increase the value of agroforestry mosaics.

Charruau, P, Henaut, Y. 2012. Nest attendance and hatchling care in wild American crocodiles (Crocodylus acutus) in Quintana Roo, Mexico. ANIMAL BIOLOGY 62(1):29-51.

Crocodilians show universal parental care, but few studies concentrate on this behavior in wild crocodiles. We studied nest and hatchling care in genetically pure wild American crocodiles (*Crococlylus acutus*) on two Caribbean islands of Mexico. From 2006 to 2009 we made direct observations of crocodile behavior upon discovery of nests and groups of hatchlings in Banco Chinchorro. In 2009, we installed camera traps at 4 nests from the time of their discovery to the hatching of each nest, in Banco Chinchorro and Cozumel Island. Twenty-one other species were observed to visit crocodile nests. No nest predation was observed but nine species represented some danger to nests and/or hatchlings. Females seemed to remain in the nest vicinity during incubation. There was variability in nest visit frequencies and no nest defense toward human intrusion was observed. Visit frequency by other species at nests decreased with increased crocodile visitation. Crocodiles mainly visited nests on darker nights, corresponding to the visits of species representing greater danger for nests. Repair of the nest by females after disturbance was observed for the first time in wild American crocodiles. Crocodile visits were more frequent at the beginning and the end of incubation, which could represent different anti-predation strategies. Although adult crocodiles helped during hatching

for the emergence of neonates, hatchling care seemed reduced compared to other crocodile species. We provide the first data on nesting behavior of genetically pure American crocodiles in the Yucatan peninsula, which provides a base for future comparisons with Morelet's crocodiles and their hybrids.

Chiang, PJ, Pei, KJC, Vaughan, MR, Li, CF. 2012. Niche Relationships of Carnivores in a Subtropical Primary Forest in Southern Taiwan. ZOOLOGICAL STUDIES 51(4): 500-511

Carnivores are at the higher trophic levels and have garnered much attention in conservation and management efforts. In this study, we attempted to understand resource partitioning among sympatric carnivores existing in a primary forest with minimal human disturbance in southern Taiwan by camera trapping after the disappearance of the top carnivore, the clouded leopard (*Neofelis nebulosa*). Niche relationships were studied in terms of habitat, diet, and time dimensions. Six carnivore species were recorded, but the Asiatic black bear (*Ursus thibetanus formosanus*) was very rare. Canonical correspondence analysis of photographic rates and habitat factors of the other 5 carnivores showed that elevation was the strongest factor explaining the composition of the carnivore community in the habitat dimension. Carnivores could be divided into 3 groups. The low- to mid-elevation group consisted of the gem-faced palm civet (*Paguma larvata taivana*) and crab-eating mongoose (*Herpestes urva formosanus*) which had contrasting activity patterns and different diets; the mid- to high-elevation group consisted of yellow-throated marten (*Martes flavigula chrysospila*) and Siberian weasel (*Mustela sibirica taivana*). These 2 mustelids had similar diets, but Siberian weasels tended to avoid yellow-throated martens temporally. The Formosan ferret badger (*Melogale moschata subaurantiaca*) was more widely distributed along the elevational gradient. Ferret badgers partitioned resource use in either diet, activity patterns, or

other habitat gradients from the other carnivores. Niche segregation and complementary resource use were observed in these 5 carnivores.

Cove, MV, Jones, BM, Bossert, A, Clever, DR, Dunwoody, RK, White, BC, Jackson, VL. 2012. Use of Camera Traps to Examine the Mesopredator Release Hypothesis in a Fragmented Midwestern Landscape. AMERICAN MIDLAND NATURALIST 168(2):456-465.

The mesopredator release hypothesis (MRH) has been suggested as a reason why many mammalian generalist mesopredators flourish and become abundant. However, the MRH has only been examined in a limited number of field studies. Some studies have argued that coyotes (*Canis latrans*) act as top predators in fragmented forest systems and coyote presence has a positive effect on song bird diversity and abundance by controlling mesopredator abundance. We integrated camera trap data and occupancy modeling to determine the factors that affect coyote detection probability and habitat use in a fragmented suburban landscape in central Missouri. We then examined the influence of coyote presence and other habitat variables on mesopredator detection probability and habitat use in the same system. Coyote detection was negatively related to increasing forest cover, whereas red fox (*Vulpes vulpes*) detection was positively related to increasing urbanization. Coyote occurrence models suggested little habitat selection, while the mesopredator occurrence models suggested an affinity for urbanization. Although there was a slight negative effect of coyote presence on site use by other mesopredators, we suggest that the smaller species are better adapted to coexisting with humans and thus have increased in abundance.

Dalloz, MF, Loretto, D, Papi, B, Cobra, P, Vieira, MV. 2012. Positional behaviour and tail use by the bare-tailed woolly opossum *Caluromys philander* (Didelphimorphia, Didelphidae). MAMMALIAN BIOLOGY 77(5):307-313.

We present the first quantitative description of postural behaviour of a free ranging metatherian, the bare-tailed woolly opossum, *Caluromys philander*. Postural behaviour was observed using 10 camera traps set in front of artificial nests, located in the understory of an Atlantic forest site in Rio de Janeiro, Brazil. Seven locomotory and positional modes were identified, with a predominance of diagonal couplets. Individuals used three types of grasp as observed in captivity, but the frequency of digital grasping was higher in the wild. The tail was used as an additional grasping limb, preventing falls and freeing hands to other activities, but the tail was also used to carry leaves for nest building. The use of camera traps may represent a breakthrough in the study of positional behaviours in the wild.

DeSa, MA, Zweig, CL, Percival, HF, Kitchens, WM, Kasbohm, JW, 2012. Comparison of Small-Mammal Sampling Techniques in Tidal Salt Marshes of the Central Gulf Coast of Florida. SOUTHEASTERN NATURALIST 11(1):G17-G28.

Use of traditional small-mammal sampling techniques is challenging in coastal salt marshes and forests. Various conditions particular to this type of environment affect the efficacy of sampling efforts. We compared various indirect (no physical capture) and direct (physical capture) techniques coupled with different baits to determine an effective method for sampling small mammals. In 1440 trap-nights, Sherman live traps caught significantly more rodents than Fitch traps (112 versus 16 respectively, Fisher's exact test: P = 0.0103), but the relationship between bait types, which included oats, scratch feed, sunflower seeds and suet, was not as apparent. However, for practical reasons, scratch feed and sunflower seeds were best used in marsh conditions due to their water resistance and ease in clean-up. Both track and scat plates were unsuccessful due to water damage and destruction by nontarget animals. Cameras yielded limited success. Target small mammals were photographed 436 times, but of those, only 26 could be positively identified to species. However, with adjustments including

improved lens quality and adjustable focus distance, this could become a useful tool for small-mammal sampling. Such improved remote cameras could offer a viable alternative when permits cannot be issued, field access is limited, or there are concerns about mortality of the target species.

Fandos, G, Fernandez-Lopez, J, Telleria, JL. 2012. Incursion of domestic carnivores around urban areas: a test in central Spain. MAMMALIA 76(2):223-225.

Although domestic carnivores are frequently considered a threat to wildlife inside and around urban areas, little is known about the incursions of these animals from urban areas to the surrounding habitats. To explore this, we sampled carnivores in wooded areas surrounding four villages located in the mountains north of Madrid by using 40 camera-trapping stations. They were distributed at regular distances within a perpendicular transect distributed from 10 to 2000 m from the urban border. The results suggest that the incidence of domestic carnivores (cats and dogs) was constrained to <400 m from the urban border, and that the presence of domestic carnivores did not interfere with the distribution of wild carnivores (foxes, beech martens, badgers, genets, etc.), which show random distribution patterns around villages. This means that overpredation at the village edges could mainly be due to the effect of domestic animals and not to that of wild carnivores attracted to urban areas.

Fattorini, N, Pokheral, CP, AF Fattorini, N, Pokheral, CP. 2012. Activity and habitat selection of the Indian crested porcupine. ETHOLOGY ECOLOGY & EVOLUTION 24(4):377-387.

Camera trapping has been used to assess the temporal activity patterns and the habitat selection of the Indian crested porcupine, *Hystrix indica* Kerr 1792, in the Shuklaphanta Wildlife Reserve (in Western Nepal). Data have

been collected during two winter sessions (December 2008-April 2009, November 2009-January 2010). The effective sampling area is approximately 250 KM2. A total of 319 photos of porcupine were recorded during the periods. Porcupines were significantly more active in the central part of the night (from 11 p. m. to 2 a. m.) than in crepuscular and daylight periods. The analysis of the habitat selection (forests and grasslands), when significant, has shown that porcupines prefer grassland. This selection may depend on the distribution of food resources or on the presence of large forest predators (e. g. the leopard *Panthera pardus*).

Favaro, B, Lichota, C, Cote, IM, Duff, SD. 2012. TrapCam: an inexpensive camera system for studying deep-water animals. METHODS IN ECOLOGY AND EVOLUTION 3(1):39-46.

1. Behavioural research in deep water (>40 m depth) has traditionally been expensive and logistically challenging, particularly because the light and sound produced by underwater vehicles make them unsuitably disruptive. Yet, understanding the behaviour of deep-water animals, especially those targeted by exploitation, is important for conservation. For example, understanding interactions between animals and deep-water fishing gear could inform the design of devices that minimize bycatch.

2. We describe the `TrapCam', a self- contained, high- definition video system that requires neither the support of a vessel once deployed nor special equipment to deploy or retrieve. This system can record 13-h videos at 1080p resolution and is deployable on any substrata at depths of up to 100 m. The system is inexpensive (<$ 3000 USD), versatile and suited to the study of animal behaviour at depths inaccessible to scuba divers.

3. We evaluate the performance and cost effectiveness of TrapCam and analyse videos retrieved frompilot deployments to observe spot prawn (Pandalus platyceros) traps at 100 mdepth. Preliminary analyses of animal-prawn trap interactions yield novel insights. We provide future directions

for researchers to use this type of camera system to study deep water-dwelling species around the world.

Foster, RJ, Harmsen, BJ. 2012. A critique of density estimation from camera-trap data. JOURNAL OF WILDLIFE MANAGEMENT 76(2):224-236.

Densities of elusive terrestrial mammals are commonly estimated from camera-trap data. Typically, this is a 2-step process involving 1) fitting conventional closed population capture-recapture models to estimate abundance, and 2) using ad hoc methods to determine the effective trapping area. The methodology needs to be accurate, robust, and reliable when results are used to guide wildlife management. We critically review 47 published studies and discuss the problems associated with contemporary population estimates of elusive species from camera-trap data. In particular we discuss 1) individual identification, 2) sample size and capture probability, 3) camera location and spacing, 4) the size of the study area, and 5) ad hoc density estimation from the calculation of an effective trapping area. We also discuss the recently developed spatially explicit capture-recapture (SECR) models as an alternative approach that does not require the intermediate step of estimating an effective trapping area. We recommend 1) greater transparency in study design and quality of the data, 2) greater rigor when reviewing manuscripts, and 3) that more attention is given to the survey design to ensure data are of sufficient quality for analysis.

Galaverni, M, Palumbo, D, Fabbri, E, Caniglia, R, Greco, C, Randi, E. 2012. Monitoring wolves (*Canis lupus*) by non-invasive genetics and camera trapping: a small-scale pilot study. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 58(1):47-58.

Monitoring populations of elusive large carnivores like wolves (*Canis lupus*), which are often distributed at low density in widespread forested areas, is difficult or exceedingly expensive. Aiming to assess the power of two indirect monitoring methods, non-invasive genetic sampling and camera trapping, we designed a small-scale pilot study that was carried out from 2006 to 2008 in and around the Corno alle Scale Regional Park, Bologna, northern Italian Apennine. We collected 103 non-invasive samples (mainly scats) that were genotyped at 12 microsatellite loci and sexed using the ZFX gene. We identified 11 distinct wolf genotypes within the park and four wolf genotypes outside. Spatial locations and kinship analyses showed that the wolves belong to three different packs. The breeding pair of the 'Park' pack showed a complete turnover in the two sampling seasons. Two dogs, but no hybrids, were identified in the area. Up to five unbaited camera traps were activated (for 1,250 trapping-nights) close to recent wolf presence marks. We obtained 103 photos of wolves, documenting the reproduction events, the minimum number of adult and young wolves, and phenotype information each year. We obtained information on health conditions detecting probable sarcoptic mange in three individuals. Camera trapping also showed that the presence of wolves in a chase area during wild boar (Sus scrofa) hunting sessions was significantly higher in the nights just after a chase (P< 0.01, chi(2) test; P<0.07, exact Fisher test). The data obtained from genetics and camera trapping were consistent with one other, and in part complementary. The total cost of the study (c. 28,000 (sic)) was moderate, suggesting that this integrated approach can be successfully used to monitor the structure and dynamics of local wolf packs.

Garrote, G, Gil-Sanchez, JM, McCain, EB, de Lillo, S, Telleria, JL, Simon, MA. 2012. The effect of attractant lures in camera trapping: a case study of population estimates for the Iberian lynx (*Lynx pardinus*). EUROPEAN JOURNAL OF WILDLIFE RESEARCH. 58(5):881-884.

Capture-recapture analysis of camera trap data is a conventional method to estimate the abundance of free-ranging wild felids. Due to notorious low

detection rates of felids, it is important to increase the detection probability during sampling. In this study, we report the effectiveness of attractants as a tool for improving the efficiency of camera trap sampling in abundance estimation of Iberian lynx. We developed a grid system of camera stations in which stations with and without attractant lures were spatially alternated across known Iberian lynx habitat. Of the ten individuals identified, five were detected at stations with no attractant (blind sets), and nine, at the lured stations. Thirty-eight percent of blind set station's independent captures and 10 % of lured station's independent captures resulted in photographs unsuitable for correct individual identification. The total capture probability at lured stations was higher than that obtained at blind set stations. The estimates obtained with blind set cameras underestimated the number of lynxes compared to lured cameras. In our study, it appears that the use of lures increased the efficiency of trail camera captures and, therefore, the accuracy of capture-recapture analysis. The observed failure to detect known individuals at blind set camera stations may violate capture-recapture assumptions and bias abundance estimates.

Gerber, BD, Karpanty, SM, Randrianantenaina, J. 2012. The impact of forest logging and fragmentation on carnivore species composition, density and occupancy in Madagascar's rainforests. ORYX 46(3):414-422.

Forest carnivores are threatened globally by logging and forest fragmentation yet we know relatively little about how such change affects predator populations. This is especially true in Madagascar, where carnivores have not been extensively studied. To understand better the effects of logging and fragmentation on Malagasy carnivores we evaluated species composition, density of fossa *Cryptoprocta ferox* and Malagasy civet *Fossa fossana*, and carnivore occupancy in central-eastern Madagascar. We photographically-sampled carnivores in two contiguous (primary and selectively-logged) and two fragmented rainforests (fragments <2.5 and <15 km from intact forest). Species composition varied, with more native carnivores in the contiguous than fragmented rainforests. *F. fossana* was absent from fragmented rainforests and at a lower density in

selectively-logged than in primary rainforest (mean 1.38 ± SE 0.22 and 3.19 ± SE 0.55 individuals km^{-2}, respectively). *C. ferox* was detected in fragments <2.5 km from forest and had similar densities in primary and selectively-logged forests (0.12 ± SE 0.05 and 0.09 ± SE 0.04 adults km^{-2}, respectively) but was absent in fragments >15 km from forest. We identified only two protected areas in Madagascar that may maintain >300 adult *C. ferox*. Occupancy of broad-striped mongoose *Galidictis fasciata* was positively related to fragment size whereas occupancy of ring-tailed mongoose *Galidia elegans elegans* was negatively associated with increasing exotic wild cat (*Felis* spp.) activity at a camera site. Degraded rainforest fragments are difficult environments for Malagasy carnivores to occupy; there is a need to prioritize the reconnection and maintenance of contiguous forest tracts.

Gerber, BD, Karpanty, SM, Kelly, MJ. 2012. Evaluating the potential biases in carnivore capture-recapture studies associated with the use of lure and varying density estimation techniques using photographic-sampling data of the Malagasy civet. POPULATION ECOLOGY 54(1):43-54.

Estimating density of elusive carnivores with capture-recapture analyses is increasingly common. However, providing unbiased and precise estimates is still a challenge due to uncertainties arising from the use of (1) bait or lure to attract animals to the detection device and (2) ad hoc boundary-strip methods to compensate for edge effects in area estimation. We used photographic-sampling data of the Malagasy civet *Fossa fossana* collected with and without lure to assess the effects of lure and to compare the use of four density estimators which varied in methods of area estimation. The use of lure did not affect permanent immigration or emigration, abundance and density estimation, maximum movement distances, or temporal activity patterns of Malagasy civets, but did provide more precise population estimates by increasing the number of recaptures. The spatially-explicit capture-recapture (SECR) model density estimates ± SE were the least precise as they incorporate spatial variation, but consistent with each other (Maximum likelihood-SECR = 1.38 ± A 0.18, Bayesian-SECR = 1.24 ± A

0.17 civets/KM^2), whereas estimates relying on boundary-strip methods to estimate effective trapping area did not incorporate spatial variation, varied greatly and were generally larger than SECR model estimates. Estimating carnivore density with ad hoc boundary-strip methods can lead to overestimation and/or increased uncertainty as they do not incorporate spatial variation. This may lead to inaction or poor management decisions which may jeopardize at-risk populations. In contrast, SECR models free researchers from making subjective decisions associated with boundary-strip methods and they estimate density directly, providing more comparable and valuable population estimates.

Gonzalez-Maya, JF, Schipper, J, Polidoro, B, Hoepker, A, Zarrate–Charry, D, Belant, JL. 2012. Baird's tapir density in high elevation forests of the Talamanca region of Costa Rica. INTEGRATIVE ZOOLOGY 7(4):381-388.

Baird's tapir (*Tapirus bairdii*) is currently endangered throughout its Neotropical range with an expected population decline >50% in the next 30 years. We present the first density estimation of Baird's tapir for the Talamanca Mountains of Costa Rica, and one of the first for the country. Ten stations with paired cameras were established in Valle del Silencio within Parque Internacional La Amistad (PILA). Seventy-seven tapir pictures of 15 individuals comprising 25 capture-recapture events were analyzed using mark-recapture techniques. The 100% minimum convex polygon of the sampled area was 5.7 km^2 and the effective sampled area using half mean maximum distances moved by tapirs was 7.16 km^2. We estimated a tapir density of 2.93 individuals/km^2 which represents the highest density reported for this species. Intermountain valleys can represent unique and important habitats for large mammal species. However, the extent of isolation of this population, potentially constrained by steep slopes of the cordillera, remains unknown. Further genetic and movement studies are required to understand meta-population dynamics and connectivity between lowland and highland areas for Baird's tapir conservation in Costa Rica.

Gopalaswamy, AM, Royle, JA, Delampady, M, Nichols, JD, Karanth, KU, Macdonald, DW. 2012. Density estimation in tiger populations: combining information for strong inference. ECOLOGY 93(7):1741-1751.

A productive way forward in studies of animal populations is to efficiently make use of all the information available, either as raw data or as published sources, on critical parameters of interest. In this study, we demonstrate two approaches to the use of multiple sources of information on a parameter of fundamental interest to ecologists: animal density. The first approach produces estimates simultaneously from two different sources of data. The second approach was developed for situations in which initial data collection and analysis are followed up by subsequent data collection and prior knowledge is updated with new data using a stepwise process. Both approaches are used to estimate density of a rare and elusive predator, the tiger, by combining photographic and fecal DNA spatial capture-recapture data. The model, which combined information, provided the most precise estimate of density (8.5 ± 1.95 tigers/100 KM^2 [posterior mean ± SD]) relative to a model that utilized only one data source (photographic, 12.02 ± 3.02 tigers/100 KM^2 and fecal DNA, 6.65 ± 2.37 tigers/100 KM^2). Our study demonstrates that, by accounting for multiple sources of available information, estimates of animal density can be significantly improved.

Gopalaswamy, AM, Karanth, KU, Kumar, NS, Macdonald, DW. 2012. Estimating tropical forest ungulate densities from sign surveys using abundance models of occupancy. ANIMAL CONSERVATION 15(6):669-679.

Large ungulates critically influence forest structure and functioning besides being seriously threatened by anthropogenic pressures. For assessing their populations, surveys of ungulate sign encounters are widely used because of their practicality. However, these yield unreliable results because of their

failure to address the problem of imperfect detection. Here, we present an innovative application to address this key weakness in traditional ungulate sign surveys. We describe the ecological process of ungulate sign deposition as well as the observation process of sign detection in our modelling. We simulate 183 ecological and sampling-related parameter values to first evaluate model performance. Simulation results demonstrate that we can achieve good estimates of animal density when the radius of the animal daily movement range is accounted for during survey design. We design and conduct a field survey of ungulate signs to estimate ungulate densities using both occupancy and distance sampling approaches. For five species of ungulates, the densities estimated from our sign survey (number of ungulate clusters km^{-2}) were 1.46(0.68) chital Axis axis, 1.42(0.67) sambar Rusa unicolor, 1.01(0.44) gaur Bos gaurus, 0.74(0.39) wild pig Sus scrofa and 1.42(1.59) muntjac Muntiacus muntjak, and were similar to those generated from line transect sampling 2.16(0.76) chital, 2.47(0.56) sambar, 0.94(0.3) gaur, 1.09(0.37) wild pig and 4.03(0.83) muntjac), except for muntjac. The potential utility of this approach extends beyond sign surveys of forest ungulates to a wider range of animal monitoring contexts, including those based on scent-station surveys and camera trap surveys of elusive mammals.

Gopalaswamy, AM, Royle, JA, Hines, JE, Singh, P, Jathanna, D, Kumar, NS, Karanth, KU. 2012. Program SPACECAP: software for estimating animal density using spatially explicit capture-recapture models. METHODS IN ECOLOGY AND EVOLUTION 3(6):1067-1072.

The advent of spatially explicit capture-recapture models is changing the way ecologists analyse capture-recapture data. However, the advantages offered by these new models are not fully exploited because they can be difficult to implement. To address this need, we developed a user-friendly software package, created within the R programming environment, called SPACECAP. This package implements Bayesian spatially explicit hierarchical models to analyse spatial capture-recapture data. Given that a large number of field biologists prefer software with graphical user

interfaces for analysing their data, SPACECAP is particularly useful as a tool to increase the adoption of Bayesian spatially explicit capture-recapture methods in practice.

Gray, TNE. 2012. Studying Large Mammals With Imperfect Detection: Status and Habitat Preferences of Wild Cattle and Large Carnivores in Eastern Cambodia. BIOTROPICA 44(4):531-536.

Studying large mammal species in tropical forests is a conservation challenge with species behavior and ecology often increasing the probability of non-detection during surveys. Consequently, knowledge of the distribution, status, and natural history of many large mammal species in Southeast Asia is limited. I developed occupancy models from camera-trapping data, thereby accounting for imperfect detection at sampling sites, to clarify the status and habitat requirements of four globally threatened or near threatened large mammals (banteng *Bos javanicus*, gaur *Bos gaurus*, dhole *Cuon alpinus*, and leopard *Panthera pardus*) in Mondulkiri Protected Forest, eastern Cambodia. Camera traps were operational for >3500 trap nights with 202 photographic encounters of the four study species. Model averaged occupancy estimates were between 5 percent (leopard) and 140 percent (gaur) higher than naive estimates (i.e., proportion of camera-trap sites species recorded from) thus highlighting the importance of accounting for detectability during conservation surveys. I recommend the use of an occupancy framework when using camera-trap data to study the status, ecology, and habitat preferences of poorly known and elusive species. The results highlight the importance of mixed deciduous and semi-evergreen forest for wild cattle in eastern Cambodia and I emphasize that these habitats must be considered in conservation planning across the Lower Mekong Dry Forest Ecoregion.

Gray, TNE, Prum, S. 2012. Leopard density in post-conflict landscape, Cambodia: Evidence from spatially explicit capture-recapture. JOURNAL OF WILDLIFE MANAGEMENT 76(1):163-169.

Effective conservation of large carnivores requires reliable estimates of population density, often obtained through capture-recapture analysis, in order to prioritize investments and assess conservation intervention effectiveness. Recent statistical advances and development of user-friendly software for spatially explicit capture-recapture (SECR) circumvent the difficulties in estimating effective survey area, and hence density, from capture-recapture data. We conducted a camera-trapping study on leopards (*Panthera pardus*) in Mondulkiri Protected Forest, Cambodia. We compared density estimates using SECR with those obtained from conventional approaches in which the effective survey area is estimated using a boundary strip width based on observed animal movements. Density estimates from Chao heterogeneity models (3.8 ± SE 1.9 individuals/100 km^2) and Pledger heterogeneity models and models accounting for gender-specific capture and recapture rates (model-averaged density 3.9 ± SE 2.9 individuals/100 km^2) were similar to those from SECR in program DENSITY (3.6 ± SE 1.0/100 km^2) but higher than estimates from Jack-knife heterogeneity models (2.9 ± SE 0.9individuals/100 km^2). Capture probabilities differed between male and female leopards probably resulting from differences in the use of human-made trails between sexes. Given that there are a number of biologically plausible reasons to expect gender-specific variation in capture probabilities of large carnivores, we recommend exploratory analysis of data using models in which gender can be included as a covariate affecting capture probabilities particularly given the demographic importance of breeding females for population recovery of threatened carnivores.

Gutierrez-Gonzalez, CE, Gomez-Ramirez, MA, Lopez-Gonzalez, CA. 2012. Estimation of the density of the Near Threatened jaguar *Panthera onca* in Sonora, Mexico, using camera trapping and an open population model. ORYX 46(3):431-437.

Our objective in this study was to determine the density of the jaguar *Panthera onca* from camera-trap data, using an open population model, in a private protected natural area, the Northern Jaguar Reserve, and 10 adjoining cattle ranches in the state of Sonora, Mexico. The region is considered a long-term jaguar conservation unit. As well as being the most northerly recorded reproductive population of the jaguar, the arid habitat of this region is atypical for the species. During 16 months of sampling we identified 10 individual jaguars and the data met the three main assumptions of open population models. The estimated mean density was $1.05 \pm SE\ 0.4$ individuals per $100\ km^2$, with a constant survival probability of 0.94 and capture probability of 0.23. This estimate of density is lower than reported in studies of the jaguar from more southerly locations in Mexico, Belize, Costa Rica, Bolivia and Brazil but cannot be attributed to a single factor even though in general there is an apparent relationship between jaguar density and precipitation. The main objectives of the management of the Northern Jaguar Reserve are to reduce the impact of cattle and restore jaguar habitat, with strategies focused on water retention, removal of invasive grass, reforestation and environmental education. Livestock have been gradually excluded since 2003 and, combined with the protection provided under the agreements with the surrounding ranches, the area is now a suitable place for long-term studies of the jaguar.

Head, JS, Robbins, MM, Mundry, R, Makaga, L, Boesch, C. 2012. Remote video-camera traps measure habitat use and competitive exclusion among sympatric chimpanzee, gorilla and elephant in Loango National Park, Gabon. JOURNAL OF TROPICAL ECOLOGY 28:571-583.

Species commonly exist in sympatry, yet ecological studies are often based on a single species approach while ignoring the impact of sympatric competitors. Over 13 mo we used 24 remote video-camera traps to monitor habitat use of sympatric chimpanzee, gorilla and elephant in four different habitat types in Loango National Park, Gabon. Habitat use by each species

was predicted to vary according to seasonal changes in food availability and precipitation. Increased interspecific competition between the three species was expected at times of reduced resource availability, leading to exclusion of the inferior competitor. Supporting the predictions, species abundance per habitat showed seasonal variation: all three species responded positively to increased fruit availability in all habitats, but the response was only significant for gorilla in mature forest and elephant in coastal forest. Responses to rainfall varied, with the chimpanzee responding negatively to rainfall in swamp forest, the gorilla responding positively to rainfall in coastal and secondary forest, and the elephant responding positively to rainfall in mature forest. Elephant presence resulted in competitive exclusion of the apes under certain conditions: the chimpanzee was excluded by the elephant where fruit availability was low, whereas the gorilla was excluded by the elephant in areas of low herb density despite high fruit availability. Our results emphasize the value of applying a multi-species, longer-term approach to studying variation in habitat use among sympatric species and highlight the impact competitors can exert on one another's distribution.

Hayward, MW, Hayward, MD. 2012. Waterhole use by African fauna. SOUTH AFRICAN JOURNAL OF WILDLIFE RESEARCH 42(2):117-127.

Water is one of the fundamental requirements of life but there has been little study on the use of water by free-ranging wildlife communities. We investigated the timing of waterhole use by African fauna using webcams to determine whether this mode of data collection was viable, to determine whether animals drank randomly throughout the day, whether there were differences between guilds in waterhole use and finally we created a relative rank of water dependency by comparing waterhole use with the relative abundance of species at Kruger and Pilanesberg National Parks. We used webcams sited at waterholes in South Africa's Kruger and Pilanesberg, Madikwe Game Reserve and Tembe Elephant Park, and Botswana's Mashatu Game Reserve to remotely monitor waterhole use at random times throughout the day. Over the 16-month study period, 1546

observations were made of 30 species at waterholes, with elephants (*Loxodonta africana*) and impala (*Aepyceros melampus*) being the most frequently observed species. There was a high degree of diurnal overlap in waterhole use amongst the herbivores, but they partitioned the time of peak waterhole use. Large predators were largely nocturnal while their prey was invariably diurnal. The index of relative water use showed that hippopotamus (*Hippopotamus amphibius*), warthog (*Phacochoerus africanus*) and blue wildebeest (*Connochaetes taurinus*) were highly water-dependent, whereas lion (*Panthera leo*), spotted hyaena (*Crocuta crocuta*) and kudu (*Tragelaphus strepsiceros*) appear relatively water independent. African fauna may partition waterhole use to avoid competition and predation. The use of webcams is a novel technique to allow remote monitoring of aspects of the ecology of African wildlife at minimal cost.

Hernandez-Diaz, M, Ramirez-Barajas, PJ, Chavez, C, Schmook, B, Calme, S. 2012. Occurrence and relative abundance of carnivores in a tropical forest impacted by Hurricane Dean (2007). REVISTA MEXICANA DE BIODIVERSIDAD 83(3):790-801.

Hurricanes are common disturbances in the Caribbean, but their effect on carnivores is unknown. The objective of this study was to evaluate the occurrence and relative abundance of carnivores in relation with vegetation damage 18 months after Hurricane Dean (2007) hit the Yucatan Peninsula. Using camera-trapping, 4 sites showing different intensities of hurricane damage were sampled. The response of carnivores was explored at 4 spatial scales. Vegetation damage was estimated as the difference in the Enhanced Vegetation Index (dEVI) before and after the hurricane using MODIS satellite images. At most resolutions, carnivores' occurrence and relative abundance were weakly or not related with vegetation damage, probably due to their little habitat specificity. Nevertheless, the apparent resistance of the studied species should be confirmed using a larger sampling effort and temporal framework.

Heurich, M, Muller, J, Burg, M. 2012. Comparison of the effectivity of different snare types for collecting and retaining hair from Eurasian Lynx (*Lynx lynx*). EUROPEAN JOURNAL OF WILDLIFE RESEARCH 58(3):579-587.

Genetic methods are increasingly being used as noninvasive tools to survey populations of wild animals. One challenge of these methods is the sampling of genetic material from the target species. Genetic material of various predators, such as bears, canids, and felids, has been successfully obtained from both hair trapped in snares and scat. However, there is currently no standard procedure for sampling genetic material from the Eurasian Lynx (*Lynx lynx*). We tested established and newly developed hair snares in two near-natural lynx enclosures in the Bavarian Forest National Park. All snares consisted of a wooden post; they differed in the type of material attached to the post for snaring hair: carpet (velour with 40 nails), wildcat (spruce wood with 2-3 mm deep, horizontal and diagonal ridges), wire brush, doormat, or rubber bands (250 g of rubber bands wrapped around the post). We determined the acceptance of the hair snares by the animals by observing their behavior with the aid of video cameras. The number of rubbing events on the different trap types did not significantly differ, but the rubbing duration was longer for the doormat hair snare. The wire brush hair snare collected the highest total amount of hair and - beside the carpet - the highest amount of hair per unit of time. Almost all hair trapped on the wire brush snare were retained during a 2-week exposure to the elements outside of the enclosures. The results of our study may hold for other felid species with hair characteristics similar to those of lynx.

Hidalgo-Mihart, MG, Contreras-Moreno, FM. 2012. White lipped pecaries (*Tayassu pecari*) recorded in the area of Terminos Lagoon Campeche, Mexico. REVISTA MEXICANA DE BIODIVERSIDAD 83(3):868-871.

We report at least one group of white lipped peccaries (*Tayassu pecari*) in Selva La Montana located in the southwestern portion of the Terminos Lagoon Flora and Fauna Protection Area, Campeche, Mexico. The record was obtained using camera traps. The presence of this species in the area shows the importance of the region for biodiversity conservation, particularly for protected species.

Jenks, KE, Kitamura, S, Lynam, AJ, Ngoprasert, D, Chutipong, W, Steinmetz, R, Sukmasuang, R, Grassman, LI, Cutter, P, Tantipisanuh, N, Bhumpakphan, N, Gale, GA, Reed, DH, Leimgruber, P, Songsasen, N. 2012. Mapping the distribution of dholes, *Cuon alpinus* (Canidae, Carnivora), in Thailand. MAMMALIA 76(2):175-184.

No recent attempt has been made to survey dhole distribution, or to estimate remaining population numbers. We surveyed 15 protected areas in Thailand with camera traps from 1996 to 2010. We used the photo locations of dholes (n = 96) in the maximum entropy (MaxEnt) model along with six environmental variables to model current dhole distribution, as well as species predictive occurrence layers for sambar, red muntjac, wild boar, tiger, and leopard. The MaxEnt model identified the predicted probability of the presence of leopards and sambar as positive and the most important variables in modeling dhole presence, indicating that maintaining a sufficient prey base may be the most important factor determining continued survival of dholes. Roughly 7% of the total land area in Thailand is potentially suitable for dholes. However, surveys to date have focused on protected areas, which make up just a third of the potential suitable areas for dholes. Only in four protected areas do they occur across the entire landscape, suggesting that in the majority of places where they occur, habitats are not uniformly suitable. Using the model, we identified several potential areas where dholes have not been reported, and therefore status surveys are needed, and where future research of the species might be focused.

Jenks, KE, Howard, J, Leimgruber, P. 2012. Do Ranger Stations Deter Poaching Activity in National Parks in Thailand? BIOTROPICA 44(6):826-833.

As protected areas become more accessible via transportation networks, fragmentation, and encroachment from the borders, carnivores in these areas frequently decline. To counter these pressures, patrolling and active wildlife enforcement are widely accepted as fundamental conservation strategies. Using the case example of Khao Yai National Park (KYNP) and data from a camera trap survey, we modeled and evaluated the effectiveness of ranger stations in reducing human access and illegal activities, and in increasing prey and predator presence. This type of data and analysis is needed to monitor and evaluate enforcement effectiveness and develop adaptive management strategies. At KYNP, we used camera-trapping data as a proxy to evaluate whether or not a positive impact of ranger stations on wildlife distribution could outweigh edge effects from human disturbance. We assessed factors affecting the distribution of poachers and wildlife using Maxent. Our analysis was based on 217 camera trap locations (6260 trap nights) and suggests that ungulates and poachers persist nearby ranger stations. Rangers should increase patrolling efforts of border areas; however, increasing wildlife patrolling in inaccessible areas with mobile range units may be more effective than establishing more ranger stations along park boundaries.

Jones, T, Bowkett, AE. 2012. New populations of an Endangered Tanzanian antelope confirmed using DNA and camera traps. ORYX 46(1)14-15.

NO ABSTRACT

Kapfer, JM, Kirk, RW. 2012. Observations of Gray Foxes *(Urocyon cinereoargenteus*) in a Suburban Landscape in the Piedmont of North Carolina. SOUTHEASTERN NATURALIST 11(3):507-516.

Studies of *Urocyon cinereoargenteus* (Gray Fox) in suburban landscapes are rare. Past work has suggested that this species will only tolerate urbanization to a certain density of residences (50-125 residences/KM^2). To test this, we employed visual observations and camera traps to monitor Gray Fox activity within a suburban and adjacent rural property from January to July 2011. We also used a geographical information system (GIS) to calculate the density of buildings associated with both properties. We observed Gray Foxes and detected them with camera traps in our properties on numerous occasions. GIS analyses revealed an estimated suburban density of 237-347 residences/KM^2 (depending on spatial scale) and rural density of 50 residences/KM^2. The number of Gray Fox observations did not differ greatly between rural and suburban properties, although the peak periods of Gray Fox observations varied by site. We propose that a tolerance for high suburban building density exhibited by Gray Foxes at our site is related to the large amount of mature wooded buffers located adjacently.

Kapfer, JM, Munoz, DJ. 2012. An Assessment of Herpetofaunal and Non-Volant Mammal Communities at Sites in the Piedmont of North Carolina. SOUTHEASTERN NATURALIST 11(1):65-88.

The southeastern United States contains a rich diversity of vertebrate species. Despite this, the Piedmont province of the southeastern US has received less attention than the more biologically diverse Coastal Plain and Mountain regions. Yet, the Piedmont region experiences the greatest anthropogenic impact and should be the focus of conservation efforts. In an attempt to obtain diversity information for this under-studied region, we surveyed amphibian, reptile, and non-volant mammal communities for one

year at two sites in the Piedmont of North Carolina. Our survey methodologies included drift fences, artificial cover objects, camera traps, and visual encounter surveys. We captured or obtained evidence of a total of 49 species across both sites (mammals = 20, amphibians = 15, reptiles = 14), and over 2000 animals were captured or detected. We calculated measures of species richness, abundance, diversity, and evenness for each study site, and calculated similarity between sites. Diversity and evenness measures varied, but were generally highest for amphibians or reptiles and lowest for mammals. Measures of similarity between study sites indicated high similarity. The species we observed were comparable to those reported by past inventory projects in the Piedmont of North Carolina, although such projects have been sparse. Our results provide much-needed information on vertebrate communities in this under-studied region.

Kamler, JF, Johnson, A, Vongkhamheng, C, Bousa, A. 2012. The diet, prey selection, and activity of dholes (*Cuon alpinus*) in northern Laos. JOURNAL OF MAMMALOGY 93(3):627-633.

Although Southeast Asia is one of the last strongholds of endangered dholes (*Cuon alpinus*), or Asiatic wild dogs, little is known about dhole ecology in this region. We used scat collections, prey surveys, and camera-trap data to determine the diet, prey selection, and activity of dholes in a national protected area in northern Laos. Results showed that dhole diets were dominated by ungulates (87% of biomass consumed), with additional prey including other carnivores (6%) and rodents < 1 kg (6%). Concerning individual prey species, only muntjac (*Muntiacus*, 45%) and sambar (*Rusa unicolor*, 33%) contributed > 7% of biomass consumed. Dholes were not random in their consumption of ungulates, because muntjac (20-28 kg) and sambar (185 kg) were selectively consumed over medium-sized (75- to 85-kg) ungulates. Dholes were almost exclusively diurnal, and their activity pattern was significantly different (all $P < 0.003$) from that of all ungulate species except wild pigs (*Sus scrofa*). Overall, prey selection by dholes appeared to be more influenced by social behavior and terrain use of ungulates, rather than by body size or activity of ungulates. In tropical

forests of northern Laos, dholes focused predation on relatively few species during diurnal hours, suggesting the management of muntjac and sambar may be important for conserving dhole populations in the region.

Kinnaird, MF, O'Brien, TG. 2012. Effects of Private-Land Use, Livestock Management, and Human Tolerance on Diversity, Distribution, and Abundance of Large African Mammals CONSERVATION BIOLOGY 26(6):1026-1039.

Successful conservation of large terrestrial mammals (wildlife) on private lands requires that landowners be empowered to manage wildlife so that benefits outweigh the costs. Laikipia County, Kenya, is predominantly unfenced, and the land uses in the area allow wide-ranging wildlife to move freely between different management systems on private land. We used camera traps to sample large mammals associated with 4 different management systems (rhinoceros sanctuaries, no livestock; conservancies, intermediate stocking level; fenced ranches, high stocking level; and group ranches, high stocking level, no fencing, pastoralist clan ownership) to examine whether management and stocking levels affect wildlife. We deployed cameras at 522 locations across 8 properties from January 2008 through October 2010 and used the photographs taken during this period to estimate richness, occupancy, and relative abundance of species. Species richness was highest in conservancies and sanctuaries and lowest on fenced and group ranches. Occupancy estimates were, on average, 2 and 5 times higher in sanctuaries and conservancies as on fenced and group ranches, respectively. Nineteen species on fenced ranches and 25 species on group ranches were considered uncommon (occupancy < 0.1). The relative abundance of most species was highest or second highest in sanctuaries and conservancies. Lack of rights to manage and utilize wildlife and uncertain land tenure dampen many owners' incentives to tolerate wildlife. We suggest national conservation strategies consider landscape-level approaches to land-use planning that aim to increase conserved areas by providing landowners with incentives to tolerate wildlife. Possible incentives include improving access to ecotourism benefits, forging

agreements to maintain wildlife habitat and corridors, resolving land-ownership conflicts, restoring degraded rangelands, expanding opportunities for grazing leases, and allowing direct benefits to landowners through wildlife harvesting.

Klailova, M, Casanova, C, Henschel, P, Lee, P, Rovero, F, Todd, A. 2012. Non-Human Predator Interactions with Wild Great Apes in Africa and the Use of Camera Traps to Study Their Dynamics. FOLIA PRIMATOLOGICA. 83(3-6):312-328.

The slow life histories of great apes (hereafter 'apes') combined with a growing inventory of predation incidents suggest that apes may be strongly affected by direct predation, as well as by predation risk. Predation risk may shape and increase behavioural flexibility by forcing individuals to adapt their behaviour to predator patterns. Forest leopards are an apex predator of primates in African rain forests and may represent a significant risk to ape populations. More field data are needed to further elucidate the behavioural modifications of apes in response to predation. We present research methods that combine the use of remote camera traps, capture-mark-recapture statistics and occupancy modelling to study predator-African ape relationships and potential antipredator behaviour through spatial variation in species co-occurrence patterns.

Koike, S, Morimoto, H, Kozakai, C, Arimoto, I, Yamazaki, K, Iwaoka, M, Soga, M, Koganezawa, M. 2012. Seed removal and survival in Asiatic black bear *Ursus thibetanus* faeces: effect of rodents as secondary seed dispersers. WILDLIFE BIOLOGY 18(1):24-34.

We investigated the fate of seeds of five tree species hill cherry *Prunus jamasakura*, Korean hill cherry *P. verecunda*, Japanese bird cherry *P. grayana*, giant dogwood *Swida controversa* and crimson glory vine *Vitis*

coignetiae in the faeces of the Asiatic black bear *Ursus thibetanus* in a temperate forest in central Japan. Clarifying the fate of seeds dispersed by endozoochorous seed dispersers will enhance assessments of their roles as primary seed dispersers. We established several experimental treatments in the field. Each faeces sample was covered by cages with different mesh sizes which limited accessibility by animals (NM: no mesh, SM: 1 mm mesh and MM: 10 mm mesh). We examined whether seed removal varied among tree species and between mesh-size treatments from 2004 to 2007 (N=625 samples). We set up an automatic camera trap 1.5 m above the ground at all NM treatments. In the NM treatments, the number of seeds of all tree species decreased immediately after the faeces were set. In June of the following year, < 1% of the seeds from any species remained in the vicinity of the faeces. However, we found 3.0-13.2% intact seeds of all species in the soil below the faeces, as well as within a 10-m radius around the faeces. In the NM treatments, most seed removals were observed within four days after the faeces were set. For all tree species in the MM treatment, most of the seeds were present on the surface of the soil, and 1-2% of the seeds germinated at the location where faeces were set. In the SM treatment, none of the seeds from any of the tree species disappeared and germinated. We took a total of 415 photographs at the NM sites, 97.8% of which were of rodents either holding or eating seeds. Many of the seeds contained in the bear faeces were removed and eaten by rodents. However, 2.1-5.1% of the seeds survived and germinated, which implies that rodents may also act as secondary seed dispersers.

Lantschner, MV, Rusch, V, Hayes, JP. 2012. Habitat use by carnivores at different spatial scales in a plantation forest landscape in Patagonia, Argentina. FOREST ECOLOGY AND MANAGEMENT 269:271-278.

Forest plantations are an increasingly important source of industrial wood around the world, and the design and management of plantations can greatly influence the relationship with wildlife. The aim of this study was to examine the effects of conversion of native open vegetation to conifer plantations on mammalian carnivore assemblages in NW Patagonia,

Argentina. We conducted camera-trap surveys at 69 sites and assessed composition of carnivore assemblages and habitat use in conifer plantations and native vegetation. We also evaluated habitat characteristics at stand and landscape scales related to presence of carnivores. Four species of carnivores were detected: *Lycalopex culpaeus*, *Conepatus chinga*, *Puma concolor*, and *Leopardus geoffroyi*. *L. culpaeus* and *C chinga* used continuous native vegetation most frequently, but also used dense conifer plantations and tended to be more abundant in firebreaks and sparse plantations than in dense plantations. *L. geoffroyi* was almost fully restricted to continuous native vegetation, but was also detected in firebreaks and native vegetation remnants between plantations: this species was never detected in plantations. *P. concolor* was detected in all habitat types and did not exhibit any preference. The presence of carnivores was associated with understory diversity, tree density, and prey availability at the stand scale, and with amount of area with native vegetation at the landscape scale. Our results suggest that management decisions at the stand and landscape scales can influence habitat quality for wildlife in the region.

Latham, ADM, Nugent, G, Warburton, B. 2012. Evaluation of camera traps for monitoring European rabbits before and after control operations in Otago, New Zealand. WILDLIFE RESEARCH 39(7):621-628.

Context. European rabbits (*Oryctolagus cuniculus*) are reaching plague proportions again in some parts of New Zealand as the effect of rabbit haemorrhagic disease begins to wane. Effective monitoring techniques are required to quantify the success of alternative methods of controlling rabbits, such as poisoning.

Aim. To evaluate camera traps as a method of estimating the percentage of rabbits killed in a poison control operation, and to compare results obtained from cameras with those from traditional monitoring methods (spotlight transects and vantage-point counts).

Methods. We deployed cameras and conducted vantage-point counts and spotlight transects to compare a priori statistical power. We then used these monitoring methods to estimate percentage kill from a case study rabbit-control operation using sodium fluoroacetate (compound 1080).

Key results. Cameras had good statistical power to detect large reductions in rabbit numbers (>90%) and the percentage kill estimated using cameras was comparable with spotlight transects and vantage-point counts.

Conclusions. Cameras set up at fixed sampling locations can be an effective method of quantitatively assessing rabbit population control outcomes. We recommend that >6 cameras per 100 ha should remain active for at least 5 days before and 5 days following control, so as to obtain reliable estimates of percentage kill.

Implications. Cameras may be preferable to conventional monitoring methods where there is insufficient area to walk or drive transects, terrain is too rugged or scrubby for transects, and there are no or few vantage points from which to count rabbits.

Leuchtenberger, C, Ribas, C, Magnusson, W, Mourao, G. 2012. To each his own taste: latrines of the giant otter as a food resource for vertebrates in Southern Pantanal, Brazil. STUDIES ON NEOTROPICAL FAUNA AND ENVIRONMENT 47(2):81-85.

Pteronura brasiliensis feeds mainly on fish and uses communal latrines for territorial marking. The aim of this study was to identify the vertebrate species associated with latrines of giant otters and which species use the feces as a food resource. From December 2010 to June 2011, we positioned camera traps in front of 21 latrines of six different giant otter groups in 24 h cycles monthly. We registered 29 vertebrate species at latrines. Latrines seem to be used as a frequent food resource for some species. Studies of giant otter diets should take into account possible changes in relative abundance of prey items due to consumption of feces.

Lhota, S, Loken, B, Spehar, S, Fell, E, Pospech, A, Kasyanto, N. 2012. Discovery of Miller's Grizzled Langur (*Presbytis hosei canicrus*) in Wehea Forest Confirms the Continued Existence and Extends Known Geographical Range of an Endangered Primate. AMERICAN JOURNAL OF PRIMATOLOGY 74(3):193-198.

Miller's Grizzled Langur (*Presbytis hosei canicrus*) is one of the least known and rarest primates in Borneo. With a limited geographic range along the central coast of East Kalimantan and the highly degraded Kutai National Park, its former stronghold, this subspecies is now extremely rare and has been listed as one of the world's 25 most endangered primates. From June 6 to August 2, 2011, we carried out both direct observation and camera trap surveys at two mineral springs (sepans) in the Wehea Forest, East Kutai district, East Kalimantan. Presbytis hosei canicrus was observed at the large sepan on 3 of 6 observation days and at the small sepan on 2 of 3 observation days with up to 11 individuals observed in a single day at a single site. Camera traps recorded a per day capture rate of 0.72 at the small sepan and 0.25 at the large sepan and a per photo capture rate of 0.50 and 0.005, respectively. These data suggest relatively frequent occurrence of *P. h. canicrus* at the sepans, but the langurs are rarely encountered elsewhere in the Wehea Forest. The discovery of *P. h. canicrus* in the Wehea Forest confirms the continued existence of this endangered primate and is the first solid evidence demonstrating that its geographic range extends further inland than previously thought. It is not known whether the population of *P. h. canicrus* within Wehea Forest is large and stable enough to be considered viable, but it is likely part of a larger population that may possibly occur across surrounding protected forests and logging concessions. Surveying this potentially large population, and securing its protection, should be a priority measure for ensuring the continued existence of *P. h. canicrus.*

Li, S, McShea, WJ, Wang, DJ, Lu, Z, Gu, XD. 2012. Gauging the impact of management expertise on the distribution of large mammals across protected areas. DIVERSITY AND DISTRIBUTIONS 18(12):1166-1167.

Aim: The world's network of protected areas (PAs) plays a critical role in biodiversity conservation. The management expertise within PAs is a function of the training, support and depth of the staff tasked with protecting the resources and should be a significant factor determining the distribution of wildlife species. However, there are few measurable linkages between wildlife populations and management effectiveness. Here, we addressed whether the management expertise within a PA is an important covariate explaining the occupancy of large terrestrial mammals, and identify the attributes of mammal species that would be effective for comparative monitoring of management effectiveness within PAs of developing countries.

Location: Six PAs within giant panda region, south-west China.

Methods: We used systematic camera-trapping as the primary field methodology to detect the presence of large mammals and used expert scoring to assess the management level of these PAs. Occupancy modelling and logistic regression were used to determine those mammal species with adequate detections to control for ecological covariates and to compare differences in management level between the sampled PAs.

Results: Thirty-eight mammal species were recorded with a total sampling effort of 16,521 camera-days at 722 sample sites. Among the 14 examined mammals, Takin (*Budorcas taxicolor*) was the most detected mammal (333 detections at 153 locations), whereas Asiatic black bear (*Ursus thibetanus*) was estimated with the highest occupancy rate (psi = 0.49) and leopard cat (*Prionailurus bengalensis*) was estimated with the highest detection probability (P = 0.55). The independently assessed estimate of management expertise was a significant positive predictor for the occupancy of 11 of the 14 mammal species.

Main conclusions: Our results suggest that there are measurable consequences for increasing PA patrolling and that standardized

monitoring of large mammals is an adequate comparative measure of management effectiveness across diverse PAs that experience extensive poaching pressure.

Lopez-Parra, M, Fernandez, L, Ruiz, G, Gil-Sanchez, JM, Simon, MA, Lopez, G, Sarmento, P. 2012. Change in demographic patterns of the Donana Iberian lynx *Lynx pardinus*: management implications and conservation perspectives. ORYX 46(3):403-413.

Over the last 20 years surveys of the population of the Iberian lynx *Lynx pardinus* in Donana National Park and its surroundings in Spain have produced estimates of a total population of 50-60 in fragmented patches. The population was estimated to be 26 adults in 2002-2003. Use of camera trapping and other field methods during 2004-2008 allowed us to determine the abundance of the lynx and to estimate demographic statistics. Estimated annual abundance of adult and subadult lynxes averaged 38 individuals (range 35-43). Although the population exhibited a continuous distribution it was concentrated in three major areas, including Do ana National Park, with an average area occupied of 620 KM^2. Our results suggest that the Do ana Iberian lynx population now has a different structure from that in the 1990s and in particular a more continuous spatial distribution. These results indicate an improved, but not secure, scenario for the population. The continuous geographical distribution suggests the population is currently less vulnerable to extinction than 10 years ago. Conservation actions now need to focus outside Do ana National Park on the reconversion of pine plantations into original Mediterranean scrubland habitat, and the continuity and intensification of ongoing restocking with rabbits in fenced areas.

Lynam, AJ, Tantipisanuh, N, Chutipong, W, Ngoprasert, D, Baker, MC, Cutter, P, Gale, G, Kitamura, S, Steinmetz, R, Sukmasuang, R, Thunhikorn,

S. 2012. Comparative sensitivity to environmental variation and human disturbance of Asian tapirs (*Tapirus indicus*) and other wild ungulates in Thailand INTEGRATIVE ZOOLOGY 7(4):389-399.

Southeast Asia's tropical forests suffer the highest rates of deforestation and disturbance of any on Earth, with poorly understood impacts on native fauna. Asian tapirs (*Tapirus indicus*) are among the least studied of the large mammals in these forests. Using records from 9 camera trap surveys in 7 of the largest (>1000 km^2) protected area complexes, we assessed the influence of environmental variation and human-induced disturbance on tapir occurrence. Tapirs were detected at 13% of locations sampled, significantly associated with evergreen forest (P < 0.001). A multiple logistic regression model predicted tapir presence 87% of the time. According to this model, tapir occurrence was positively influenced by annual rainfall and proximity to the forest edge. However, tapirs may not avoid edges but instead prefer wetter evergreen forest, a habitat type that tended to occur further from the forest edge at higher elevations in our particular study sites (P < 0.001). By comparison, 4 other wild ungulate species that share habitats with tapirs showed a range of differing responses. Tapirs are expected to be less sensitive to disturbance because they are not targets for hunting and trade, and are almost entirely active at night, so avoid peak traffic periods in parks. Tapir populations in Thailand may be more stable than in other parts of their global range because rates of forest loss have decreased >40% over the past 20 years. We recommend surveys to fill gaps in the understanding of the status in lesser-known protected areas, research to better understand the fine-scale environmental influences on behavior and habitats of tapirs, and other forest ungulates, and continued legal status for tapirs in the highest category of protection.

Manzo, E, Bartolommei, P, Rowcliffe, JM, Cozzolino, R. 2012. Estimation of population density of European pine marten in central Italy using camera trapping. ACTA THERIOLOGICA 57(2):165-172.

Evaluating presence and abundance of small carnivores is essential for their conservation. In Italy, there is scarce information on European pine marten distribution, and no data are published on its abundance. Camera traps have been widely used to estimate population density applying capture-recapture models for species in which individual recognition is possible. Here we estimate the abundance of European pine martens in central Italy using camera trapping and a model that allows the estimation of population density without the need for individual recognition Rowcliffe et al. (Anim Conserv 11:185-186, 2008). Camera trapping was also used to evaluate habitat use patterns by martens. Fifteen camera traps were deployed in 90 placements for 15 days each, for a total of 1,334 camera days. Pine martens were captured in 24% of camera trap placements with a mean trap success rate of 0.33 photographs per camera placement. Estimated pine marten population density in the study area was 0.34 individuals km^{-2}. Marten trap rate was not strongly associated with any habitat type, although there were trends towards lower probability of records at locations with high coverage of cultivated fields and higher probability of records at locations with high coverage of human-made woodland. The results suggest that pine martens in this area are not confined to wooded habitat. To our knowledge, this study is the first application of the Rowcliffe et al. (Anim Conserv 11:185-186, 2008) method to a wild carnivore population and, furthermore, the first estimation of population density of pine martens in Italy.

McCarthy, JL, Fuller, TK, McCarthy, KP, Wibisono, HT, Livolsi, MC. 2012. Using camera-trap photographs and direct sightings to identify possible refugia for the Vulnerable Sumatran striped rabbit *Nesolagus netscheri*. ORYX 46(3):438-441.

The endemic Sumatran striped rabbit *Nesolagus netscheri*, categorized as Vulnerable on the IUCN Red List, is one of the rarest lagomorphs and little is known about its ecology, status or distribution. After nearly a decade with

no published sightings, new camera-trap photos have been taken and observations made in Bukit Barisan Seletan and Kerinci Seblat National Parks, renewing interest in this rare species. We suggest that Bukit Barisan Seletan National Park is an ideal location to initiate a much needed ecological study of the species. Documentation and protection of a population in this Park would facilitate refinement of study techniques applicable to other areas in Sumatra, including Kerinci Seblat National Park, and thus facilitate an assessment of the status and distribution of the species. We believe that in light of ongoing encroachment and deforestation in many of Sumatra's protected areas it is important to implement immediate conservation initiatives in both parks to ensure the persistence of these known populations.

Meek, PD, Pittet, A. 2012. User-based design specifications for the ultimate camera trap for wildlife research. WILDLIFE RESEARCH 39(8):649-660.

Context. The adoption of camera trapping in place of traditional wildlife survey methods has become common despite inherent flaws in equipment and a dearth of research to test their fit for purpose. Overwhelmingly, the development of commercial camera traps has been driven by the needs of North American hunters. Camera-trap models and features are influenced by these market forces that drive the changes in designs as new technologies develop. This focus on recreation, rather than research has often frustrated wildlife professionals as the equipment has rarely met minimum standards for scientific application.

Aims. We investigated the demand for white-flash camera traps around the world to highlight the demand for such camera traps in wildlife research to the manufacturing industry. We also compiled the camera-trap specifications required by scientists through the world in an effort to influence and improve the quality of camera traps for research.

Methods. We carried out an internet-based survey of biologists, zoologists, conservationists and other wildlife researchers by using a questionnaire to

gather baseline market data on camera-trap use and demand. We also conducted an informal survey of scientists via email and in person, asking for their preferences and features of an ultimate camera-trap design.

Key result. Infrared camera traps are widely used and more so than white-flash camera traps, although the demand for white flash remains significant. Cost, speed, size, ease of use, versatility and the range of settings were the key features identified in a good camera trap.

Conclusions. The present paper describes and discusses the desired features and specifications as defined by over 150 scientists using camera traps around the world. Data gathered also provide some insight into the market demand for camera traps by biologists, zoologists, conservationists and other wildlife researchers around the world. These design features are discussed under the guise of the ultimate camera trap for wildlife research, with the disclaimer that no such camera trap currently exists.

Implications. The information provided in the paper has and will be a useful guide to future camera-trap designs, although it is unlikely that all of the features required will ever be produced in a cheap camera trap.

Meek, PD, Zewe, F, Falzon, G. 2012. Temporal activity patterns of the swamp rat (*Rattus lutreolus*) and other rodents in north-eastern New South Wales, Australia. AUSTRALIAN MAMMALOGY 34(2):223-233.

The activity patterns and partitioning of time by four small mammal species, with a focus on the swamp rat (*Rattus lutreolus*) in north-eastern New South Wales, was investigated using camera trap data from two studies. Analysis was carried out on 1079 camera trap events over 1530 camera trap nights or 36 720 h of camera trap deployment in the field. The activity patterns of Rattus lutreolus were distinctly diurnal with crepuscular peaks of activity but this differed between sites and when in the presence of competitors. The Hastings River mouse (*Pseudomys oralis*) and the bush rat (*Rattus fuscipes*) displayed typical bimodal patterns of nocturnal activity. Antechinus were mostly nocturnal but were occasionally active during the day. These data

indicate that where species of Muridae co-occur, diurnal time partitioning by *R. lutreolus* may reduce competition for food resources. It also confirms the speculation that *R. lutreolus* displays diurnal behaviour, albeit dependent on the presence of other murids.

Melo, GL, Sponchiado, J, Caceres, NC. 2012. Use of camera-traps in natural trails and shelters for the mammalian survey in the Atlantic Forest. IHERINGIA SERIE ZOOLOGIA 102(1):88-94.

In order to evaluate the efficiency of different mammalian survey methods, we compared traditional sampling techniques (use of camera-traps on roads and artificial trails, track censuses, and direct field visualization) with an alternative sampling design (camera-traps positioned in natural areas such as natural trails and shelters). We conducted the study in a deciduous Atlantic-Forest park in southern Brazil, and additionally compared our results with a previous intensive study carried out in the same area. Our considerably smaller sampling effort (example: 336 trap. day for our camera-traps versus 2,154 trap. day for the earlier study) registered the presence of 85% of the local known species, with camera-traps being 68% efficient. Moreover, shelter camera-traps revealed a different species composition regarding most of other sampling methods. This sampling strategy involving natural forest sites was therefore able to effectively optimize the chances of evaluating species composition in a shorter period, especially with respect to lower-density and cryptic species, as well as to detect species that avoid open, disturbed sites such as roads and man-made forest trails.

Mesa-Zavala, E, Alvarez-Cardenas, S, Galina-Tessaro, P, Troyo-Dieguez, E, Guerrero-Cardenas, I. 2012. Terrestrial vertebrates recorded by camera traps in areas with seasonal streams and creeks of superficial waters in a semiarid habitat of Baja California Sur, Mexico. REVISTA MEXICANA DE BIODIVERSIDAD 83(1):235-245.

Permanent or ephemeral water ponds (puddles, catchments, drains, and so on) located on ground depressions, such as streams and creeks, are a fundamental support for ecosystems in dry areas. This study identified the species of native terrestrial vertebrates in 4 sites in the southernmost part of the Sierra El Mechudo, B.C.S., including how such species use these bodies of water based on the periods of species activity. Habitats were characterized in 4 sites (topography, vegetation, and water sources); camera-traps were placed around water ponds from March to October 2007. The 4 sites differed in their environmental characteristics. Overall, there were 41 species of terrestrial vertebrates (3 reptiles, 31 birds, and 7 mammals), with several unidentified species of bats that were also found. Specific richness and visit (record) frequency were also different at each site. Species activity schedule was similar in the 4 sites with the exception of 3 species of mammals. This study provides important information of superficial water in semiarid areas, including description of habitat, species, and their behavior, which are basic elements for conservation and management of natural resources.

Molina-Vacas, G, Bonet-Arboli, V, Rodriguez-Teijeiro, JD. 2012. Habitat selection of two medium-sized carnivores in an isolated and highly anthropogenic Mediterranean park: the importance of riverbank vegetation. ITALIAN JOURNAL OF ZOOLOGY 79(1):128-135.

Since habitat selection is a key aspect of animal activity, its study in anthropogenic environments could show some clues about how medium-sized carnivores deal with the fact of living in suburban Mediterranean habitats. Compositional analysis was performed to evaluate the habitat selection of foxes and genets in a highly humanized metropolitan park of the NE Iberian Peninsula at population level by using the results obtained by a camera-trapping survey. A significant selection was found for the two species. Both species positively selected for riverbank vegetation. On the other hand, the red fox selected negatively for shrubs, while the genet did it

for crop fields. Species results are discussed considering their respective ecological particularities.

Monterrubio-Rico, TC, Charre-Medellin, JF, Zavala-Paramo, MG, Cano-Camacho, H, Pureco-Rivera, MQ, Leon-Paniagua, L. 2012. Photographic, biological and genetic evidences of the presence of jaguaroundi (*Puma yagouaroundi*) at the moment in Michoacan, Mexico. REVISTA MEXICANA DE BIODIVERSIDAD 83(3):825-833.

The jaguaroundi is one of the least studied felids on the American continent, despite its wide Neotropical distribution. Genetic studies concerning the species are also inexistent. For the state of Michoacan, it has always been assumed as present, since the distribution maps for the species in Mexico include the state, but only one record existed from 1970. Combining survey methods (camera traps, skulls and tissue found in the field, and transects) and molecular genotyping, we obtained photographic, biological and genetic evidence that confirms the actual presence of the jaguaroundi (*Puma yagouaroundi*) in 3 regions of Michoacan, Mexico. Eleven records were obtained from 7 localities that present tropical forests. Seven photographic records revealed that the species main activity period is during the afternoon, that both pelage phases occur in the state with a greater proportion in the clear pelage phase, and that breeding activity occurs in the state. Based on the distance and independence among Arteaga and Lazar Cardenas records, we hypothesize a continuous distribution of a population along the Sierra Madre del Sur and Pacific coast of Michoacan. We are unaware if a continuous distribution occurs as well along the Balsas basin. 1 089 and 1 096 pb cytochrome b gene sequences were obtained and constitute the longest sequences reported for the species in Mexico and to the north of the continent. The sequences also revealed the presence of 2 distinct haplotypes. The presence of species in 3 regions and the presence of 2 haplotypes allow us to hipothezise that in Michoacan the species may possess important genetic diversity, although a greater sample size is required for confirmation. The sequences obtained will allow the comparison with individuals from other regions of the country

in order to increase the knowledge on the species genetic variability, and will provide support for the identification of populations of conservation interest.

Msuha, MJ, Carbone, C, Pettorelli, N, Durant, SM. 2012. Conserving biodiversity in a changing world: land use change and species richness in northern Tanzania. BIODIVERSITY AND CONSERVATION 21(11):2747-2759.

Even though human induced habitat changes are a major driver of biodiversity loss worldwide, our understanding of the impact of land use change on ecological communities remains poor. Yet without such information it is difficult to develop management strategies for maintaining biodiversity in the face of anthropogenic change. To address this gap, we explored how land use practices impacted species richness in a mammalian community in northern Tanzania. Using camera traps, we estimated the number of mammalian species inhabiting three land use types subjected to increasing levels of anthropogenic pressure: (1) Tarangire National Park, (2) pastoral grazing areas; and (3) cultivated areas outside the park. Results showed that land use practice is correlated with different levels of species richness. Interestingly, mammal species richness was highest in the grazing areas and lowest in cultivated areas. When we focused our analyses on carnivores, we found little significant difference in species richness between the park and pastoral grazing areas, however, carnivore richness were significantly lower in the cultivated areas. We found no significant link between species body weight and presence in the three areas considered. Altogether, our results show that biodiversity conservation can be achieved outside national parks, with pastoral grazing areas holding a significant proportion of mammal communities; however increasing cultivation of pastoral rangelands may represent a major threat to mammalian communities.

Negroes, N, Sollmann, R, Fonseca, C, Jacomo, ATA, Revilla, E, Silveira, L. 2012. One or two cameras per station? Monitoring jaguars and other mammals in the Amazon. ECOLOGICAL RESEARCH 27(3):639-648.

Camera trapping has become a popular technique to monitor carnivore populations due to its usefulness in estimating abundance. Nevertheless, there are a number of problems associated with study design which are motivating researchers to search for a compromise that ensures improvement of precision while being cost-effective. We have used data from a capture-recapture study in a forested area in central Brazil to evaluate the effectiveness of using one versus two cameras per trapping station for determining jaguar density and capture rates of several other mammals. The capture rate for the jaguar and other species recorded with only one camera was lower than that with two cameras. The number of jaguars identified using photos from one camera ranged between six and seven animals, but reached ten individuals when two-camera sets were used where pictures of both flanks could be positively individualized. These differences, combined with different estimates of effective sampled area size, resulted in jaguar densities estimates ranging from 2.18 to 5.40 and 3.99 individuals/100 KM^2 when one and two cameras were used per station, respectively (using the half-MMDM and Heterogeneity model). Based on our results, we recommend the use of two cameras per station for jaguar density monitoring to ensure reasonable levels of reliability and accuracy of estimates despite a small sample size.

Ngoprasert, D, Lynam, AJ, Sukmasuang, R, Tantipisanuh, N, Chutipong, W, Steinmetz, R, Jenks, KE, Gale, GA, Grassman, LI, Kitamura, S, Howard, J, Cutter, P, Cutter, P, Leimgruber, P, Songsasen, N, Reed, DH. 2012. Occurrence of Three Felids across a Network of Protected Areas in Thailand: Prey, Intraguild, and Habitat Associations. BIOTROPICA 44(6):810-817.

Clouded Leopard, Leopard, and Tiger are threatened felids in Southeast Asia, but little is known about the factors influencing their distributions. Using logistic regression, we assessed how habitat variables, prey detection patterns, and presence of intraguild predators affect the occurrence of these felids across 13 protected areas within Thailand. Our analysis is based on data from 1108 camera-trap locations (47,613 trap-nights). Clouded Leopard and Leopard are associated with habitat where Red Muntjac and Eurasian Wild Pig were most likely to be present. Tiger are associated with habitat with a higher likelihood for the presence of Gaur, Eurasian Wild Pig, and Sambar. Clouded Leopard and Tiger were both weakly associated with areas with mature evergreen forest. Besides availability of prey, associations with potential competitors also appear to influence the distribution of these felids, although the strength of these effects requires further investigation. Occurrence rates for Clouded Leopard were no different in protected areas with Leopard versus without Leopards. Leopard had similar occurrence rates regardless of the presence of Tiger, but Leopards were less likely to be detected at the same camera-trap points with the larger felid. Our results suggest that the two most commonly photographed prey species in the study areas serve as key prey species, Eurasian Wild Pig for all three carnivores and Red Muntjac for Leopard and Clouded Leopard.

Ngoprasert, D, Reed, DH, Steinmetz, R, Gale, GA. 2012. Density estimation of Asian bears using photographic capture-recapture sampling based on chest marks. URSUS 23(2):117-133.

Assessing the conservation status of species of concern is greatly aided by unbiased estimates of population size. Population size is one of the primary parameters determining urgency of conservation action, and it provides baseline data against which to measure progress toward recovery. Asiatic black bears (*Ursus thibetanus*) and sun bears (*Helarctos malayanus*) are vulnerable to extinction, but no statistically rigorous population density estimates exit for wild bears of either species. We used a camera-based approach to estimate density of these sympatric bear species. First, we

tested a technique to photograph bear chest marks using 3 camera traps mounted on trees facing each other in a triangular arrangement with bait in the center. Second, we developed criteria to identify individual sun bears and black bears based on chest-mark patterns and tested the level of congruence among 5 independent observers using a set of 234 photographs. Finally, we camera-trapped wild bears at 2 study areas (Khlong E-Tow, 33 KM^2, and Khlong Samor-Pun, 40 KM^2) in Khao Yai National Park, Thailand, and used chest marks to identify individual bears and thereby derive capture histories for bears of each species. Average congruence among observers' identifications of individual bears was 78.4% for black bear and 92.9% for sun bear across sites. At Khlong E-Tow, we recorded 13 black bears (8 M, 4 F, 1 unknown sex) and 8 sun bears (1 M, 5 F, 2 unknown sex). At Khlong Samor-Pun, we recorded 10 black bears (6 M, 4 F) and 6 sun bears (4 M, 2 F). We used a spatially explicit capture-recapture method, resulting in density estimates of 8.0 (SE = 3.04) and 5.8 (SE = 2.31) black bears per 100 KM^2 and 5.9 (SE = 3.07) and 4.3 (SE = 2.32) sun bears per 100 KM^2 for each study area, respectively. Our camera trap design and chest-mark identification criteria can be used to estimate density of sun bears and black bears, enhancing knowledge of the conservation status of these threatened and little-known bear species.

Norris, D, Ramirez, JM, Zacchi, C, Galetti, M. 2012. A survey of mid and large bodied mammals in Nucleo Caraguatatuba, Serra do Mar State Park, Brazil. BIOTA NEOTROPICA 12(20):127-133.

We applied complementary survey techniques to obtain a baseline species list of mid and large bodied mammals in Nucleo Caraguatatuba, Serra do Mar State park, Brazil. Between May and September 2011 we surveyed the community of mid and large bodied mammals using diurnal line transect census (212.4 km), camera-traps (223.2 camera-trap days) and track-stations (478 track-station days). A total of 18 species were recorded from 14 families in eight orders. We recorded the presence of seven species considered threatened in the State of Sao Paulo, including Primates

(*Brachyteles arachnoides*), Artiodactyla (*Mazama* cf. *americana* and *Tayassu pecari*), Carnivora (*Leopardus pardalis*, *Leopardus tigrinus* and *Puma concolor*) and Perissodactyla (*Tapirus terrestris*). Based on extrapolated (First order jackknife) species richness estimates we predict that there are between 19 and 32 species of mid and large bodied mammals in the Nucleo. Our revised Mammal Priority Index ranked Nucleo Caraguatatuba as being of medium overall importance for the conservation of mid and large bodied mammals in the Atlantic Forest. Combined with the number and diversity of species recorded, our results demonstrate that this Nucleo is an important area for mammal conservation.

Noss, AJ, Gardner, B, Maffei, L, Cuellar, E, Montano, R, Romero-Munoz, A, Sollman, R, O'Connell, AF. 2012. Comparison of density estimation methods for mammal populations with camera traps in the Kaa-Iya del Gran Chaco landscape. ANIMAL CONSERVATION 15(5):527-535.

Sampling animal populations with camera traps has become increasingly popular over the past two decades, particularly for species that are cryptic, elusive, exist at low densities or range over large areas. The results have been widely used to estimate population size and density. We analyzed data from 13 camera trap surveys conducted at five sites across the Kaa-Iya landscape, Bolivian Chaco, for jaguar, puma, ocelot and lowland tapir. We compared two spatially explicit capture-recapture (SCR) software packages: secr, a likelihood-based approach, and SPACECAP, a Bayesian approach, both of which are implemented within the R environment and can be used to estimate animal density from photographic records of individual animals that simultaneously employ spatial information about the capture location relative to the sample location. As a non-spatial analysis, we used the program CAPTURE 2 to estimate abundance from the capture-recapture records of individuals identified through camera trap photos combined with an ad hoc estimation of the effective survey area to estimate density. SCR methods estimated jaguar population densities from 0.31 to 1.82 individuals per 100 km^2 across the Kaa-Iya sites; puma from 0.36 to 7.99; ocelot from 1.67 to 51.7; and tapir from 7.38 to 42.9. Density

estimates using either secr or SPACECAP were generally lower than the estimates generated using the non-spatial method for all surveys and species; and density estimates using SPACECAP were generally lower than that using secr. We recommend using either secr or SPACECAP because the spatially explicit methods are not biased by an informal estimation of an effective survey area. Although SPACECAP and secr are less sensitive than non-spatial methods to the size of the grid used for sampling, we recommend grid sizes several times larger than the average home range (known or estimated) of the target species.

Oliveira-Santos, LGR, Graipel, ME, Tortato, MA, Zucco, CA, Caceres, NC, Goulart, FVB. 2012. Abundance changes and activity flexibility of the oncilla, *Leopardus tigrinus* (Carnivora: Felidae), appear to reflect avoidance of conflict. ZOOLOGIA 29(2):115-120.

We investigated the density and activity of the oncilla, *Leopardus tigrinus* (Schreber, 1775), a threatened small cat, in the Brazilian Atlantic Forest, using camera-trap data. We described differences in the activity of individuals occurring alone or in sympatry with larger cats. Oncilla presented low densities (7-13 ind./100 KM^2) and high flexibility in its activity. The oncillas were primarily nocturnal in the absence of other larger cat species - margay, ocelot and puma - but became more diurnal, with a cathemeral activity pattern, when the other cats were present. Oncilla is likely to be in a subordinate position in interactions with larger cats and changes its activity to decrease the chances for interspecific encounters. In this study, however, the presence of other cat species covaries with habitat changes (from coastal forest patches to dense evergreen forests). We also verified the highest oncilla relative abundance in an area with no sympatric larger cats, with abundance decreasing when it was in sympatry with margay, ocelot and puma. Our results, together with recent records of oncilla in other degraded landscapes of the Atlantic Forest of Brazil, provide evidence that oncillas may thrive even in harsh environments where other cats have already been extinct. This raise interesting conservation

insights, as in the absence of other cats, *L. tigrinus* may assume a top predator role of these impoverished vertebrate communities.

Olson, ER, Marsh, RA, Bovard, BN, Randrianarimanana, HLL, Ravaloharimanitra, M, Ratsimbazafy, JH, King, T. 2012. Arboreal camera trapping for the Critically Endangered greater bamboo lemur *Prolemur simus.* ORYX 46(4):593-597.

Camera traps are standard tools for assessing populations of medium-large terrestrial mammals, particularly for rare, elusive or cryptic species, yet few researchers have attempted to employ camera traps to document rare primates in arboreal settings. We examined different arboreal camera-trap techniques to document the Critically Endangered greater bamboo lemur *Prolemur simus* in Madagascar. We documented P. simus at two sites, confirming presence at one site. Most species, including 86% of all lemur occurrences, were documented in low light conditions (c. < 105 lux). Our study suggests that camera traps can be effective in validating unconfirmed sightings of rare or secretive primate species. We recommend that future work with cameras in arboreal settings considers seasonal activity patterns, targets sites with high food densities, uses local knowledge, and utilizes available techniques (e. g. traditional trapping techniques) and landscape topography to concentrate animal movement (e. g. steep slopes or ridge lines).

Palomares, F, Godoy, JA, Lopez-Bao, JV, Rodriguez, A, Roques, S, Casas-Marce, M, Revilla, E, Delibes, M. 2012. Possible Extinction Vortex for a Population of Iberian Lynx on the Verge of Extirpation. CONSERVATION BIOLOGY 26(4):689-697.

Theory suggests that demographic and genetic traits deteriorate (i.e., fitness and genetic diversity decrease) when populations become small, and that

such deterioration could precipitate positive feedback loops called extinction vortices. We examined whether demographic attributes and genetic traits have changed over time in one of the 2 remaining small populations of the highly endangered Iberian lynx (*Lynx pardinus*) in Donana, Spain. From 1983 to 2008, we recorded nontraumatic mortality rates, litter size, offspring survival, age at territory acquisition, and sex ratio. We combined these demographic attributes with measures of inbreeding and genetic diversity at neutral loci (microsatellites) and genes subjected to selection (major histocompatibility complex). Data on demographic traits were obtained through capture and radio tracking, checking dens during breeding, track surveys, and camera trapping. For genetic analyses, we obtained blood or tissue samples from captured or necropsied individuals or from museum specimens. Over time a female-biased sex ratio developed, age of territory acquisition decreased, mean litter size decreased, and rates of nontraumatic mortality increased, but there were no significant changes in overall mortality rates, standardized individual heterozygosity declined steadily, and allelic diversity of exon 2 of class II major histocompatibility complex DRB genes remained constant (2 allelic variants present in all individuals analyzed). Changes in sex ratio and age of territory acquisition may have resulted from demographic stochasticity, whereas changes in litter size and nontraumatic mortality may be related to observed increases in inbreeding. Concomitant deterioration of both demographic attributes and genetic traits is consistent with an extinction vortex. The co-occurrence, with or without interaction, of demographic and genetic deterioration may explain the lack of success of conservation efforts with the Donana population of Iberian lynx.

Paschoal, AMO, Massara, RL, Santos, JL, Chiarello, AG. 2012. Is the domestic dog becoming an abundant species in the Atlantic forest? A study case in southeastern Brazil. MAMMALIA 76(1):67-76.

The Brazilian Atlantic forest has been reduced to a small fraction of its original area, with most remaining fragments being small and surrounded by anthropogenic matrices. This degree of disturbance, together with the

increasing sprawl of cities towards the rural zone, greatly facilitates the entrance of domestic animals into these remnants. We used camera traps to compare the abundances of the domestic dog with a similarly sized native carnivore, the ocelot, in a 957-ha reserve of the Brazilian Atlantic forest in a landscape largely composed by pastures and agriculture. The dog was the most recorded species among all 17 mammal species "captured" by the cameras. Dog abundance (32-38 dogs) and density (0.812-1.813 dogs/KM^2) were significantly higher than that of the ocelot (n=2 ocelots; density=0.158-0.347 ocelots/KM^2). Although our result is restricted to a single study site, it is supported by an increasing number of recent studies, which have detected dogs inside other Atlantic forest reserves. Our study suggests, therefore, that this invasion might be more widespread than generally thought. The presence of the domestic dog is a threat to native fauna and constitutes an important edge effect of human presence at the rural zone.

Paull, DJ, Claridge, AW, Cunningham, RB. 2102. Effective detection methods for medium-sized ground-dwelling mammals: a comparison between infrared digital cameras and hair tunnels. WILDLIFE RESEARCH 39(6):545-553.

Context. Conservation planning for threatened species depends on improved knowledge of the whereabouts of critical populations and thus the development of optimal detection methods.

Aims. To compare the effectiveness of infrared cameras and hair tunnels for detecting small to medium-sized ground-dwelling mammals in south-eastern Australian forests.

Methods. Reconyx PC90 cameras were paired with Handiglaze hair tunnels at 110 stations in south-eastern New South Wales. All devices were baited using rolled oats, peanut butter and pistachio essence and left in situ for a minimum duration of 30 days. Camera detection data were analysed for the first 15 and 30 days, whereas hair-tunnel detection data were

analysed for the entire duration of deployment. Linear mixed models with site as a random effect and device as a fixed effect were developed for mammal species richness. Linear mixed logistic regression models for binary data were developed for detection probabilities of five taxa of interest, namely, Isoodon, Perameles, Potorous, Trichosurus and Wallabia.

Key results. Hair tunnels detected eight mammal species, whereas cameras detected 18 species. Modelled detection rates using cameras were 3.16 ± 0.21 species per site after 15 days and 4.24 ± 0.23 species per site after 30 days, whereas hair tunnels detected 0.34 ± 0.21 species over the entire deployment. Cameras were therefore approximately 9 - 12 times better at measuring mammal richness than were hair tunnels, depending on survey duration. In all calculations, the probability of detecting the five taxa of interest was significantly greater using cameras than using hair tunnels.

Conclusions. Infrared cameras and hair tunnels offer ethical advantages over direct detection methods such as cage trapping for small to medium-sized ground-dwelling mammals. Cameras also offer practical benefits because they work for protracted periods, without frequent checking by field researchers. Cameras are more effective at detecting a wide range of species than are hair tunnels and are significantly better for detecting the taxa we examined. Unlike hair tunnels, cameras sometimes allow for the identification of individual animals, and provide information about frequency of habitat use, reproductive status and aspects of behaviour.

Implications. On a unit by unit basis, infrared cameras are a far more efficient way to census a broad spectrum of ground-dwelling mammals than are hair tunnels.

Pebsworth, PA, Bardi, M, Huffman, MA. 2012. Geophagy in chacma baboons: patterns of soil consumption by age class, sex, and reproductive state. AMERICAN JOURNAL OF PRIMATOLOGY 74(1):48-57.

Despite baboons' widespread distribution across Africa, geophagy among all subspecies has been poorly documented. We used video camera traps

and soil analyses to investigate geophagy in chacma baboons (*Papio cynocephalus ursinus*) inhabiting the Western Cape of South Africa. During an 18-month study, from August 2009 to January 2011, we continually monitored the largest and most frequently visited geophagy sites with camera traps for 545 days and captured soil consumption at one or more sites on 266 of those days (49%). In 3,500 baboon visits to geophagy sites, video camera traps captured 58.6 hr of geophagy. From these data, we evaluated site preference based on time spent consuming soil among these four geophagy sites. One hundred and seventy days of soil consumption data from the most frequently visited geophagy site allowed us to look for demographic trends in geophagy. Selected consumed soils from geophagy sites were analyzed for mineral, physical, and chemical properties. The baboons spent more time consuming white alkaline soils with high percentages of clay and fine silt, which contained higher concentrations of sodium than non-white acidic soils that contained higher concentrations of iron. Our data indicate that pregnant chacma baboons spent more time consuming soil at monitored geophagy sites than baboons of any other age class, sex, or reproductive state. Based on analytical results, the soils consumed would be effective at alleviating gastrointestinal distress and possibly supplementing minerals for all age/sex classes, but potentially for different age/sex requirements.

Pereira, P, da Silva, AA, Alves, J, Matos, M, Fonseca, C. 2012. Coexistence of carnivores in a heterogeneous landscape: habitat selection and ecological niches. ECOLOGICAL RESEARCH 27(4):745-753.

Understanding distributional patterns and mechanisms used by species for habitat selection is crucial to adopt effective land management policies in terms of biodiversity conservation. A heterogeneous landscape may allow coexistence of species. That coexistence will be dependent on the availability of the resources in the habitat that has to be sufficient to fulfil their basic needs. The present study aimed to investigate habitat selection, niche breadth and niche overlap of three sympatric carnivore species (*Vulpes vulpes*, *Genetta genetta* and *Martes foina*) in a typically fragmented

landscape from Central Portugal, using camera-trapping techniques. The results obtained revealed that the investigated species use the available habitats differently and in a non-random way. The red fox showed the most specialized behaviour, positively selecting coniferous forests. The common genet preferred eucalyptus, avoiding old-growth mixed woodland, in contrast with stone marten that exhibited a strong preference for this late habitat, avoiding eucalyptus. Concerning the niche breadth, the genet had the highest value while the red fox had the lowest one. The results obtained at the camera-trap level showed that the highest niche overlap occurred between the genet and the stone marten which suggests that these species can coexist and share the available resources. Regarding the habitat level, the greatest niche overlap was found for the stone marten and the red fox, indicating the exploration of the same general habitat conditions by both species. The results obtained in the present study support the concept that landscape complexity allows coexistence between species within the same trophic level.

Perez-Cortez, S, Enriquez, PL, Sima-Panti, D, Reyna-Hurtado, R, Naranjo, EJ. 2012. Influence of water availability in the presence and abundance of *Tapirus bairdii* in the Calakmul forest, Campeche, Mexico. REVISTA MEXICANA DE BIODIVERSIDAD 83(3)753-761.

In 15 waterholes (aguadas) grouped in 3 micro-regions (North, Central and South) and surrounding areas, we evaluated the environmental characteristics that could determine presence and abundance of the tapir (*Tapirus bairdii*) in Calakmul Biosphere Reserve (CBR), Campeche. Tapir presence were recorded in 14 watering holes between 2008 and 2010, with a sample effort of 3 470 days/camera-trap. The abundance was of 37.57-individuals/1 000 nights traps. Tapirs showed a nocturnal activity pattern and the age structure was dominated by adults with a sex ratio of 1:1. The southern micro-region and the waterhole 6 (central micro-region) had highest abundance. Abundance, food and water availability showed spatial and temporal variations. Water presence in waterholes was crucial to the presence of tapirs; the environmental variables more related to tapir's

abundance were water percentage in waterholes and vegetation dominance such as secondary forest and rain forest. Waterholes must be part of conservation priorities in Calakmul region.

Perez-Solano, LA, Mandujano, S, Contreras-Moreno, F, Salazar, JM. 2012. New record of the red brocket deer *Mazama temama* in the proximity of the Tehuacan-Cuicatlan Biosphere Reserve, Mexico. REVISTA MEXICANA DE BIODIVERSIDAD 83(3):875-878.

From April to December of 2010, we searched for the presence of the red brocket deer *Mazama temama* in the Sierra de Juarez, Oaxaca, and in the Sierra Negra, Puebla, in the proximity of the Tehuacan-Cuicatlan Biosphere Reserve. Using camera traps, we recorded the species in Santa Maria Papal. Oaxaca and Xaltepec, Puebla. The presence of the red brocket deer in the area, enhances the importance of the Reserve and importance to improve the protection of the surrounding areas.

Racheva, V, Zlatanova, D, Peshev, D, Markova, E. 2012. Camera Traps Recorded Use of Sett Sites by Badgers (*Meles meles* L., Mammalia) in Different Habitats. ACTA ZOOLOGICA BULGARICA 64(2):145-150.

Two main badger setts were monitored in different habitats (lowland and mountain) by Moultrie camera traps (model I-40 with infrared flash) from September 2008 till August 2009 (totally 712 trapnights - 353 in lowlands and 359 in mountain). The camera traps were set to make 5 second video clips, accompanied with info photo about time, temperature and moon phase. From 3343 registered events (n(lowland) = 2774; n(mountain) = 569) 1891 were of badgers (n(lowland) = 1676; n(mountain) = 215). The data analysis shows that badgers spend more time near the sett during winter and spring than other seasons. The peak hours are right before and after full moon (gibbous moon) similar for both habitats. In the mountainous

habitat there are two peaks of activity at sett emerge and return time - from 19:00 to 21:00 and from 3:00 to 5:00 h. Unique activity can be observed only in this habitat from 13:00 to 15:00 h due to less disturbed environment. Daytime emerge and sleeping near the sett are observed only in the remote mountainous area. In the lowland area the emerge peaks are at the same time from 19:00 to 21:00 but the return time peak is not definite. Higher activity can be observed in both habitats at the temperature interval between -2 degrees and 12 degrees C.

Ramesh, T, Kalle, R, Sankar, K, Qureshi, Q. 2012. Factors affecting habitat patch use by sloth bears in Mudumalai Tiger Reserve, Western Ghats, India. URSUS 23(1):78-85.

Of the threats facing sloth bear (*Melursus ursinus*) populations, habitat fragmentation is the most pressing. Although conservation requires protection of habitat, little is known about the factors governing sloth bear occurrence. We used camera-trapping data to investigate occupancy of sloth bears in Mudumalai Tiger Reserve, an important conservation site in India during January-April 2010. Presence-absence data, collected under a systematic sampling framework, were used to test a priori hypotheses incorporating covariates believed to influence sloth bear occurrence. The estimated occupancy of sloth bears in the study area was 0.83 (SE = 0.01) with a detection probability of 0.23 (SE = 0.07). We found that no model with covariates was as strongly supported as the null model, suggesting that covariates we chose were relatively weak predictors of use. That said, our results suggested that sloth bear use was associated with deciduous forests; weaker evidence was found for association with termite mounds and fruiting trees. In the future, monitoring programs for wide-ranging species could benefit from using occupancy surveys.

Ramesh, T, Kalle, R, Sankar, K, Qureshi, Q. 2012. Spatio-temporal partitioning among large carnivores in relation to major prey species in Western Ghats. JOURNAL OF ZOOLOGY 287(4):269-275.

Spatio-temporal partitioning is a viable mechanism for minimizing resource competition among sympatric species. The occurrence of sympatric large carnivores tiger Panthera tigris, leopard Panthera pardus and dhole Cuon alpinus in forests of the Indian subcontinent is complemented with high dietary overlap. We characterized temporal and spatial patterns of large carnivores with major prey species using photo-captures from 50 camera trap stations in Mudumalai Tiger Reserve, Western Ghats during 2008-2010. We tested whether major prey species' activity and spatial use acted as drivers for coexistence among large carnivores. Tiger exhibited cathemeral activity in the night and is spatially correlated with sambar and gaur, supporting hypotheses related to large-sized prey. Leopard was active throughout the day and is spatially correlated with almost all prey species with no active separation from tiger. Dhole exhibited diurnal activity and spatial use in relation to chital and avoided felids to a certain extent. Leopard exhibited spatial correlation with tiger and dhole, while tiger did not correlate with dhole. Leopard exhibited relatively broader temporal and spatial tolerance due to its generalist nature, which permits opportunistic exploitation of resources. This supports the hypothesis that predators actively used areas at the same time as their principal prey species depending upon their body size and morphological adaptation. We conclude that resource partitioning in large carnivores by activity and spatial use of their principal prey governs spatio-temporal separation in large carnivores.

Ramesh, T, Sridharan, N, Sankar, K, Qureshi, Q, Selvan, KM, Gokulakkannan, N, Francis, P, Narasimmarajan, K, Jhala, YV, Gopal, R. 2012. Status of large carnivores and their prey in tropical rainforests of South-western Ghats, India. TROPICAL ECOLOGY 53(2):137-148.

Information on large carnivores and their prey is generally lacking in many tropical rainforest habitats of the world. During March to October 2006, 2007 and 2010, we conducted sign and automated camera trap surveys for tiger (*Panthera tigris*), leopard (*Panthera pardus*) and dhole (*Cuon alpinus*) in Kalakad-Mundanthurai Tiger Reserve (KMTR), Western Ghats. Line transect sampling was carried out to estimate prey species density (total effort 353.2 km). Highest sign encounter rate per km walk was observed for leopard (1.26), followed by dhole (0.67) and tiger (0.18). Spatially explicit maximum likelihood and Bayesian model estimates (individuals 100 km^{-2}) were 2.2 ± 1.6 and 2.9 ± 1.4 for tigers and 2.8 ± 2.0 and 2.4 ± 1.3 for leopards, respectively. Photographic encounter rate of dhole was 1.9 in 2006 and 0.6 in 2010 / 100 trap-nights. Leopards exhibited peak activity at night while tigers were active during early mornings and late evenings. Dholes appeared to be mostly diurnal. Overall ungulate density was 11.9 ± 3.7 individuals km^{-2}. The ungulate biomass was 2614 kg km^{-2}. This study provides baseline information on prey - predator population in Kalakad-Mundanthurai Tiger Reserve.

Ramirez-Bravo, OE, Hernandez-Santin, L. 2012. New records of tepezcuincle (*Cuniculus paca*) in Puebla, Central Mexico. REVISTA MEXICANA DE BIODIVERSIDAD 83(3):872-874.

The state of Puebla has little information about mammal presence and distribution. In a study to determine jaguar presence using camera traps and interviews, we obtained 16 new records of tepezcuincle (*Cuniculus paca*) in different vegetation types such as tropical rainforest and cloud forest, as well as in coffee plantations. The records prove that the species is widely spread along the Sierra Norte of Puebla, but the distribution of populations in the Sierra Negra is uncertain.

Ratnayeke, S, van Manen, FT. 2012. Assessing sloth bears as surrogates for carnivore conservation in Sri Lanka. URSUS 23(2):206-217.

Bears are large, charismatic mammals whose presence often garners conservation attention. Because healthy bear populations typically require large, contiguous areas of habitat, land conservation actions often are assumed to benefit co-occurring species, including other mammalian carnivores. However, we are not aware of an empirical test of this assumption. We used remote camera data from 2 national parks in Sri Lanka to test the hypothesis that the frequency of detection of sloth bears (*Melursus ursinus*) is associated with greater richness of carnivore species. We focused on mammalian carnivores because they play a pivotal role in the stability of ecological communities and are among Sri Lanka's most endangered species. Seven of Sri Lanka's carnivores are listed as endangered, vulnerable, or near threatened, and little empirical information exists on their status and distribution. During 2002-03, we placed camera traps at 152 sites to document carnivore species presence. We used Poisson regression to develop predictive models for 3 categories of dependent variables: species richness of (1) all carnivores, (2) carnivores considered at risk, and (3) carnivores of least conservation concern. For each category, we analyzed 8 a priori models based on combinations of sloth bear detections, sample year, and study area and used Akaike's information criterion (AIC(c)) to test our research hypothesis. We detected sloth bears at 55 camera sites and detected 13 of Sri Lanka's 14 Carnivora species. Species richness of all carnivores showed positive associations with the number of sloth bear detections, regardless of study area. Sloth bear detections were also positively associated with species richness of carnivores at risk across both study years and study areas, but not with species richness of common carnivores. Sloth bears may serve as a valuable surrogate species whose habitat protection would contribute to conservation of other carnivores in Sri Lanka.

Rayan, DM, Mohamad, SW, Dorward, L, Aziz, SA, Clements, GR, Wong, CTC, Traeholt, C, Magintan, D. 2012. Estimating the population density of the Asian tapir (*Tapirus indicus*) in a selectively logged forest in Peninsular Malaysia. INTEGRATIVE ZOOLOGY 7(4):373-380.

The endangered Asian tapir (*Tapirus indicus*) is threatened by large-scale habitat loss, forest fragmentation and increased hunting pressure. Conservation planning for this species, however, is hampered by a severe paucity of information on its ecology and population status. We present the first Asian tapir population density estimate from a camera trapping study targeting tigers in a selectively logged forest within Peninsular Malaysia using a spatially explicit capture-recapture maximum likelihood based framework. With a trap effort of 2496 nights, 17 individuals were identified corresponding to a density (standard error) estimate of 9.49 (2.55) adult tapirs/100 km^2. Although our results include several caveats, we believe that our density estimate still serves as an important baseline to facilitate the monitoring of tapir population trends in Peninsular Malaysia. Our study also highlights the potential of extracting vital ecological and population information for other cryptic individually identifiable animals from tiger-centric studies, especially with the use of a spatially explicit capture-recapture maximum likelihood based framework.

Roos, AL, de Souza, EA, de Campos, CB, de Paula, RC, Morato, RG. 2012. First documented record of the Rufous-vented Ground-Cuckoo *Neomorphus geoffroyi* Temminck, 1820 for the Caatinga biome. REVISTA BRASILEIRA DE ORNITOLOGIA 20(1):81-85.

First documented record of the Rufous-vented Ground-Cuckoo *Neomorphus geoffroyi* Temminck, 1820 for the Caatinga biome. We reported the first records of the Rufous-vented Ground-Cuckoo *Neomorphus geoffroyi* for the caatinga region in northern Bahia. Those records were documented through camera trap photographs taken in May 2007 and August 2009, both in the Boqueirao da Onca region, municipality of Sento Se. These records extend the known species' distribution in approximately 400 km to the northwest, raising questions about its true distribution, habitat requirements, and subspecies' range limits.

Rowcliffe, JM, Carbone, C, Kays, R, Kranstauber, B, Jansen, PA. 2012. Bias in estimating animal travel distance: the effect of sampling frequency. METHODS IN ECOLOGY AND EVOLUTION 3(4):653-662.

1. The distance travelled by animals is an important ecological variable that links behaviour, energetics and demography. It is usually measured by summing straight-line distances between intermittently sampled locations along continuous animal movement paths. The extent to which this approach underestimates travel distance remains a rarely addressed and unsolved problem, largely because true movement paths are rarely, if ever, available for comparison. Here, we use simulated movement paths parameterized with empirical movement data to study how estimates of distance travelled are affected by sampling frequency. 2. We used a novel method to obtain fine-scale characteristics of animal movement from camera trap videos for a set of tropical forest mammals and used these characteristics to generate detailed movement paths. We then sampled these paths at different frequencies, simulating telemetry studies, and quantified the accuracy of sampled travel distance estimation. 3. For our focal species, typical telemetry studies would underestimate distances travelled by 6793%, and extremely high sampling frequencies (several fixes per minute) would be required to get tolerably accurate estimates. The form of the relationship between tortuosity, sample frequency, and distance travelled was such that absolute distance cannot accurately be estimated by the infrequent samples used in typical tracking studies. 4. We conclude that the underestimation of distance travelled is a serious but underappreciated problem. Currently, there is no reliable, widely applicable method to obtain approximately unbiased estimates of distance travelled by animals. Further research on this problem is needed.

Rustam, Yasuda, M, Tsuyuki, S. 2012. Comparison of mammalian communities in a human-disturbed tropical landscape in East Kalimantan, Indonesia. MAMMAL STUDY 37(4):299-311.

To examine the impact of human disturbance on mammalian community in a human-disturbed tropical landscape in Borneo, we conducted a baited camera trapping study in East Kalimantan, Indonesia, from 2005 to 2010. Along a gradient of habitat degradation, we established four camera trapping sites within a 20-km radius, one in Sungai Wain Protection Forest and three in Bukit Soeharto Grand Forest Park. From the camera trapping carried out for 1,017 camera-days, we obtained 3,753 images of 29 mammal species, including an alien species, the domestic dog (*Canis lupus familiaris*). The trapping efficiency and species composition of mammals recorded differed between the two kinds of bait (banana and shrimp). The number of species decreased, and the species composition changed along the gradient of habitat degradation, suggesting that human-mediated habitat degradation has a significant effect on the mammalian communities. Our results suggest that forest cover is essential for at least 14 out of 29 recorded mammal species to survive, and that the forest fires and habitat isolation strongly affect particular species, i.e. *Lariscus insignis* and *Trichys fasciculata* (Rodentia) and *Arctogalidia trivirgata* (Carnivora).

Santos, FD, Mendes-Oliveira, AC. 2012. Diversity of medium and large sized mammals in the Urucu basin, Amazonas, Brazil. BIOTA NEOTROPICA 12(3):282-291.

Between April 2008 and May 2009, studies on the species richness, composition and relative abundance of the medium and large sized mammals were carried out in the Urucu basin (Brazilian Amazon). The survey was conducted using line transect sampling method, active search for signs and camera-traps. A total of 41 species of 17 families and eight orders were recorded. Primates was the group with the highest species richness in sympatry (13 species), followed by carnivores (11 species). Primates, Perissodactyla, Artiodactyla and Rodentia were the most abundant groups. The high diversity of medium and large sized mammals

presented here indicates the importance of the region for mammals conservation in Amazonia.

Silva-Rodriguez, EA, Sieving, KE. 2012. Domestic dogs shape the landscape-scale distribution of a threatened forest ungulate. BIOLOGICAL CONSERVATION 150(1):103-110.

Domestic dogs are the most abundant carnivores worldwide, primarily due to human support. Food and other subsidies to dogs do not necessarily prevent dog predation on wildlife, particularly where dogs are allowed to range freely. Dog impacts on wildlife are suspected to be significant, yet the nature of dog-wildlife interactions is not fully understood. We tested the hypothesis that the distribution of dogs can significantly influence the space use of potential prey, and that both lethal and non-lethal mechanisms may underlie this interaction. If this is true, then we predicted that (1) evidence of predation and harassment by dogs should be evident where prey and dog activities overlap and (2) potential prey should be less frequent in areas where the probability of dog presence is high. To test these predictions we conducted two related studies. (1) We interviewed dog owners to estimate the probability of dog attack on pudu (*Pudu puda*), a globally vulnerable deer, and the lethality of these attacks. (2) We conducted a camera-trap survey documenting the landscape-scale distribution of pudu and dogs. Interviews showed that both the probability of dog attack on pudu (>85%) and the lethality of such attacks was high (50%). In occupancy models applied to the camera-trap data, the variable that best explained the distribution of pudus was the probability of dog presence. We tested three alternative explanations for the negative association between pudus and dogs that were not supported. Our findings suggest that dogs are efficient at chasing pudu they detect and that both predation and non-lethal (avoidance) consequences of harassment may be shaping the distribution of pudu. This work brings into focus important mechanisms underlying the threats of domestic dogs to endangered prey.

Smith, JK, Coulson, G. 2012. A comparison of vertical and horizontal camera trap orientations for detection of potoroos and bandicoots. AUSTRALIAN MAMMALOGY. 34(2):196-201.

Camera traps are increasingly used to monitor wildlife that is otherwise difficult to study. Traditionally, camera traps are set aimed horizontally towards a scent lure, capturing images of animals as they move past. A vertical camera orientation is also being used, whereby the camera lens and sensor face vertically down towards the scent lure, capturing images from above. We aimed to compare detection of southern brown bandicoots and long-nosed potoroos by camera traps set horizontally, to those set vertically. We also considered the number of false triggers and ease of species identification.

Over 21 nights, we monitored 18 camera stations, each consisting of one PixController Inc. DigitalEye (TM) 7.2 camera aimed horizontally and one vertically, towards the same scent lure. We used PRESENCE (Version 3.0 (Beta)) to estimate detection probabilities for the two species, comparing a null model to a model with camera orientation as a covariate affecting probability of detection. Detection probabilities for both species was 2-5 times higher by vertical than by horizontal cameras, with no significant difference in false triggers. Vertical cameras also increased case of species identification. Vertical camera orientation is shown to be superior in our study system, providing a valid alternative method.

Sollmann, R, Furtado, MM, Hofer, H, Jacomo, ATA, Torres, NM, Silveira, L. 2012. Using occupancy models to investigate space partitioning between two sympatric large predators, the jaguar and puma in central Brazil. MAMMALIAN BIOLOGY 77(1):41-46.

Coexistence of sympatric species is mediated by resource partitioning. Pumas occur sympatrically with jaguars throughout most of the jaguar's range but few studies have investigated space partitioning between both

species. Here, camera trapping and occupancy models accounting for imperfect detection were employed in a Bayesian framework to investigate space partitioning between the jaguar and puma in Emas National Park (ENP), central Brazil. Jaguars were estimated to occupy 54.1% and pumas 39.3% of the sample sites. Jaguar occupancy was negatively correlated with distance to water and positively correlated with the amount of dense habitat surrounding the camera trap. Puma occupancy only showed a weak negative correlation with distance to water and with jaguar presence. Both species were less often present at the same site than expected under independent distributions. Jaguars had a significantly higher detection probability at cameras on roads than at off-road locations. For pumas, detection was similar on and off-road. Results indicate that both differences in habitat use and active avoidance shape space partitioning between jaguars and pumas in ENP. Considering its size, the jaguar is likely the competitively dominant of the two species. Owing to its habitat preferences, suitable jaguar habitat outside the park is probably sparse. Consequently, the jaguar population is likely largely confined to the park, while the puma population is known to extend into ENP's surroundings.

Sollmann, R, Gardner, B, Belant, JL. 2012. How Does Spatial Study Design Influence Density Estimates from Spatial Capture-Recapture Models? PLOS ONE 7(4):e34575.

When estimating population density from data collected on non-invasive detector arrays, recently developed spatial capture-recapture (SCR) models present an advance over non-spatial models by accounting for individual movement. While these models should be more robust to changes in trapping designs, they have not been well tested. Here we investigate how the spatial arrangement and size of the trapping array influence parameter estimates for SCR models. We analysed black bear data collected with 123 hair snares with an SCR model accounting for differences in detection and movement between sexes and across the trapping occasions. To see how the size of the trap array and trap dispersion influence parameter estimates, we repeated analysis for data from subsets of traps: 50% chosen at

random, 50% in the centre of the array and 20% in the South of the array. Additionally, we simulated and analysed data under a suite of trap designs and home range sizes. In the black bear study, we found that results were similar across trap arrays, except when only 20% of the array was used. Black bear density was approximately 10 individuals per 100 KM^2. Our simulation study showed that SCR models performed well as long as the extent of the trap array was similar to or larger than the extent of individual movement during the study period, and movement was at least half the distance between traps. SCR models performed well across a range of spatial trap setups and animal movements. Contrary to non-spatial capture-recapture models, they do not require the trapping grid to cover an area several times the average home range of the studied species. This renders SCR models more appropriate for the study of wide-ranging mammals and more flexible to design studies targeting multiple species.

Stahlschmidt, P, Patzold, A, Ressl, L, Schulz, R, Bruhl, CA. 2012. Constructed wetlands support bats in agricultural landscapes. BASIC AND APPLIED ECOLOGY 13(2):196-203.

Bats are known to use aquatic habitats as foraging habitats. Agricultural intensification is perceived to be a main reason for the loss of wetlands. However, artificial wetland creation (i.e. the construction of retention-ponds) in the agricultural landscape aiming at water or nutrient retention has recently gained importance. We evaluated to what extent bats use these artificial wetlands as foraging habitats in an agricultural landscape. Bat activity and prey density were compared in matched pairs at retention-ponds and neighbouring vineyard sites using stationary bat-detectors and sticky-traps, respectively. To examine if bat activity is related to the number of bat individuals, a thermal infrared imaging camera was used. Pipistrellus pipistrellus, the dominant species, served as an example to assess habitat selection between retention-ponds and vineyards. This was performed by relating foraging activity to the available area available within the potential home-range. Total bat activity and nocturnal prey density were significantly higher above the retention-ponds than above vineyards. High differences of

activity levels between the ponds and the respective vineyard sites were found for *Pipistrellus* spp. (*P. pipistrellus* and *P nathusii*) and *Myotis* spp. (*M. daubentonii* and *M. mystacinus*), being about 180 times and 50 times higher above the retention-ponds, respectively. A significant correlation was found between recorded bat activity and the maximum number of bat individuals observed with a thermal infrared imaging camera. When relating foraging activity to habitat availability within the assumed home-range of P. pipistrellus, retention-ponds had on average a higher importance as a foraging habitat than the complete vineyard area although they covered less than 0.1% of its area. This study indicates that artificial wetlands such as retention-ponds provide foraging habitats for bats. Therefore, creation of wetlands in intensively used agricultural landscapes benefits bats.

Taylor, BD Goldingay, RL. 2012. Restoring Connectivity in Landscapes Fragmented by Major Roads: A Case Study Using Wooden Poles as "Stepping Stones" for Gliding Mammals. RESTORATION ECOLOGY 20(6):671-678.

Tree-dwelling mammals may be vulnerable to road mortality if forced to cross canopy gaps on the ground. This group of mammals has received scant attention worldwide despite major road projects potentially causing severe fragmentation to their habitat. Gliding mammals may be enabled to cross road gaps that exceed their gliding capability by the installation of tall wooden poles to act as stepping stones. We investigated whether such glide poles installed across two land-bridges in eastern Australia could restore landscape connectivity for small gliding petaurid marsupials. Hair-traps revealed repeated use of all poles at both locations over periods of 13 years. Camera traps at one site suggest a crossing frequency on the poles by the squirrel glider (*Petaurus norfolcensis*) of once every 3.8 nights. Radio-tracked animals did not glide directly over the road but instead used the poles to cross on the bridge. Hair-traps and camera traps installed within the middle of two reference land-bridges that lacked glide poles failed to detect crossings by gliding mammals despite their presence in

adjacent forest. These observations suggest that glide poles can facilitate road crossing and thereby restore habitat connectivity for gliding mammals. This lends support to the notion that glide poles have the potential to mitigate road-induced habitat fragmentation for gliding mammals worldwide.

Thompson, CM, Royle, JA, Garner, JD, 2012. A framework for inference about carnivore density from unstructured spatial sampling of scat using detector dogs. JOURNAL OF WILDLIFE MANAGEMENT 76(4):863-871.

Wildlife management often hinges upon an accurate assessment of population density. Although undeniably useful, many of the traditional approaches to density estimation such as visual counts, livetrapping, or markrecapture suffer from a suite of methodological and analytical weaknesses. Rare, secretive, or highly mobile species exacerbate these problems through the reality of small sample sizes and movement on and off study sites. In response to these difficulties, there is growing interest in the use of non-invasive survey techniques, which provide the opportunity to collect larger samples with minimal increases in effort, as well as the application of analytical frameworks that are not reliant on large sample size arguments. One promising survey technique, the use of scat detecting dogs, offers a greatly enhanced probability of detection while at the same time generating new difficulties with respect to non-standard survey routes, variable search intensity, and the lack of a fixed survey point for characterizing non-detection. In order to account for these issues, we modified an existing spatially explicit, capturerecapture model for camera trap data to account for variable search intensity and the lack of fixed, georeferenced trap locations. We applied this modified model to a fisher (*Martes pennanti*) dataset from the Sierra National Forest, California, and compared the results (12.3 fishers/100 km^2) to more traditional density estimates. We then evaluated model performance using simulations at 3 levels of population density. Simulation results indicated that estimates based on the posterior mode were relatively unbiased. We believe that this approach provides a flexible analytical framework for reconciling the

inconsistencies between detector dog survey data and density estimation procedures.

Thornton, DH, Branch, LC, Sunquist, ME. 2012. Response of large galliforms and tinamous (Cracidae, Phasianidae, Tinamidae) to habitat loss and fragmentation in northern Guatemala. ORYX 46(4):567-576.

The potential conservation value of fragmented or countryside landscapes in the tropics is being increasingly recognized. However, the degree to which fragmented landscapes can support species and the key patch and landscape features that promote population persistence remain poorly understood for elusive species such as ground-dwelling birds. We examined the presence/absence of seven species of galliforms and tinamous in 50 forest patches of 2.9-445 ha in northern Guatemala using camera traps and audiovisual surveying. After accounting for differences in detectability among species we found great variation in patterns of vulnerability of these species to habitat loss and fragmentation, with the three largest species being the most vulnerable. Distribution patterns of species among patches was influenced more strongly by measures of landscape context, such as the amount and configuration of habitat in the surrounding landscape, than within-patch variation in vegetation structure or disturbance. Our results indicate that large-bodied game birds may be particularly sensitive to habitat loss and fragmentation and emphasize that management efforts for these species need to go beyond consideration of local, within-patch factors to consider the impact of processes in the surrounding landscape. Our findings also demonstrate the utility of camera traps as a methodology for surveying large terrestrial bird species in fragmented landscapes.

Torres, NM, De Marco, P, Santos, T, Silveira, L, Jacomo, ATD, Diniz, JAF. 2012. Can species distribution modelling provide estimates of population densities? A case study with jaguars in the Neotropics. DIVERSITY AND DISTRIBUTIONS 18(6):615-627.

Aim To test the prediction that environmental suitability derived from species distribution modelling (SDM) could be a surrogate for jaguar local population density estimates. Location Americas. Methods We used 1409 occurrence records of jaguars to model the distribution of the species using 11 SDM methods. We tested whether models suitability is linearly correlated with jaguar population densities estimated from 37 different locations. We evaluated whether the relationship between density and suitability forms a constraint envelope, in which higher densities are found mainly in regions with high suitability, whereas low densities can occur in regions with variable suitability. We tested this using heteroscedasticity test and quantile regressions. Results A positive linear relationship between suitability and jaguar density was found only for four methods [bioclimatic envelope (BIOCLIM), genetic algorithm for rule set production (GARP), maximum entropy (Maxent) and generalized boosting models (GBM)], but with weak explanatory power. BIOCLIM showed the strongest relationship. Variance of suitability for lower densities values was larger than for higher values for many of the SDM models used, but the quantile regression was significantly positive only for BIOCLIM and random forests (RF). RF and GBM provided the most accurate models when measured with the standard SDM evaluation metrics, but possess poor relationship with local density estimates. Main conclusions Results indicate that the relationship between density and suitability could be better described as a triangular constraint envelope than by a straight positive relationship, and some of the SDM methods tested here were able to discriminate regions with high or low local population densities. Low jaguar densities can occur in areas with low or high suitability, whereas high values are restricted to areas where the suitability is greater. In high suitability areas but with low jaguar density estimates, we discuss how extrinsic factors driving abundance could act at local scales and then prevent higher densities that would be expected by the favourable regional environmental conditions.

Tsukada, H, Ishikawa, K, Shimizu, N. 2012. Damage to round bale silage caused by sika deer (*Cervus nippon*) in central Japan. GRASSLAND SCIENCE 58(4):179-187.

Round bale silage is a widely used forage production system in Japan. In recent years, several suspected instances of damage to bales of round bale silage by sika deer were reported on a dairy farm in central Japan. We sought to confirm whether this damage was indeed caused by sika deer, and if so, when and how they caused the damage. We also analyzed the effects of possible covariates on seasonal and spatial variances in the incidence of the observed damage. Continuous monitoring using camera traps revealed that sika deer were responsible for the damage to the bales of round bale silage. The sika deer were observed to nibble at the surface of the bales of round bale silage after puncturing the plastic film used to promote anaerobic digestion of the silage. Several sika deer were responsible for damaging the bales of round bale silage, and the incidence of damage to the bales increased as snow cover increased in winter. Further, the incidence of damage to the bales of round bale silage was greatest farthest away from the center of the farm facilities, and farthest inside the wildlife protection area, which covered a large proportion of the farm. The findings clarified the extent of damage caused by sika deer to bales of round bale silage, and illustrated the need to prevent such damage throughout the country.

Wallace, R, Ayala, G, Viscarra, M. 2012. Lowland tapir (*Tapirus terrestris*) distribution, activity patterns and relative abundance in the Greater Madidi-Tambopata Landscape. INTEGRATIVE ZOOLOGY 7(4):407-419.

Lowland tapir distribution is described in northwestern Bolivia and southeastern Peru within the Greater Madidi-Tambopata Landscape, a priority Tapir Conservation Unit, using 1255 distribution points derived

from camera trapping efforts, field research and interviews with park guards from 5 national protected areas and hunters from 19 local communities. A total of 392 independent camera trapping events from 14 camera trap surveys at 11 sites demonstrated the nocturnal and crepuscular activity patterns (86%) of the lowland tapir and provide 3 indices of relative abundance for spatial and temporal comparison. Capture rates for lowland tapirs were not significantly different between camera trapping stations placed on river beaches versus those placed in the forest. Lowland tapir capture rates were significantly higher in the national protected areas of the region versus indigenous territories and unprotected portions of the landscape. Capture rates through time suggested that lowland tapir populations are recovering within the Tuichi Valley, an area currently dedicated towards ecotourism activities, following the creation (1995) and subsequent implementation (1997) of the Madidi National Park in Bolivia. Based on our distributional data and published conservative estimates of population density, we calculated that this transboundary landscape holds an overall lowland tapir population of between 14 540 and 36 351 individuals, of which at least 24.3% are under protection from national and municipal parks. As such, the Greater Madidi-Tambopata Landscape should be considered a lowland tapir population stronghold and priority conservation efforts are discussed in order to maintain this population.

Wang, YW, Fisher, DO. 2012. Dingoes affect activity of feral cats, but do not exclude them from the habitat of an endangered macropod. WILDLIFE RESEARCH 39(7):611-620.

Context. The loss of large predators has been linked with the rise of smaller predators globally, with negative impacts on prey species (mesopredator release). Recent studies suggest that the dingo, Australia's top terrestrial predator, inhibits predation on native mammals by the invasive red fox, and therefore reduces mammal extinctions. Feral cats also have negative effects on native mammals, but evidence that dingoes suppress cats remains equivocal.

Aims. We sought to examine whether dingoes might spatially or temporally suppress the activity of feral cats at a site containing the sole wild population of an endangered macropod subject to feral cat predation (the bridled nailtail wallaby).

Methods. We used camera traps to compare coarse and fine-scale spatial associations and overlaps in activity times of mammals between August 2009 and August 2010.

Key results. Dingoes and cats used the same areas, but there was evidence of higher segregation of activity times during wet months. Potential prey showed no spatial avoidance of dingoes. Peak activity times of dingoes and their major prey (the black-striped wallaby) were segregated during the wetter time of year (December to March). We did not find evidence that cats were spatially excluded from areas of high prey activity by dingoes, but there was low overlap in activity times between cats and bridled nailtail wallabies.

Conclusions. These findings support the contention that fear of dingoes can sometimes affect the timing of activity of feral cats. However, cats showed little spatial avoidance of dingoes at a coarse scale.

Implications. Control of dingoes should not be abandoned at the site, because the potential moderate benefits of reduced cat activity for this endangered and geographically restricted wallaby may not outweigh the detrimental effects of dingo predation.

Weingarth, K, Heibl, C, Knauer, F, Zimmermann, F, Bufka, L, Heurich, M. 2012. First estimation of Eurasian lynx (*Lynx lynx*) abundance and density using digital cameras and capture-recapture techniques in a German national park. ANIMAL BIODIVERSITY AND CONSERVATION 35(2):197-207.

First estimation of Eurasian lynx (*Lynx lynx*) abundance and density using digital cameras and capture recapture techniques in a German national

park. Eurasian lynx are individually identifiable by their unique coat markings, making them ideal candidates for capture recapture (CMR) surveys. We evaluated the use of digital photography to estimate Eurasian lynx population abundance and density within the Bavarian Forest National Park. From November 2008 to January 2009 we placed 24 camera trap sites, each with two cameras facing each other (on well used walking tracks). The units were placed based on a systematic grid of 2.7 km. We captured five independent and three juvenile lynx and calculated abundance estimates using Program Mark. We also compared density estimates based on the MMDM method (Mean Maximum Distance Moved) from telemetry data (1/2MMDM(GPS)) and from camera trapping data (1/2MMDM(CAM)). We estimated that in an effectively sampled area of 664 KM^2 the Eurasian lynx density was 0.9 individuals/100 KM^2 with 1/2MMDM(CAM). The Eurasian lynx density calculated with 1/2MMDM(GPS) was 0.4 individuals/100 KM2 in an effectively sampled area of 1,381 KM^2. Our results suggest that long term photographic CMR sampling on a large scale may be a useful tool to monitor population trends of Eurasian lynx in accordance with the Fauna-Flora-Habitat Directive of the European Union.

Wilting, A, Mohamed, A, Ambu, LN, Lagan, P, Mannan, S, Hofer, H, Sollmann, R. 2012. Density of the Vulnerable Sunda clouded leopard *Neofelis diardi* in two commercial forest reserves in Sabah, Malaysian Borneo. ORYX 46(3):423-426.

Recently the Sunda clouded leopard *Neofelis diardi* was recognized as a separate species distinct from the clouded leopard Neofelis nebulosa of mainland Asia. Both species are categorized as Vulnerable on the IUCN Red List. Little is known about the newly identified species and, in particular, information from forests outside protected areas is scarce. Here we present one of the first density estimates calculated with spatial capture-recapture models using camera-trap data. In two commercial forest reserves in Sabah (both certified for their sustainable management practices) the density of the Sunda clouded leopard was estimated to be c. 1 per 100 km^2 (0.84 ± SE

0.42 and 1.04 ± SE 0.58). The presence of the Sunda clouded leopard in such forests is encouraging for its conservation but additional studies from other areas, including protected forests, are needed to compare and evaluate these densities.

2011

Ahumada, J.A., C. Faresin, K. Gajapersad, C. Hallam, J. Hurtado, E. Martin, A. McWilliam, B. Mugerwa, T. O'Brien, F. Rovero, D. Sheil, W. Spironello, N. Winarni, and S.J. Andelman. 2011. Community structure and diversity of tropical forest mammals: data from a global camera trap network. Philosophical Transactions of the Royal Society of London B-Biological Sciences. 366:2703-2711.

Terrestrial mammals are a key component of tropical forest communities as indicators of ecosystem health and providers of important ecosystem services. However, there is little quantitative information about how they change with local, regional and global threats. In this paper, the first standardized pantropical forest terrestrial mammal community study, we examine several aspects of terrestrial mammal species and community diversity (species richness, species diversity, evenness, dominance, functional diversity and community structure) at seven sites around the globe using a single standardized camera trapping methodology approach. The sites-located in Uganda, Tanzania, Indonesia, Lao PDR, Suriname, Brazil and Costa Rica-are surrounded by different landscape configurations, from continuous forests to highly fragmented forests. We obtained more than 51 000 images and detected 105 species of mammals with a total sampling effort of 12 687 camera trap days. We find that mammal communities from highly fragmented sites have lower species richness, species diversity, functional diversity and higher dominance when compared with sites in partially fragmented and continuous forest. We emphasize the importance of standardized camera trapping approaches for obtaining baselines for monitoring forest mammal communities so as to adequately understand the effect of global, regional and local threats and appropriately inform conservation actions.

Albayrak, T. 2011. Anthropogenic barriers to the distribution of the Grey Wolf (*Canis lupus* Linnaeus, 1758) in the Beydaglari Mountains area, Turkey (Mammalia: Carnivora). ZOOLOGY IN THE MIDDLE EAST 52:11-16.

Field observations, interviews with local people and Forestry Department workers and camera trapping were used to determine the status of wolves in the Beydaglari Mountains and surroundings. Following interview data, camera traps were placed at 17 stations between 1100 and 1900 m asl, in Ciglikara Nature Protected Area (NPA) and were maintained for 1031 camera days, from 29 May to 25 September 2009. Wolf pictures were taken during the time period of 20:00 and 06:00 hours and at the altitude of 1600-1800 in asl The population density of wolves was 0.9 individual per 100 KM^2 in the trapping polygon, with a buffer area of 445.5 KM^2 calculated using Geographic Information System (GIS). Ciglikara NPA regularly hosts a wolf population in the Beydaglari region due to anthropogenic barriers, topological barriers (high mountain ranges) and habitat preferences. The other areas of the Beydaglari region have human structures such as villages, roads, farmland, high platehouses, etc, that negatively affect the wolf distribution pattern.

Amico, GC, Rodriguez-Cabal, MA, Aizen, MA. 2011. Geographic variation in fruit colour is associated with contrasting seed disperser assemblages in a south-Andean mistletoe. ECOGRAPHY 34(2):318-326.

Fruit colour influences fruit choice by seed dispersers. The mistletoe *Tristerix corymbosus* (Loranthaceae) produces mature fruits of two different colours in two different biomes: yellow in the Chilean matorral and green in the temperate forest of southern South America. We conducted field surveys to establish the association between fruit colour and disperser identity throughout the entire geographical range of *T. corymbosus*. We selected 22 populations, eight of which were located in the Chilean matorral and

14 in the temperate forest south of the matorral. To identify the seed dispersers of the mistletoe we used direct observation, camera traps, and live-trapping of small mammals. We also report experiments to assess fruit selection by seed dispersers based on differences in colour. The assemblages of dispersers of *T. corymbosus* differ between the two biomes: yellow fruits in Chilean matorral are exclusively dispersed by three bird species while green fruits in the temperate forest are exclusively dispersed by a marsupial. The differences in the assemblages of seed dispersers can be explained by differences in food-finding strategies between the two assemblages. Green fruits in temperate forest are not easily detected by birds, while colour might not be an important cue for the marsupial because it is nocturnal and uses other senses to locate food. We propose that the association between the marsupial and the green-fruited mistletoe constitutes an ecological fitting rather than the outcome of a co-evolutionary process. The marsupial might have allowed the mistletoe *T. corymbosus* to retain green coloration in mature fruit, a condition to which it is preadapted by a slower ripening process in temperate forest populations.

Andanje, SA, Bowkett, AE, Agwanda, BR, Ngaruiya, GW, Plowman, AB, Wacher, T, Amin, R. 2011. A new population of the Critically Endangered Aders' duiker *Cephalophus adersi* confirmed from northern coastal Kenya. ORYX 45(3):444-447.

Aders' duiker *Cephalophus adersi* is a small antelope endemic to the coastal forests of east Africa. Threatened by habitat loss and hunting, the species is categorized as Critically Endangered on the IUCN Red List. Until recently Aders' duiker was known to persist only on Zanzibar, Tanzania, and in the Arabuko-Sokoke Forest National Reserve, Kenya. However, in 2004 a sighting of a single individual was reported from the Dodori forest in northern coastal Kenya, raising the possibility that the species survives elsewhere. Subsequently, anopportunistic camera-trap survey was conducted in September and October 2008 to establish the occurrence of Aders' duiker in Kenyan coastal forests north of the Tana River. One hundred and fifty six images of Aders' duikers were obtained from 12 of

28 camera-trap sites (46 of 358 camera-trap days), confirming the existence of a population of Aders' duiker in the Boni-Dodori forest both inside and outside the National Reserves. In addition, we sighted individuals of the species on three occasions. The relatively high encounter rates per unit effort compared to similar data from Arabuko-Sokoke forest suggest the Boni-Dodori population is significant. Initial surveys of the local Awer community revealed that Aders' duiker is well known by the name guno. These findings significantly improve the conservation prospects for Aders' duiker and highlight the need for greater research and management efforts in the poorly known Boni-Dodori forest.

Araldi, A, Zambarda, A, Giacoma, C, Gamba, M. 2011. Primates as Leopards' Prey in Western Soutpansberg, South Africa. FOLIA PRIMATOLOGICA 82(4-5):269-270.

NO ABSTRACT

Arzate, EM, Davalos, LII, Gonzalez, CAL. 2011. High elevation records of ocelots (Leopardus pardalis) in Jalisco, Mexico. MAMMALIA 75(4)387-388.

NO ABSTRACT

Bengsen, A, Butler, J, Masters, P. 2011. Estimating and indexing feral cat population abundances using camera traps. WILDLIFE RESEARCH 38(8):732-739.

Context. The ability to monitor changes in population abundance is critical to the success of pest animal management and research programs. Feral

cats (*Felis catus*) are an important pest animal, but current monitoring techniques have limited sensitivity or are limited in use to particular circumstances or habitats. Recent advances in camera-trapping methods provide the potential to identify individual feral cats, and to use this information to estimate population abundances using capture-mark-recapture (CMR) methods.

Aims. Here, we use a manipulative study to test whether camera-trapping and CMR methods can be used to estimate feral cat abundances.

Methods. We established a grid of infrared cameras and lure stations over three pastoral properties on Kangaroo Island, Australia, for 15 days. We then reduced the population abundance with an intensive trapping program and repeated the camera survey. We estimated population abundances using robust design CMR models, and converted abundance estimates to densities using home-range data from GPS tracking. We also calculated relative abundance indices from the same data.

Key results. The CMR methods produced credible estimates of the change in population abundance, with useful confidence intervals, showing a statistically identifiable population decline from at least 0.7 cats km^{-2} before trapping down to 0.4 cats km^{-2} after trapping. The indexing method also showed a statistically identifiable decrease in abundance.

Conclusions. Camera-trapping and CMR methods can provide a useful method for monitoring changes in the absolute abundance of feral cat populations. Camera-trap data may also be used to produce indices of relative abundance when the assumptions of CMR models cannot be met.

Implications. These methods are widely applicable. The ability to reliably estimate feral cat abundances allows for more effective management than is generally available.

Bengsen, AJ, Leung, LKP, Lapidge, SJ, Gordon, IJ. 2011. Using a General Index Approach to Analyze Camera-Trap Abundance Indices. JOURNAL OF WILDLIFE MANAGEMENT 75(5)1222-1227.

The lack of variance estimates constrain the utility of abundance indices calculated from camera-trap data. We adapted a General Index model, which allows variance estimation, to analyze camera-trap observations of feral pigs (*Sus scrofa*) for population monitoring in a tropical rainforest. We tested whether the index would respond to population manipulation, and found that it decreased by 57% following removal of 24 pigs and remained low in the following period. Our method is useful for monitoring other large animals in difficult landscapes, and the model can be used to enhance the value of existing data sets.

Benitez-Lopez, A, Mougeot, F, Martin, CA, Casas, F, Calero-Riestra, M, Garcia, JT, Vinuela, J. 2011. An improved night-lighting technique for the selective capture of sandgrouse and other steppe birds. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 57(2):389-393.

The night-lighting technique is routinely used to catch birds. We improved this technique using a thermal infrared camera to catch steppe birds such as the sandgrouse. Target birds were located by an observer using the thermal camera, and approached and dazzled by another observer carrying a spotlight attached to a helmet and a hand-held net together with a playback noise to camouflage the footsteps of the observer. Using this improved technique, we caught on average 1.14 individuals per 3-h capture session (N = 81) and a total of 92 sandgrouse in 2007-2010 (86 pin-tailed sandgrouse Pterocles alchata and six black-bellied sandgrouse Pterocles orientalis). Capture rate and success were negatively influenced by moonlight (lowest during full moon nights). Our night-lighting technique is a highly selective and harmless method to capture sandgrouse and can be used for other small/medium-sized open-land birds or mammals.

Burton, AC, Sam, MK, Kpelle, DG, Balangtaa, C, Buedi, EB, Brashares, JS. 2011. Evaluating persistence and its predictors in a West African carnivore community. BIOLOGICAL CONSERVATION 144(9):2344-2353.

Carnivore extinctions frequently have cascading impacts through an ecosystem, so effective management of ecological communities requires an understanding of carnivore vulnerability. This has been hindered by the elusive nature of many carnivores, as well as a disproportionate focus on large-bodied species and particular geographic regions. We use multiple survey methods and a hierarchical multi-species occupancy model accounting for imperfect detection to assess extinction risk across the entire carnivore community in Ghana's Mole National Park, a poorly studied West African savanna ecosystem. Only 9 of 16 historically occurring carnivore species were detected in a camera-trap survey covering 253 stations deployed for 5469 trap days between October 2006 and January 2009, and our occupancy model indicated low overall likelihoods of false absence despite low per-survey probabilities of detection. Concurrent sign, call-in, and village surveys, as well as long-term law enforcement patrol records, provided more equivocal evidence of carnivore occurrence but supported the conclusion that many carnivores have declined and are likely functionally or fully extirpated from the park, including the top predator, lion (*Panthera leo*). Contrary to expectation, variation in carnivore persistence was not explained by ecological or life-history traits such as body size, home range size or fecundity, thus raising questions about the predictability of carnivore community disassembly. Our results imply an urgent need for new initiatives to better protect and restore West Africa's embattled carnivore populations, and they highlight a broader need for more empirical study of the response of entire carnivore communities to anthropogenic impact.

Campbell, G, Boesch, C, Mundry, R, Kuehl, H. 2011. Remotely Monitoring Chimpanzee Populations Using Camera-Traps. FOLIA PRIMATOLOGICA 82(6):350-350.

NO ABSTRACT

Can, OE, Kandemir, I, Togan, I.2011. The wildcat *Felis silvestris* in northern Turkey: assessment of status using camera trapping. ORYX 45(1):112-118.

The wildcat *Felts silvestris* is a protected species in Turkey but the lack of information on its status is an obstacle to conservation initiatives. To assess the status of the species we interviewed local forestry and wildlife personnel and conducted field surveys in selected sites in northern, eastern and western Turkey during 2000-2007. In January-May 2006 we surveyed for the wildcat using 16 passive infrared-trigged camera traps in Yaylacik Research Forest, a 50-KM^2 forest patch in Yenice Forest in northern Turkey. A total sampling effort of 1,200 camera trap days over 40 KM^2 yielded photo-captures of eight individual wildcats over five sampling occasions. Using the software MARK to estimate population size the closed capture-recapture model M(0), which assumes a constant capture probability among all occasions and individuals, best fitted the capture history data. The wildcat population size in Yaylacik Research Forest was estimated to be 11 (confidence interval 9-23). Yenice Forest is probably one of the most important areas for the long-term conservation of the wildcat as it is the largest intact forest habitat in Turkey with little human presence, and without human settlements, and with a high diversity of prey species. However, it has been a major logging area and is not protected. The future of Yenice Forest and its wildcat population could be secured by granting this region a protection status and enforcing environmental legislation.

Carver, BD, Kennedy, ML, Houston, AE, Franklin, SB. 2011. Assessment of temporal partitioning in foraging patterns of syntopic Virginia opossums and raccoons. JOURNAL OF MAMMALOGY 92(1):134-139.

Temporal partitioning in foraging patterns of syntopic Virginia opossums (*Didelphis virginiana*) and raccoons (*Procyon lotor*) was investigated at 3 sites in western Tennessee through the use of timers attached to live traps on trapping grids and through time-stamped remote photography using infrared-triggered cameras at bait stations. Data were analyzed using Watson's U^2-test, chi-square analyses, and probability tests. Results revealed no intraspecific differences in time of foraging for either species and a lack of interspecific differentiation. A high degree of overlap in foraging times of the species was observed. Virginia opossums and raccoons apparently did not partition their times of foraging. Foraging patterns of each species seem to be independent of the other (neutral association).

Cheyne, SM, Macdonald, DW. 2011. Wild felid diversity and activity patterns in Sabangpeat-swamp forest, Indonesian Borneo. ORYX 45(1):119-124.

A study to identify the felid biodiversity of the SabangForest, Central Kalimantan, Indonesia, was initiated in May 2008 and involved continuous sampling until October 2009. A total of 44 cameras in 27 locations were used and 5,777 functional trap nights (of 6,542 survey nights) resulted in confirmed sightings of the Sunda clouded leopard *Neofelis nebulosa*, leopard cat *Prionailurus bengalensis*, marbled cat *Pardofelis marmorata* and flatheaded cat *Prionailurus planiceps*, representing four of the five wild felids of Borneo. The long-term use of fixed and roving cameras provided insight into the movements, occurrence and activity patterns of these elusive felids within a disturbed peat-swamp forest. In an area of 145 KM^2 (including buffer) the clouded leopard was the most commonly photographed felid (22 photo-captures of 53 total captures), followed by the leopard cat (21), flat-headed cat (7) and marbled cat (3). A total of 231 camera-trap nights were required to obtain the first photograph of a felid, the leopard cat, 704 for the clouded leopard, 3,498 for the flat-headed cat, and 5,423 (476 calendar days) for the marbled cat. A female clouded leopard was not photographed until 5,764 trap nights. This highlights the importance of long-term camera-trapping studies to maximize capture

probability of these elusive felids and especially to account for potential differences in home range size and use by clouded leopard males and females.

Collen, B, Howard, R, Konie, J, Daniel, O, Rist, J. 2011. Field surveys for the Endangered pygmy hippopotamus *Choeropsis liberiensis* in Sapo National Park, Liberia. ORYX 45(1):35-37.

Conservation of a threatened species is reliant upon good quality monitoring information to provide population estimates and trends to inform management practices. Surveying to establish such data can be costly and difficult, particularly for cryptic species in forest habitats. We therefore used remotely triggered cameras to survey for the presence of the pygmy hippopotamus *Choeropsis liberiensis* in Sapo National Park in Liberia. In 1,247 trap days we obtained seven camera-trap photographs, the first photographic records of the species in Liberia. Habitat destruction, principally from illegal gold mining, is the greatest threat to the persistence of the pygmy hippopotamus within the Park. A range-wide survey of the pygmy hippopotamus is required to establish a robust baseline from which future conservation efforts can be developed. Understanding how this species is able to cope with the effects of habitat fragmentation across its range, and controlling commercial hunting, will dictate how it is able to survive the ongoing pressures of land conversion in West Africa.

Davis, ML, Kelly, MJ, Stauffer, DF. 2011. Carnivore co-existence and habitat use in the Mountain Pine Ridge Forest Reserve, Belize. ANIMAL CONSERVATION 14(1):56-65.

To protect and manage an intact neotropical carnivore guild, it is necessary to understand the relative importance of habitat selection and intraguild competition to the ecology of individual species. This study examined

habitat use of four carnivores in the Mountain Pine Ridge Forest Reserve, Belize. We calculated photographic trap success (TS) rates for jaguars *Panthera onca*, pumas *Puma concolor*, ocelots *Leopardus pardalis*, grey foxes *Urocyon cinereoargenteus*, potential prey and humans at 47 remote camera stations spaced along roads and trails within the 139 km2 study site. At each station, we used manual habitat sampling in combination with geographic information systems to estimate habitat characteristics pertaining to vegetation cover. We used negative binomial models to analyse species-specific TS as a response to habitat (including vegetation and landscape variables, prey activity and human activity) and co-predator activity rates. Jaguars [TS=7.56 ± 1.279 (se) captures per 100 trap-nights (TN)] and grey foxes (31.5 ± 6.073 captures per 100 TN) were commonly captured by cameras, while pumas (0.66 ± 0.200 captures per 100 TN) and ocelots (0.55 ± 0.209 captures per 100 TN) were rare. Model selection via Akaike's information criterion (AIC) revealed that models including habitat variables generally performed better than models including co-predator activity. Felid captures were positively associated with small bird TS and with the width or length of surrounding roads, while fox counts showed few habitat associations. Ocelot activity was positively related to jaguar captures, an effect probably explained by their shared preference for areas with more roads. Pumas were negatively related to human activity and jaguars showed a similar, though non-significant, trend, suggesting that these felids may be sensitive to human disturbance even within protected areas. Results suggest that these predators do not spatially partition habitat and that the jaguar could function as an umbrella species for smaller sympatric carnivores.

de la Torre, JA, Medellin, RA. 2011. Jaguars *Panthera onca* in the Greater Lacandona Ecosystem, Chiapas, Mexico: population estimates and future prospects ORYX 45(4):546-553.

Jaguar *Panthera onca* populations have declined severely in Mexico because of habitat loss and poaching of the species and its natural prey. One of the most important, but poorly known, populations of the jaguar

remaining in Mexico resides in the Greater Lacandona Ecosystem in Chiapas. Our objective was to determine the density of jaguars in southern Montes Azules Biosphere Reserve and to estimate population size inside the Natural Protected Areas of this Ecosystem. Jaguar densities were estimated during the dry and rainy seasons of 2007 and the dry season of 2008 using camera-trapping combined with closed capture-recapture models. The lowest density estimate was recorded during the 2007 dry season (1.7 ± SE 0.7 per 100 KM^2) and the highest during the 2008 rainy season (4.6 ± SE 1.6 per too KM^2). Estimating the extent of potential jaguar habitat in the Natural Protected Areas and extrapolating density estimates to these reserves indicates that they could support 62-168 jaguars. This result highlights the potential importance of this Ecosystem for the conservation of the jaguar in the Mayan Forest and Mexico. The implementation of measures to secure the long-term conservation of this population and jaguar population connectivity in the Mayan Forest is urgently required.

Easton, J, Chao, N, Mulindahabi, F, Ntare, N, Rugyerinyange, L, Ndikubwimana, I. 2011. Status and conservation of the only population of the Vulnerable owl-faced monkey *Cercopithecus hamlyni* in Rwanda. ORYX 45(3):435-438.

The elusive, Vulnerable owl-faced monkey *Cercopithecus hamlyni* is a rare and little studied species and one of the least known of the African Cercopithecidae. This study describes the distribution and relative abundance of the only known population in East Africa, in Nyungwe National Park, Rwanda. This species is restricted to a small (32 KM^2) area of bamboo and bamboo-forest mix in the southern sector of the Park, close to the international border with Burundi. We present the first empirical data of its abundance in the bamboo forests of Nyungwe. A total length of 185 km of transect were surveyed to estimate relative abundance of diurnal primates. Encounter rates with the owl-faced monkey were 0.081 groups km^{-1} (n = 15). Mean group size was 3.6 individuals. Eight independent photographs of C. hamlyni were obtained from five camera traps during 182 camera-days. Four other species of primates occur in the bamboo

forest: eastern chimpanzee *Pan troglodytes schweinfurthii*, Angola colobus *Colobus angolensis*, L'Hoest's monkey *Cercopithecus l'hoest* and blue monkey *Cercopithecus mitis*. The main threats to the bamboo forest are from the illegal harvesting of bamboo, trapping and tree-cutting. These threats originate from both Rwanda and Burundi. There is an urgent need for conservation action to halt the destruction and degradation of the bamboo forest and to ensure the long-term survival of the owl-faced monkey in Rwanda.

Efford, MG. 2011. Estimation of population density by spatially explicit capture-recapture analysis of data from area searches. ECOLOGY 92(12):2202-2207.

The recent development of capture-recapture methods for estimating animal population density has focused on passive detection using devices such as traps or automatic cameras. Some species lend themselves more to active searching: a polygonal plot may be searched repeatedly and the locations of detected individuals recorded, or a plot may be searched just once and multiple cues (feces or other sign) identified as belonging to particular individuals. This report presents new likelihood-based spatially explicit capture-recapture (SECR) methods for such data. The methods are shown to be at least as robust in simulations as an equivalent Bayesian analysis, and to have negligible bias and near-nominal confidence interval coverage with parameter values from a lizard data set. It is recommended on the basis of simulation that plots for SECR should be at least as large as the home range of the target species. The R package "secr" may be used to fit the models. The likelihood-based implementation extends the spatially explicit analyses available for search data to include binary data (animal detected or not detected on each occasion) or count data (multiple detections per occasion) from multiple irregular polygons, with or without dependence among polygons. It is also shown how the method may be adapted for detections along a linear transect.

Espartosa, KD, Pinotti, BT, Pardini, R. 2011. Performance of camera trapping and track counts for surveying large mammals in rainforest remnants. BIODIVERSITY AND CONSERVATION 20(12):2815-2829.

Getting information on terrestrial large mammals is particularly difficult in tropical rainforests and in altered landscapes, since the traditionally used method (line-transect census) presents low efficiency in dense vegetation, and is difficult to standardize among heterogeneous, fragmented areas where the small size of patches restricts the length of transects. Aiming to generate information to guide the choice of field protocols for surveying terrestrial large mammals in heterogeneous rainforest remnants, we compared the performance and the correlation between the results of two alternative techniques (track counts and camera trapping), and of two types of bait, in 24 forest remnants in a fragmented Atlantic forest landscape. Techniques resulted in similar observed and estimated richness and species composition at the study landscape, including medium-sized and nocturnal species usually poorly represented in line-transect censuses. Although camera trapping resulted in a higher recording rate of the most common species (*Didelphis aurita*) and track counts in higher recording rates of some less common species (e. g. *Dasypus novemcinctus*), observed richness and recording rates of most species were correlated across the 24 sites between techniques. Conversely, the use of different baits strongly influenced results, indicating the importance of standardizing baits in comparative studies. Our results suggest that the two alternative techniques present similar performance and are suitable for studying the factors affecting the distribution of large mammals in altered rainforest landscapes. The choice of field protocols should then focus on the available resources and infrastructure, and on particularities of the study area.

Fegraus, EH, Lin, K, Ahumada, JA, Baru, C, Chandra, S, Youn, C. 2011. Data acquisition and management software for camera trap data: A case study from the TEAM Network. ECOLOGICAL INFORMATICS 6(6):345-353.

Camera traps and the images they generate are becoming an essential tool for field biologists studying and monitoring terrestrial animals, in particular medium to large terrestrial mammals and birds. In the last five years, camera traps have made the transition to digital technology, where these devices now produce hundreds of instantly available images per month and a large amount of ancillary metadata (e.g., date, time. temperature, image size, etc.). Despite this accelerated pace in the development of digital image capture, field biologists still lack adequate software solutions to process and manage the increasing amount of information in a cost efficient way. In this paper we describe a software system that we have developed, called DeskTEAM, to address this issue. DeskTEAM has been developed in the context of the Tropical Ecology Assessment and Monitoring Network (TEAM), a global network that monitors terrestrial vertebrates. We describe the software architecture and functionality and its utility in managing and processing large amounts of digital camera trap data collected throughout the global TEAM network. DeskTEAM incorporates software features and functionality that make it relevant to the broad camera trapping community. These include the ability to run the application locally on a laptop or desktop computer, without requiring an Internet connection, as well as the ability to run on multiple operating systems; an intuitive navigational user interface with multiple levels of detail (from individual images, to whole groups of images) which allows users to easily manage hundreds or thousands of images; ability to automatically extract EXIF and custom metadata information from digital images to increase standardization; availability of embedded taxonomic lists to allow users to easily tag images with species identities; and the ability to export data packages consisting of data, metadata and images in standardized formats so that they can be transferred to online data warehouses for easy archiving and dissemination. Lastly, building these software tools for wildlife scientists provides valuable lessons for the ecoinformatics community.

Figel, JJ, Duran, E, Bray, DB. 2011. Conservation of the jaguar *Panthera onca* in a community-dominated landscape in montane forests in Oaxaca, Mexico. ORYX 45(4):554-560.

We examined the presence of the jaguar *Panthera onca*, and human-jaguar interactions, in a community-dominated montane tropical forest landscape with formally recognized indigenous/community conserved areas in the Sierra Norte of Oaxaca state, Mexico. We used camera traps to detect jaguars, and social data were collected through informal interviews and 46 semistructured and 106 structured interviews with community leaders and members. During June 2007-June 2008 camera traps registered two jaguars in the four study communities after 1,164 trap nights, with a photo-capture rate of 7.8 jaguar captures per b000 trap nights. Interviews documented 86 jaguar sightings since 1990. Despite some history of livestock predation, 68% of the interviewed farmers indicated jaguar presence was positive, 20% that jaguar presence was both positive and negative, and 12% thought jaguars were a negative presence. All of the respondents with negative attitudes had either owned cattle previously or lost cattle to predation. Despite ongoing risks to jaguars the emergence of community-conserved areas, local conservation initiatives, and a community-imposed hunting ban are supported by 93% of community members. An emerging culture of conservation in the study communities suggests there is an opportunity for jaguar conservation on community lands that should be explored elsewhere in jaguar range countries.

Franco, M, Quijano, A, Soto-Gamboa, M. 2011. Communal nesting, activity patterns, and population characteristics in the near-threatened monito del monte, *Dromiciops gliroides*. JOURNAL OF MAMMALOGY 92(5):994-1004.

The "living fossil," *Dromiciops gliroides* (monito del monte), is an endemic marsupial inhabiting the temperate rain forests of South America. It is

cavity-dependent and faces high energetic costs associated with thermoregulation during the austral winter. Although *D. gliroides* is well known for seed dispersal in temperate rain forests, its ecology, behavior, and long-term population dynamics have received little attention. We monitored a population of *D. gliroides* and studied variation in abundance and density and seasonal changes in body mass and body condition index (BCI). In addition, we monitored activity and communal nesting with camera traps and nest boxes, respectively. Over 4 years we documented a mean population density of 26 (95% confidence interval 5 19-32) individuals/ha. We found significantly greater body mass and BCI for females than for males, suggesting different energetic strategies during the prehibernation period. Animals were nocturnal and active until dawn. Communal nesting occurred during summer and early fall, but torpor by single individuals and small groups was increasingly frequent during winter. Communal nesting could be a key behavioral strategy affecting survival. However, given the greater frequency in warm seasons and groups composed of postreproductive females and juveniles, communal nesting might be more related to parental care associated with kin selection than to thermoregulation.

Garrote, G, de Ayala, RP, Pereira, P, Robles, F, Guzman, N, Garcia, FJ, Iglesias, MC, Hervas, J, Fajardo, I, Simon, M, Barroso, JL. 2011. Estimation of the Iberian lynx (*Lynx pardinus*) population in the Doana area, SW Spain, using capture-recapture analysis of camera-trapping data. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 57(2):355-262.

The Iberian lynx (Lynx pardinus) has a highly restricted geographic distribution, limited even within the Iberian Peninsula. The last national survey reported less than 200 remaining individuals, distributed in two isolated areas-AndA(0)jar-Cardea and Doana-and in consequence, the Iberian lynx was listed by the International Union for Conservation of Nature as "Critically Endangered". In this study, we estimate the Iberian lynx population size in the Doana area using capture-recapture analysis of camera-trapping data. A model with different capture probability for each

individual (M-h) yielded an estimate of 26 Iberian lynxes (SE = 5.26) more than 1 year old. It is considered that a small slant in the estimation of the number of individuals could exist due to the presence of dispersers inside the study area that were not detected. Our study shows: (1) a reduction in number since the 1980s (45 individuals), and falling below the theoretical threshold of genetic viability, (2) changes in the species' spatial distribution in this area, and (3) as for other carnivore species, photographic capture-recapture methods are applicable for estimating the size of Iberian lynx populations.

Garshelis, DL. 2011. Andean bear density and abundance estimates - How reliable and useful are they? URSUS 22(1):47-64.

Few attempts have been made to estimate numbers and densities of Andean bears (*Tremarctos ornatus*). It is understandable that the many challenges involved in these efforts have made it difficult to produce rigorous estimates. A crude estimate of similar to 20,000 Andean bears was derived by extrapolating the lowest observed density of American black bears (*Ursus americanus*) across the range of Andean bears. A second estimate, based on rangewide genetic diversity, produced a wide range of values; however, the low end of the confidence interval roughly matched the population estimate based on minimum black bear density. A mark-recapture analysis of 3 camera-trapped bears in Bolivia also yielded a similar density (4.4-6 bears/100 KM^2), but overlapping home ranges of 2 radiocollared bears at that same site suggested a higher density (>= 12 bears/100 KM^2). Neither of these estimates can be considered reliable or representative of the wider population because of the small sample sizes. Moreover, the effective sampling area for the camera-trapping study was uncertain. A DNA hair-trapping mark-recapture study in Ecuador sampled a greater number of bears (n = 25) within a larger study area, but a male-biased sex ratio suggested that closure was violated, precluding a simple estimate of density based on the area of the trapping grid. Also, low capture rates in what was perceived (from incidence of bear sign) as prime bear habitat might be indicative of a sampling bias. These issues are not

simply incorporated into confidence intervals (CIs): CIs only include uncertainty due to sampling error, not biased sampling or an ambiguous sampling area. Whereas these (low density) estimates may provide guidance for conservation, their greatest usefulness may be in providing directions for improvement of future studies of Andean bears, as well as bears in Asia, which also lack rigorous population estimates.

Gil-Sanchez, JM, Moral, M, Bueno, J, Rodriguez-Siles, J, Lillo, S, Perez, J,

Martin, JM, Valenzuela, G, Garrote, G, Torralba, B, Simon-Mata, MA. 2011. The use of camera trapping for estimating Iberian lynx (*Lynx pardinus*) home ranges. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 57(6):1203-1211.

The use of non-invasive long-term monitoring data to estimate home ranges of the critically endangered Iberian lynx has been evaluated. This programme began in 2002 and consisting of both annual latrine and camera-trap surveys, with the aims of detecting and individually identifying the maximum number of individuals and delineating female home range boundaries. Radio-tracking data were used to evaluate the accuracy of home range estimates constructed with camera-trapping data. There was little overlap of camera-trapping home ranges (7.0% ± 1.47), which suggests the existence of real territories consistent with the land tenure system expected for the species. Camera trapping home range estimates were half the size of radio-tracking data (54.1% ± 6.0 of overlapping). When comparing core areas, only the radio-tracking data did not yield improved results (36.7 ± 5.4 of overlapping). Estimation of territories, which escaped detection each year, ranged from 0.0% to 5.7%. The results produced by camera-trapping data in this non-intrusive monitoring programme could be considered precise, and are therefore well suited to provide the knowledge required for appropriate conservation of this endangered species.

Gormley, AM, Forsyth, DM, Griffioen, P, Lindeman, M, Ramsey, DSL, Scroggie, MP, Woodford, L. 2011. Using presence-only and presence-absence data to estimate the current and potential distributions of established invasive species. JOURNAL OF APPLIED ECOLOGY 48(1):25-34.

1. Predicting the current and potential distributions of established invasive species is critical for evaluating management options, but methods for differentiating these distributions have received little attention. In particular, there is uncertainty among invasive species managers about the value of information from incidental sightings compared to data from designed field surveys. This study compares the two approaches, and develops a unifying framework, using the case of invasive sambar deer Cervus unicolor in Victoria, Australia.

2. We first used 391 incidental sightings of sambar deer and 12 biophysical variables to construct a presence-only habitat suitability model using Maxent. We then used that model to stratify field sampling, with proportionately greater sampling of cells with high predicted habitat suitability. Field sampling, consisting of faecal pellet surveys, sign surveys and camera trapping, was conducted in 80 4-km^2 grid cells. A Bayesian state-space occupancy model was used to predict probability of suitable habitat from the field data.

3. The Maxent and occupancy models predicted similar spatial distributions of habitat suitability for sambar deer in Victoria and there was a strong positive correlation between the rankings of cells by the two approaches. The congruence of the two models suggests that any spatial and detection biases in the presence-only data were relatively unimportant in our study.

4. We predicted the extent of suitable habitat from the occupancy model using a threshold that gave a false negative error rate of 0 center dot 05. The current distribution was the suitable habitat within a kernel that had a 99 center dot 5% chance of including the presence locations pooled from incidental sightings and field surveys: the potential distribution was suitable habitat outside that kernel. Several discrete areas of potential distribution

were identified as priorities for surveillance monitoring with the aim of detecting and managing incursions of sambar deer.

5. Synthesis and applications. Our framework enables managers to robustly estimate the current and potential distributions of established invasive species using either presence-only and/or presence-absence data. Managers can then focus control and/or containment actions within the current distribution and establish surveillance monitoring to detect incursions within the potential distribution.

Gray, TNE, Phan, C. 2011. Habitat preferences and activity patterns of the larger mammal community in Phnom Prich Wildlife Sanctuary, Cambodia. RAFFLES BULLETIN OF ZOOLOGY 59(2):311-318.

The northern and eastern plains of Cambodia support one of the largest extents of lowland deciduous forest in South-east Asia and are globally significant for mammal conservation. Between Dec.2008 and Aug.2009 intensive camera-trapping was conducted within mosaic deciduous dipterocarp and mixed-deciduous/semi-evergreen forest in the east of Phnom Prich Wildlife Sanctuary, Mondulkiri province, Cambodia. Forty camera-trap locations were set up for >2700 camera-trap nights producing 707 independent encounters of 23 mammal species. Eight globally threatened species of mammals were recorded including the Asian elephant (*Elephas maximus*), banteng (*Bos javanicus*) and dhole (*Cuon alpinus*). Two species, the gaur (*Bos gaurus*) and pig-tailed macaque (*Macaca nemestrina*), showed significant preference for forest type (higher Relative Abundance Index of both species in mixed-deciduous/semi-evergreen forest). The mix of drier deciduous dipterocarp forest and wetter mixed-deciduous and semi-evergreen forest appears important for maintaining the conservation value of the site. Camera trap encounter rates were lower in areas within a day's walk from villages at the periphery of the protected area whilst cathemeral species displayed higher proportions of nocturnal

activity than in similar studies from elsewhere in South-east Asia. We suggest disturbance and hunting may therefore be affecting the distribution and activity patterns of key species. Managing the Non Timber Forest Product (NTFP) collectors as well as finalising, and enforcing, zonation within the protected area are recommended conservation measures for the mammal community.

Guillera-Arroita, G, Morgan, BJT, Ridout, MS, Linkie, M. 2011. Species Occupancy Modeling for Detection Data Collected Along a Transect. JOURNAL OF AGRICULTURAL BIOLOGICAL AND ENVIRONMENTAL STATISTICS 16(3):301-317.

The proportion of sampling sites occupied by a species is a concept of interest in ecology and biodiversity conservation. Occupancy surveys based on collecting detection data along transects have become increasingly popular to monitor some species. To date, the analysis of such data has been carried out by discretizing the data, dividing the transects into discrete segments. Here we propose alternative occupancy models which describe the detection process as a continuous point process. These models provide a more natural description of the data and eliminate the need to divide transects into segments, which can be arbitrary and may lead to increased bias in the estimator of occupancy or increased chances of obtaining estimates on the boundary of the parameter space. We present a model that assumes independence between detections and an alternative model that describes the detection process as a Markov modulated Poisson process to account for potential clustering in the detections. The utility of these models is illustrated with the analysis of data from a recent survey of the Sumatran tiger *Panthera tigris sumatrae*. The models can also be applied to surveys that collect continuous data in time, such as those based on the use of camera-trap devices.

Gonzalez-Maya, JF, Cardenal-Porras, J. 2011. Ocelot density in the Carribean slope of the Talamanca region, Costa Rica. HYSTRIX-ITALIAN JOURNAL OF MAMMALOGY 22(2):355-360.

Ocelot *Leopardus pardons* is one of the most widespread species in America. Nevertheless, its ecology, distribution and population status are not well known in several countries, including Costa Rica. Here we present the first published population density estimations in Costa Rica and the first effort for the Caribbean slope of the country. Using camera-trapping, we estimated ocelot density through capture-recapture analysis within the Talamanca-Caribbean Biological Corridor. An abundance of 8 and 5 individuals were estimated by Mo and Mh models, respectively. Based on previous home-range studies, three Effective Sampling Areas (ESA) were used to estimate absolute density. Density was calculated in 8.95, 10.33 and 11.61 individuals (Mo model) and 5.59, 6.45 and 7.25 (Mh model) individuals x 100 km^{-2} for the maximum, mean and minimum ESA estimates, respectively. Gross extrapolations of the expected population size indicate a low abundance and co-dependence between the corridor and surrounding areas for the long term maintenance of the species in the region.

Hariyadi, ARS, Priambudi, A, Setiawan, R, Daryan, D, Yayus, A, Purnama, H. 2011. Estimating the population structure of Javan rhinos (*Rhinoceros sondaicus*) in Ujung Kulon National Park using the mark-recapture method based on video and camera trap identification. PACHYDERM 49:90-99.

The population structure of the Javan rhino (*Rhinoceros sondaicus*) in Ujung Kulon National Park (NP) in Banten, Indonesia was assessed using visual identification and mark-recapture estimation. The software program CAPTURE was used for selecting the best fit estimator for the mark-recapture calculation and yields M(th) as the best model. The software results delivered a mean estimation of 32 rhinos (a minimum of 29 and maximum of 47 rhinos) with a 95% confidence level based on the dataset obtained from April 2008 to September 2009. The visual identification suggests that

the current population in Ujung Kulon NP is male biased by a 3: 2 sex ratio of males versus females. The demography shows that the population consists of mainly adult individuals that have a tendency of 1% population growth per year.

Harmsen, BJ, Foster, RJ, Silver, SC, Ostro, LET, Doncaster, CP. 2011. Jaguar and puma activity patterns in relation to their main prey. MAMMALIAN BIOLOGY76(3):320-324.

Activity patterns of top predators are adapted for efficient predation, whereas their prey must contend with the conflicting demands of acquiring resources and avoiding predators. Here we analyse the activity of jaguars (*Panthera onca*) and pumas (*Puma concolor*) in relation to their most important prey species, armadillos (*Dasypus novemcinctus*) and pacas (*Agouti paca*) respectively, in the Cockscomb Basin Wildlife Sanctuary, Belize using large-scale camera-trap data. jaguars and pumas have similar 24 h activity patterns as armadillos and pacas, both burrow-dwelling species, and negligible overlap with less frequently consumed prey species such as red brocket deer (*Mazama americana*) and peccaries. Activity of armadillos and pacas varied with moon phase, with reduced activity during periods of brighter illumination, perhaps as a predator-avoidance strategy. Across the study area, moon phase had no overall influence on jaguar and puma activity; however at locations associated with armadillos, jaguar activity declined with brighter illumination, perhaps indicating a shift to alternative prey during full moon when armadillos avoided foraging above ground. No such relationship was found for pumas and moon phase at locations associated with pacas.

Harmsen, BJ, Foster, RJ, Doncaster, CP. 2011. Heterogeneous capture rates in low density populations and consequences for capture-recapture analysis of camera-trap data. POPULATION ECOLOGY 53(1):253-259.

Closed population capture-recapture analysis of camera-trap data has become the conventional method for estimating the abundance of individually recognisable cryptic species living at low densities, such as large felids. Often these estimates are the only information available to guide wildlife managers and conservation policy. Capture probability of the target species using camera traps is commonly heterogeneous and low. Published studies often report overall capture probabilities as low as 0.03 and fail to report on the level of heterogeneity in capture probability. We used simulations to study the effects of low and heterogeneous capture probability on the reliability of abundance estimates using the M(h) jack-knife estimator within a closed-population capture-recapture framework. High heterogeneity in capture probability was associated with under- and over-estimates of true abundance. The use of biased abundance estimates could have serious conservation management consequences. We recommend that studies present capture frequencies of all sampled individuals so that policy makers can assess the reliability of the abundance estimates.

Henschel, P, Hunter, LTB, Coad, L, Abernethy, KA, Muhlenberg, M. 2011. Leopard prey choice in the Congo Basin rainforest suggests exploitative competition with human bushmeat hunters. JOURNAL OF ZOOLOGY 285(1):11-20.

Analyses of leopard *Panthera pardus* prey choice reveal a strong preference for species weighing 10-40 kg. In the Congo Basin rainforests, species within this weight range are also targeted by bushmeat hunters, potentially leading to exploitative competition between leopards and hunters. We investigated leopard prey choice along a gradient of human disturbance, hypothesizing that leopards will exploit smaller prey where competition is strong, possibly resulting in reduced leopard densities at highly hunted sites. We determined leopard diet by means of scat analysis at four rainforest sites in central Gabon, which varied according to their distance from human settlements. Camera trap data collected at each of the four study sites revealed that human hunting intensity increased with

proximity to settlements, while the abundance of potential leopard prey species decreased. We found no evidence of leopards at the site nearest to settlements. At the remaining sites, the number of scats collected, mean leopard prey weight and the proportion of large prey (420 kg) in leopard diet increased with distance from settlements. Camera trap data demonstrated that leopard population density increased with distance from settlements, from 2.7 perpendicular to 0.94 leopards/100 KM^2 to 12.1 perpendicular to 5.11 leopards/100 KM^2. Our results document an increasing use of smaller prey species and a decrease in leopard density in proximity to settlements, supporting our hypothesis. Comparison of leopard diet with hunter return data revealed a high dietary niche overlap between leopards and hunters at sites situated at similar distances from settlements. Our results suggest that bushmeat hunting may precipitate the decline in leopard numbers through exploitative competition and that intensively hunted areas are unlikely to support resident leopard populations. Conserving the leopard in the Congo Basin will rely on effective protected areas and alternative land.

Hernandez-Guzman, A, Payan, E, Monroy-Vilchis, O. 2011. Food habits of *Puma concolor* (Carnivora: Felidae) in the Parque Nacional Natural Purace, Colombia. REVISTA DE BIOLOGIA TROPICAL 59(3):1285-1294.

Food habits of *Puma concolor* (Carnivora: Felidae) in the Parque Nacional Natural Purace, Colombia. Neotropical puma (*Puma concolor*) diet is scarcely known, in particular that of mountain dwelling individuals from Northern South America. This is the first study on pumas from the paramo and the first puma diet analysis for Colombia. The puma diet was studied from 2007 to 2009 in the Purace National Park in the South Colombian Andes. Paramos are unique Neotropical high altitude ecosystems which store and regulate water, and are currently threatened by agricultural expansion and climate change. Seven latrines were monitored for three years and scat collected, washed and dried. Items in scat such as hair, bones, claws and others were separated. Hairs were inspected by microscopy and compared to voucher hair museum specimens. Bone

fragments, claws and teeth were also compared to museum collections and identified wherever possible. Additionally, six cameras were set along game trails to document puma and potential prey presence in the area. Food items from five species were identified in 60 puma scats; Northern Pudu (*Pudu mephistophiles*) was the most important prey in their diet. A total of 354 camera trap-nights photographed a male and female puma, Northern pudu and Spectacled bear (Tremarctos ornatus). The main conclusion suggests a strong dependence of puma on the threatened and mysterious Northern Pudu in paramo habitats. This behavior might reflect restricted prey availability in the high Andes Mountains of Colombia, and highlights the plasticity in the puma diet. Conservation actions in the paramo should thus, focus on focal wild species, and in particularly those that show a relationship, such as the one evidenced here with the dependence of puma on Northern Pudu. These findings contribute to increase the little known ecology of Andean puma populations and the species as a whole in Colombia. Baseline data on puma prey populations in different ecosystems throughout their range, is critical to understand the regional requirements for survival, and design conservation actions, to follow and evaluate the need for particular protected areas along their geographical gradients.

Janecka, JE, Munkhtsog, B, Jackson, RM, Naranbaatar, G, Mallon, DP, Murphy, WJ. 2011. Comparison of noninvasive genetic and camera-trapping techniques for surveying snow leopards. JOURNAL OF MAMMALOGY 92(4):771-783.

The endangered snow leopard (*Panthera uncia*) is widely but sparsely distributed throughout the mountainous regions of central Asia. Detailed information on the status and abundance of the snow leopard is limited because of the logistical challenges faced when working in the rugged terrain it occupies, along with its secretive nature. Camera-trapping and noninvasive genetic techniques have been used successfully to survey this fetid. We compared noninvasive genetic and camera-trapping snow leopard surveys in the Gobi Desert of Mongolia. We collected 180 putative

snow leopard scats from 3 sites during an 8-day period along 37.74 km of transects. We then conducted a 65-day photographic survey at I of these sites, approximately 2 months after scat collection. In the site where both techniques were used noninvasive genetics detected 5 individuals in only 2 days of fieldwork compared to 7 individuals observed in the 65-day camera-trapping session. Estimates of population size from noninvasive genetics ranged between 16 and 19 snow leopards in the 314.3-KM^2 area surveyed, yielding densities of 4.9-5.9 individuals/100 KM^2. In comparison, the population estimate from the 65-day photographic survey was 4 individuals (adults only) within the 264-KM^2 area, for a density estimate of 1.5 snow leopards/100 KM^2. Higher density estimates from the noninvasive genetic survey were due partly to an inability to determine age and exclude subadults, reduced spatial distribution of sampling points as a consequence of collecting scats along linear transects, and deposition of scats by multiple snow leopards on common sites. Resulting differences could inflate abundance estimated from noninvasive genetic surveys and prevent direct comparison of densities derived from the 2 approaches unless appropriate adjustments are made to the study design.

Jenks, KE, Chanteap, P, Damrongchainarong, K, Cutter, P, Cutter, P, Redford, T, Lynam, AJ, Howard, J, Leimgruber, P. 2011. Using relative abundance indices from camera-trapping to test wildlife conservation hypotheses - an example from Khao Yai National Park, Thailand. TROPICAL CONSERVATION SCIENCE 4(2):113-131.

Khao Yai National Park (KYNP) is well known for its biodiversity and has the potential to serve as a regional model for wildlife conservation. From October 2003 through October 2007, the managers of KYNP conducted a Carnivore Conservation Project to develop and implement long-term monitoring of their large mammal populations. We present these data as an example to demonstrate the usefulness of long-term camera-trapping despite data that cannot be fitted to mark/recapture or occupancy statistical frameworks. Overall, a relatively high number of camera trap photographs was obtained for viverrids (four species; 44 photos) and ursids (two

species; 39 photos). However, a relatively low number (range, one to eight) of camera trap photographs was obtained for each of the four felid species and two canid species detected by cameras. Of a total survey effort of 6,260 trap nights, no tigers (*Panthera tigris*) were detected by camera traps, suggestive of at best a small, non-viable tiger population. Compared to previous camera-trapping efforts at KYNP, we expanded intensive sampling beyond the core area to include all zones and edges of the park. We found significantly lower relative abundance indices (RAIs) for certain mammal species, and collectively for all mammals compared to data obtained in 1999-2000 from 34 similar survey locations, suggesting population declines linked to increased human activity. Information from long-term camera-trapping can provide critical information on the occurrence of elusive species, hotspots, the role of invasive or domestic species, and an indication of the effectiveness of patrolling and other management and conservation interventions.

Jhala, Y, Qureshi, Q, Gopal, R. 2011. Can the abundance of tigers be assessed from their signs? JOURNAL OF APPLIED ECOLOGY 48(1):14-24.

1. Indices of abundance offer cost effective and rapid methods for estimating abundance of endangered species across large landscapes, yet their wide usage is controversial due to their potential of being biased. Here, we assess the utility of indices for the daunting task of estimating the abundance of the endangered tiger at landscape scales.

2. We use double sampling to estimate two indices of tiger abundance (encounters of pugmarks and scats per km searched) and calibrate those indices against contemporaneous estimates of tiger densities obtained using camera-trap mark-recapture (CTMR) at 21 sites (5185 km^2) in Central and North India. We use simple and multiple weighted regressions to evaluate relationships between tiger density and indices. A model for estimating tiger density from indices was validated by Jackknife analysis and precision was assessed by correlating predicted tiger density with CTMR density. We

conduct power analysis to estimate the ability of CTMR and of indices to detect changes in tiger density.

3. Tiger densities ranged between 0 center dot 25 and 19 tigers 100 km^{-2} were estimated with an average coefficient of variation of 13 center dot 2(SE 2 center dot 5)%. Tiger pugmark encounter rates explained 84% of the observed variability in tiger densities. After removal of an outlier (Corbett), square root transformed scat encounter rates explained 82% of the variation in tiger densities.

4. A model including pugmark and scat encounters explained 95% of the variation in tiger densities with good predictive ability (PRESS R^2 = 0.99). Overall, CTMR could detect tiger density changes of > 12% with 80% power at alpha = 0.3, while the index based model had 50% to 85% power to detect > 30% declines. The power of indices to detect declines increased at high tiger densities.

5. Synthesis and applications. Indices of tiger abundance obtained from across varied habitats and a range of tiger densities could reliably estimate tiger abundance. Financial and temporal costs of estimating indices were 7% and 34% respectively, of those for CTMR. The models and methods presented herein have application in evaluation of the abundance of cryptic carnivores at landscape scales and form part of the protocol used by the Indian Government for evaluating the status of tigers.

Jones, JPG. 2011. Monitoring species abundance and distribution at the landscape scale. JOURNAL OF APPLIED ECOLOGY 48(1):9-13.

1. The abundance and distribution of a species are affected by processes which operate at multiple scales. Large-scale dynamics are increasingly recognized in conservation responses such as metapopulation management, transfrontier protected areas and softening the agricultural matrix. Landscape-scale monitoring is needed both to inform and judge their efficacy. In this Special Profile we address some of the challenges presented by monitoring at the landscape scale, how models of species

distribution can be used to inform policy, and we discuss how monitoring at the global-scale could be approached.

2. Collecting data over a large area is inherently costly, so methods which can provide robust information at low-cost are particularly valuable. We present two papers which test low-cost approaches against more data-hungry methods (indices of abundance vs. direct density estimates, and species distribution models built from presence-only vs. presence/absence data).

3. Occupancy modelling is a useful approach for landscape-scale monitoring due to the relatively low-cost of collecting detection/non-detection data. We discuss challenges, such as non-random sampling locations and periodical unavailability for detection, in using detection/non-detection data for monitoring species distribution. Such data can also provide estimates of abundance and we show how existing models have been modified to allow the abundance of multiple species to be estimated simultaneously.

4. Models of species distribution can be used to project likely future scenarios and thus inform conservation planning where distributions are likely to change because of climate change or changing disturbance patterns. We also discuss how an optimization framework can be used to make efficient management decisions for invasive species management in the light of imperfect information.

5. Synthesis and applications. Monitoring is needed for many purposes including auditing past management decisions and informing future choices. Much monitoring data are collected at the site scale, although management authorities increasingly recognize landscape-scale dynamics. Recent global targets for conservation require monitoring which can report trends at the global-scale. Integrating data collected at a variety of scales to draw robust inference at the scale required is a challenge which deserves more attention from applied ecologists.

Jordan, MJ, Barrett, RH, Purcell, KL. 2011. Camera trapping estimates of density and survival of fishers *Martes pennant*. WILDLIFE BIOLOGY 17(3):266-276.

Developing efficient monitoring strategies for species of conservation concern is critical to ensuring their persistence. We have developed a method using camera traps to estimate density and survival in mesocarnivores and tested it on a population of fishers Martes pennanin an area of approximately 300 KM² of the southern Sierra Nevada Mountains in California. Fishers in this region are isolated from other populations by a gap of approximately 400 km, and the status of individual populations in the southern Sierra Nevada is poorly understood, making management decisions difficult. We caught fishers in live traps, marked them with ear tags, and resighted them with camera traps. We measured latency to first detection and detection rate to compare our results to previous camera trapping studies of fishers. We used the robust design Poisson log-normal mixed-effects mark-resight model to obtain annual estimates of density and apparent survival. Our values for latency to first detection and detection rate were slightly lower than those obtained by previous studies. Fishers in this isolated region occur at lower densities than at other locations across their range with only approximately 6-11 animals/100 KM². Their average annual, adult survival rate (0.94) was comparable to that found in other studies, though this parameter had very low precision. We experienced relatively high levels of tag loss in our study, suggesting our estimates of abundance are biased upward. We provide recommendations for improving the precision and accuracy of results obtained from this type of study. Our results demonstrate a novel application of mark-resight methods to estimate density and survival for mesocarnivores. These estimates provide timely information to managers about fishers at the local population level in the southern Sierra Nevada Mountains.

Kalle, R, Ramesh, T, Qureshi, Q, Sankar, K. 2011. Density of tiger and leopard in a tropical deciduous forest of Mudumalai Tiger Reserve, southern

India, as estimated using photographic capture-recapture sampling. ACTA THERIOLOGICA 56(4):335-342.

Density of tiger *Panthera tigris* and leopard *Panthera pardus* was estimated using photographic capture-recapture sampling in a tropical deciduous forest of Mudumalai Tiger Reserve, southern India, from November 2008 to February 2009. A total of 2,000 camera trap nights for 100 days yielded 19 tigers and 29 leopards within an intensive sampling area of 107 KM^2. Population size of tiger from closed population estimator model M(b) Zippin was 19 tigers (SE=+/- 0.9) and for leopards M(h) Jackknife estimated 53 (SE=+/- 11) individuals. Spatially explicit maximum likelihood and Bayesian model estimates were 8.31(SE=+/- 2.73) and 8.9 (SE=+/- 2.56) per 100 KM^2 for tigers and 13.17 (SE=+/- 3.15) and 13.01 (SE=+/- 2.31) per 100 KM^2 for leopards, respectively. Tiger density for MMDM models ranged from 6.07 (SE=+/- 1.74) to 9.72 (SE=+/- 2.94) per 100 KM^2 and leopard density ranged from 13.41 (SE=+/- 2.67) to 28.91 (SE=+/- 7.22) per 100 KM^2. Spatially explicit models were more appropriate as they handle information at capture locations in a more specific manner than some generalizations assumed in the classical approach. Results revealed high density of tiger and leopard in Mudumalai which is unusual for other high density tiger areas. The tiger population in Mudumalai is a part of the largest population at present in India and a source for the surrounding Reserved Forest.

Kapfer, JM, Gammon, DE, Groves, JD. 2011. Carrion-feeding by Barred Owls (*Strix varia*). WILSON JOURNAL OF ORNITHOLOGY 123(3):646-649.

Few documented reports exist that describe carrion-feeding by owls. We produce a conclusive record of carrion-feeding by Barred Owls (*Strix varia*) from photographs taken with a passive-infrared wildlife camera trap baited with the whole or partial carcasses of road-killed mammals (eastern gray

squirrel [*Sciurus carolinensis*] and white-tailed deer [*Odocoileus virginianus*]). We recorded multiple pictures in two documented occurrences (one in Oct 2010 and the other in Dec 2010) over multiple days of a Barred Owl visiting both fresh and mostly-decayed carcasses. Attempts to lure owls to camera traps through use of tainted chicken and turkey meat were unsuccessful, and no additional owl pictures were obtained from unbaited cameras throughout 2010.

Kery, M, Gardner, B, Stoeckle, T, Weber, D, Royle, JA. 2011. Use of Spatial Capture-Recapture Modeling and DNA Data to Estimate Densities of Elusive Animals. CONSERVATION BIOLOGY 25(2):356-364.

Assessment of abundance, survival, recruitment rates, and density (i.e., population assessment) is especially challenging for elusive species most in need of protection (e.g., rare carnivores). Individual identification methods, such as DNA sampling, provide ways of studying such species efficiently and noninvasively. Additionally, statistical methods that correct for undetected animals and account for locations where animals are captured are available to efficiently estimate density and other demographic parameters. We collected hair samples of European wildcat (*Felis silvestris*) from cheek-rub lure sticks, extracted DNA from the samples, and identified each animals' genotype. To estimate the density of wildcats, we used Bayesian inference in a spatial capture-recapture model. We used WinBUGS to fit a model that accounted for differences in detection probability among individuals and seasons and between two lure arrays. We detected 21 individual wildcats (including possible hybrids) 47 times. Wildcat density was estimated at $0.29/km^2$ (SE 0.06), and 95% of the activity of wildcats was estimated to occur within 1.83 km from their home-range center. Lures located systematically were associated with a greater number of detections than lures placed in a cell on the basis of expert opinion. Detection probability of individual cats was greatest in late March. Our model is a generalized linear mixed model; hence, it can be easily extended, for instance, to incorporate trap- and individual-level covariates. We believe that the combined use of noninvasive sampling techniques and

spatial capture-recapture models will improve population assessments, especially for rare and elusive animals.

Kouakou, CY, Boesch, C, Kuehl, HS. 2011. Identifying hotspots of chimpanzee group activity from transect surveys in Tai National Park, Cote d'Ivoire. JOURNAL OF TROPICAL ECOLOGY 27:621-630.

Locating activity hotspots-areas of higher density, more intense use, or distinct social units-is a prerequisite for answering many questions in animal ecology. However, for many species, carrying out such research from direct observations in tropical habitat is time-consuming and unrealistic for non-habituated animals. This study aimed to locate chimpanzee home ranges from transect nest counts. For validation purposes, 233 line transects were sampled within the home ranges of four habituated social groups of chimpanzees in Tai National Park, Cote d'Ivoire. In total, 373 km of transects were surveyed over 188 days and 683 nests of chimpanzee were recorded. First, we characterized heterogeneity of nest distribution patterns, including variation in density and group size within the area. Second, we used scan statistics, a likelihood-based cluster technique to locate chimpanzee social groups and compared them with the known home range boundaries. Chimpanzee nest distribution was characterized by a positive density and group-size gradient away from the range periphery. Furthermore, nest distribution clusters corresponding to the four groups could be successfully identified, although additional clusters for, for example, low-density areas between social groups seem to be an unavoidable by-product. The approach taken can be extended to a wide spectrum of data stemming from direct observations, camera traps, acoustic or genetic sampling to derive information about structure and patchiness of wild animal populations.

Link, A, Galvis, N, Fleming, E, Di Fiore, A. 2011. Patterns of Mineral Lick Visitation by Spider Monkeys and Howler Monkeys in Amazonia: Are Licks

Perceived as Risky Areas? AMERICAN JOURNAL OF PRIMATOLOGY 73(4):386-396.

Mineral licks-also known as "salados," "saladeros," or "collpas"-are specific sites in tropical and temperate ecosystems where a large diversity of mammals and birds come regularly to feed on soil. Although the reasons for vertebrate geophagy are not completely understood, animals are argued to obtain a variety of nutritional and health benefits from the ingestion of soil at mineral licks. We studied the temporal patterns of mineral lick use by white-bellied spider monkey (*Ateles belzebuth*) and red howler monkey (*Alouatta seniculus*) in a lowland rain forest in Amazonian Ecuador. Using camera and video traps at four different mineral licks, combined with behavioral follows of one group of spider monkeys, we documented rates of mineral lick visitation by both primate species and the relative frequency and intensity of mineral lick use by spider monkeys. On the basis of 1,612 days and 888 nights of mineral lick monitoring, we found that *A. belzebuth* and *A. seniculus* both visit mineral licks frequently throughout the year (on average similar to 14% of days for both species), and mineral lick visitation was influenced by short-term environmental conditions (e.g. sunny and dry weather). For spider monkeys, the area surrounding the lick was also the most frequently and most intensively used region within the group's home range. The fact that spider monkeys spent long periods at the lick area before coming to the ground to obtain soil, and the fact that both species visited the lick preferentially during dry sunny conditions (when predator detectability is presumed to be relatively high) and visited simultaneously more often than expected by chance, together suggest that licks are indeed perceived as risky areas by these primates. We suggest that howler and spider monkeys employ behavioral strategies aimed at minimizing the probability of predation while visiting the forest floor at risky mineral lick sites.

Link, A, de Luna, AG, Arango, R, Diaz, MC. 2011. Geophagy in Brown Spider Monkeys (*Ateles hybridus*) in a Lowland Tropical Rainforest in Colombia. FOLIA PRIMATOLOGICA 82(1):25-32.

Spider monkeys and howler monkeys are the only Neotropical primates that eat soil from mineral licks. Not all species within these genera visit mineral licks, and geophagy has been restricted to populations of *Ateles belzebuth belzebuth*, *Ateles belzebuth chamek* and *Alouatta seniculus* in western Amazonian rainforests. With the aid of a camera trap we studied the visitation patterns of a group of brown spider monkeys (*Ateles hybridus*) to a mineral lick at Serrania de Las Quinchas, in Colombia. Spider monkeys visited the lick frequently throughout the year, with a monthly average of 21.7 ± 7.2 visits per 100 days of camera trapping (n = 14 months). Spider monkeys visited the mineral lick almost always on days with no rain, or very little (<3 mm) rain, suggesting that proximate environmental variables might determine spider monkeys' decisions to come to the ground at the licks. This study expands the geographical occurrence of mineral lick use by spider monkeys providing additional data for future assessments on the biogeographical correlates of mineral lick use by platyrrhines.

Linkie, M, Ridout, MS. 2011. Assessing tiger-prey interactions in Sumatran rainforests. JOURNAL OF ZOOLOGY 284(3):224-229.

Little is known about interactions between the critically endangered Sumatran tiger *Panthera tigris sumatrae* and its prey because of the difficulties associated with detecting these species. In this study, we quantify temporal overlap between the Sumatran tiger and five of its presumed prey species from four study areas comprising disturbed lowland to primary submontane forest. Data from 126 camera traps over 8984 camera days were used to estimate species activity patterns and, in turn, their overlap through the coefficient D (ranging from 0 to 1, i.e. no overlap to complete overlap). A newly developed statistical technique was applied to determine confidence intervals associated with respective overlap, which is important, as such measures of precision are usually not estimated in these types of study. Strong temporal overlap was found between tiger and muntjac *Muntiacus muntjac* (Delta = 0.80, 95% CI = 0.71-0.84) and tiger and

sambar *Cervus unicolor* (Delta = 0.81, 0.55-0.85), with the latter illustrating the importance of measuring precision. According to the foraging theory, Sumatran tigers should focus on expending lower levels of energy searching for and then capturing larger bodied prey that present the least risk. Hence, surprisingly, there was little overlap between the crepuscular tiger and the largest-bodied prey species available, the nocturnal tapir *Tapirus indicus* (0.52, 0.44-0.60), suggesting that it is not a principal prey species. This study provides the first insights into Sumatran tiger-prey temporal interactions. The ability to estimate overlap statistics with measures of precision has obvious and wide benefits for other predator-prey and interspecific competition studies.

Martinez-Calderas, JM, Rosas-Rosas, OC, Martinez-Montoya, JF, Tarango-Arambula, LA, Clemente-Sanchez, F, Crosby-Galvan, MM, Sanchez-Hermosillo, MD. 2011. Distribution of the ocelot (*Leopardus pardalis*) in San Luis Potosi, Mexico. REVISTA MEXICANA DE BIODIVERSIDAD 82(3):997-1004.

To determine the geographic distribution of ocelot in the state of San Luis Potosi, Mexico, we obtained new records. The study was conducted from January 2007 to April 2009. We recorded 41 ocelot records by interviews and camera-trapping. Ocelot records were located in tropical deciduous forest (37%), semitropical thornscrub (22%), oak forest (15%), tropical forest (10%), tall tropical deciduous forest, desert scrub, pine-oak forest and clouded forest (10%). Ocelot records were located in the municipalities of Ciudad del Maiz, El Naranjo, Cerritos, Guadalcazar, San Nicolas Tolentino and Ciudad Valles where the elevation ranged from 38 to 2 400 m. The evidence of this research suggests that ocelot range is more extended to the west than its original geographical range. This study defined new regions with presence of ocelots that may be considered to develop conservation strategies for ocelots in San Luis Potosi.

Matsubayashi, H, Ahmad, AH, Wakamatsu, N, Nakazono, E, Takyu, M, Majalap, N

Lagan, P, Sukor, JRA. 2011. Natural-licks use by orangutans and conservation of their habitats in Bornean tropical production forest. RAFFLES BULLETIN OF ZOOLOGY 59(1):109-115.

The use of natural-licks by orangutans (*Pongo pygmaeus*) was investigated with camera traps in the Deramakot production forest, Sabah, Malaysian Borneo. The results showed that 1) Although orangutans were in the top three species at all the natural-licks, visitation frequency differed at the natural-licks depending on the surrounding environment; 2) Natural-licks use by orangutans was impacted more by human activity than concentration of the minerals; and 3) Visiting proportion of each orangutan class: flanged male, female with infant, and others, showed that flanged male accounted for 31%; female with infant, 17%; and others, 52%; although we had anticipated a bias toward the flanged male. These results suggest that the natural-licks are key habitats for all classes of orangutans and suitable sites for ground monitoring. Therefore, it is strongly recommended that other production forests adopt protection of natural-licks and managed as a monitoring site for orangutan habitat conservation. Furthermore, as orangutans are vulnerable to human activity, it is necessary to manage natural-licks as protected area with buffer zones of reduced human activity.

McCoy, JC, Ditchkoff, SS, Steury, TD. 2011. Bias Associated With Baited Camera Sites for Assessing Population Characteristics of Deer. JOURNAL OF WILDLIFE MANAGEMENT 75(2):472-477.

Camera surveys often involve placing bait in front of the camera to capture animals more frequently, which could introduce biases in parameter estimates. From September 2008 to March 2009, we monitored cameras placed at random, along game trails, and at feed stations to determine if camera placement influenced measures of population demographics in a

herd of white-tailed deer (*Odocoileus virginianus*). There was no time period in which cameras placed at feed stations provided sex ratio and recruitment estimates similar to those acquired from randomly placed cameras. Trail-based camera surveys provided population estimates similar to those from random sites and may provide a feasible alternative to using baited camera stations.

Mendoza, E, Martineau, PR, Brenner, E, Dirzo, R. 2011. A Novel Method to Improve Individual Animal Identification Based on Camera-Trapping Data. JOURNAL OF WILDLIFE MANAGEMENT 75(4):973-979.

We present a novel method to improve individual identification of animals based on camera-trapping data. The method combines computer tools and human visual recognition to help multiple users to reach identification agreement. Application of this method to a bobcat (*Lynx rufus*) picture database from the Jasper Ridge Biological Preserve resulted in a progressive increase in identification agreement between 2 users, as measured by the adjusted Rand index (ARI). An initial ARI value of 0.28 increased to a final value of 0.84 (1 maximum agreement). In contrast, comparisons involving random picture groupings consistently rendered low ARI values (<= 0.05). The numbers of individuals named by the 2 users decreased from initial values of 46 and 43 to final values of 25 and 29, respectively. The tool presented here will help researchers and wildlife managers to identify individual mammals and monitor populations.

Michalski, F, Norris, D. 2011. Activity pattern of *Cuniculus paca* (Rodentia: Cuniculidae) in relation to lunar illumination and other abiotic variables in the southern Brazilian Amazon. ZOOLOGIA 28(6):701-708.

Understanding what influences the activity of organisms is important for both ecological understanding and species conservation. Using data from

2,707 camera trap days distributed across 24 forest sites, we present quantitative analyses of the activity pattern of *Cuniculus paca* (Linnaeus, 1766) in southern Amazonia. We compared the activity pattern of this species across four designated subsets of the 24-hours diel cycle (dawn, dusk, day and night). Using linear regression models we tested the influence of season, temperature and rainfall on the activity patterns of *C. paca* (paca). We also evaluated the nocturnal photos of paca (N = 111) as a function of the degree of lunar illumination in order to test the prediction that pacas minimize their activity during moon phase when illumination is brighter. Pacas were not recorded during the day but were active at dawn, dusk and night time. We found differences in the influence of the abiotic variables on the nocturnal activity of pacas in the study area. There was no significant difference between the observed (expressed as the frequency of total counts of independent photos over the five classes of lunar illumination) and the expected activity of pacas, based on the frequency of days in the lunar cycle with different classes of lunar illumination, whereas lunar illumination had a weak negative influence on the timing of paca activity (i.e. pacas were active closer to sunset with increasing lunar illumination). However, the timing of nocturnal activity in pacas was not influenced by season, temperature or rainfall. Our findings highlight the ecological plasticity of this Neotropical rodent which has a key function in the maintenance of Neotropical forests.

Monroy-Vilchis, O, Zarco-Gonzalez, MM, Ramirez-Pulido, J, Aguilera-Reyes, U. 2011. Diversity of mammals in the Natural Reserve Sierra Nanchititla, Mexico. REVISTA MEXICANA DE BIODIVERSIDAD 82(1):237-248.

The Sierra Nanchititla Natural Reserve (SNNR) is the second largest natural protected area in the State of Mexico, however its biodiversity is largely unknown. The aim of this research was to estimate its mammalian diversity. Direct trapping was used to capture small mammals and camera-trapping for the study of medium and large mammals. Diversity was calculated from Margalef's index, dominance and equity were evaluated through Simpson's

and Shannon-Wiener indexes, respectively. Fifty three species were registered, 3 of them are the first record for the State of Mexico, 10 are endemic to Mexico and 4 are considered in some category of vulnerability by the Mexican government. The area is inhabited by 5 of the 6 Mexican felid species. The mastofaunistic composition of SNRN was compared with that of the Sierra Purepecha, Michoacan, according to Jaccard's index, the similarity between them is low, sharing 38% of species. Considering the results, it is clear the importance of SNNR, regarding its mastofaunistic diversity, and the need to implement strategies for its conservation.

Monterroso, P, Alves, PC, Ferreras, P. 2011. Evaluation of attractants for non-invasive studies of Iberian carnivore communities. WILDLIFE RESEARCH 38(5):446-454.

Context. The estimation of population parameters for mammalian carnivore species is a challenging task because of their low densities and large home ranges, which make detection probabilities very low. Several factors, such as the species abundance, habitat structure or the use of an attractant affect carnivore detection probabilities; however, attractants are the most easily manipulated. Some previous research suggests that the use of effective attractants can significantly increase detection probabilities.

Aims. To assess the effectiveness of several attractants for Iberian carnivores, and to evaluate their usefulness for non-invasive survey methods.

Methods. The responses of seven carnivore species to six potential attractants were evaluated through cafeteria-like experiments with captive specimens. A selectivity index was applied to assess the relative attractiveness of each tested substance. The enclosure tests were followed by field trials with camera-trapping, using the most promising attractants for field evaluation of their efficiency.

Key results. Enclosure trials revealed that lynx urine was the most effective and generalist attractant because it successfully attracted six of the seven species tested. Rubbing behaviour was also induced in the greatest number

of species by lynx urine. Field tests using a combination of lynx urine and valerian extract solution induced investigative behaviours in over 50% of all detection events in all species, with the exception of the Eurasian badger.

Conclusions. No single attractant is effective for all species. Nevertheless, a combination of lynx urine and valerian solution should efficiently attract the majority of species present in Iberian carnivore communities. Furthermore, some species exhibit a rubbing behaviour when they come in contact with the attractants. Regardless of the generalist efficiency of the lynx urine, other tested substances revealed promising results for single-species monitoring.

Implications. Our results provide a baseline for selecting attractants in survey and monitoring programs that focus on carnivore species. The rubbing behaviours exhibited by several of the species tested suggest the use of these attractants could improve the efficiency of field studies that rely on rub-pads for the collection of biological samples.

Monteverde, MJ, Piudo, L. 2011. Activity patterns of the culpeo fox (*Lycalopex culpaeus magellanica*) in a non-hunting area of northwestern Patagonia, Argentina. MAMMAL STUDY 36(3):119-125.

The culpeo fox is the largest native canid in Patagonia. The majority of past studies on culpeo foxes have focused on trophic ecology, population dynamics, natural history, competitive interactions, management, and habitat use. Little work has been done on determining activity patterns of the fox and thus, conclusions regarding culpeo fox activity patterns have been based on limited data. The objective of our study was to determine culpeo fox activity patterns in a protected area (Lanin National Park, Argentina) using "camera-traps" to test the hypothesis that the culpeo fox is still nocturnal in non-hunting areas. Data were collected from October 2008 through May 2009 at 29 infrared triggered camera stations. We obtained 1,261 culpeo fox photos of which 234 were used for analyses. Diet was studied from 34 culpeo fox scats. Culpeo foxes were most active during

nighttime (>70% of the records) confirming the general patterns obtained in other studies. Additionally, examination of culpeo fox scats revealed that they mostly preyed on nocturnal small mammals. The present study offers evidence against the widespread assumption that nocturnal activity of this species is a behavioral response to human harassment, as it was conducted in a protected area where culpeo foxes are not hunted. Instead, their nocturnal behavior may be related to prey activity patterns.

Munari, DP, Keller, C, Venticinque, EM. 2011. An evaluation of field techniques for monitoring terrestrial mammal populations in Amazonia. MAMMALIAN BIOLOGY 76(4):401-408.

In the Amazon region diurnal line-transect census is the technique used by most monitoring programs to collect data on medium and large terrestrial mammals. However, this method usually fails to provide high quality information (e.g. abundance, occurrence) for some species, especially for larger bodied and less abundant ones, which are mostly threatened by human disturbances. Aiming to provide guidelines for monitoring programs in the region we compared the efficiency of three field techniques: (1) diurnal surveys (i.e. diurnal line-transect census with sign surveys), (2) nocturnal surveys and (3) camera trapping in non-flooded and seasonally flooded forest sites at the Uacari Sustainable Development Reserve, western Brazilian Amazonia. Nocturnal surveys provided poor information for all species, except pacas. Tracks accounted for 50% of the observations recorded during diurnal surveys, the most effective technique for smaller diurnal species and ungulates. For armadillos and rare species camera trapping was the most effective technique. Moreover, all techniques failed to detect the most common species, agouti, in at least two sites. High sampling effort using a combination of sampling methods and statistical analyses that enable the integration of different source data, such as photos, tracks and visual sightings, are necessary steps to maximize the efficiency of medium and large mammals monitoring programs in Amazonian forests.

Naidu, A, Smythe, LA, Thompson, RW, Culver, M. Genetic Analysis of Scats Reveals Minimum Number and Sex of Recently Documented Mountain Lions. JOURNAL OF FISH AND WILDLIFE MANAGEMENT 2(1)106-111.

Recent records of mountain lions *Puma concolor* and concurrent declines in desert bighorn sheep Ovis canadensis mexicana on Kofa National Wildlife Refuge in Arizona, United States, have prompted investigations to estimate the number of mountain lions occurring there. We performed noninvasive genetic analyses and identified species, individuals, and sex from scat samples collected from the Kofa and Castle Dome Mountains. From 105 scats collected, we identified a minimum of 11 individual mountain lions. These individuals consisted of six males, two females and three of unknown sex. Three of the 11 mountain lions were identified multiple times over the study period. These estimates supplement previously recorded information on mountain lions in an area where they were historically considered only transient. We demonstrate that noninvasive genetic techniques, especially when used in conjunction with camera-trap and radiocollaring methods, can provide additional and reliable information to wildlife managers, particularly on secretive species like the mountain lion.

Negroes, N, Revilla, E, Fonseca, C, Soares, AMVM, Jacomo, ATA, Silveira, L. 2011. Private forest reserves can aid in preserving the community of medium and large-sized vertebrates in the Amazon arc of deforestation. BIODIVERSITY AND CONSERVATION 20(3):505-518.

Due to the advancing agricultural frontier in the Brazilian Amazon, the present rate of deforestation engenders a pessimistic scenario for vertebrate diversity in the area. Protected areas are an essential conservation tool to limit biodiversity loss, but their efficiency have yet to be proven. Here, we used camera-trap data on the presence of medium and large-size vertebrates in a protected area (Canto State Park) and a neighbouring

private forest reserve (Santa F, Ranch) to evaluate their effectiveness in protecting biodiversity. We also gathered information on seasonality and activity patterns. A total sampling effort of 7929 trap-nights revealed a diverse vertebrate fauna in the region. A total of 34 mammal species, belonging to 8 different orders was detected in the study area, some of which have a high level of conservation interest and value. The photographic index showed that diversity was more abundant outside the protected area of Canto State Park, where seasonality could play a major role in vertebrate occurrence. Overall, the influence of seasonality on distribution appears to be species-specific. During the wet season around 40% of the common species were not detected inside the park, whereas in Santa F, Ranch most species (62.5%) suffered only a slight decrease in relative abundance probably due to changes in the availability of food resources. Our results highlight the importance of private land for vertebrate conservation in the Amazon and alert to the need for increased law enforcement in these areas to secure biodiversity preservation.

Norris, D, Rocha-Mendes, F, Ferraz, SFD, Villani, JP, Galetti, M. 2011. How to not inflate population estimates? Spatial density distribution of white-lipped peccaries in a continuous Atlantic forest. ANIMAL CONSERVATION 14(5):492-501.

In a world with poor biological inventorying and rapid land-use change, predicting the spatial distribution of species is fundamental for the effective management and conservation of threatened taxa. However, on a regional scale, predicting the distribution of rare terrestrial mammals is often unreliable and/or impractical, especially in tropical forests. We apply a recently developed analytic process that integrates density estimation (kernel smoothing), niche-analysis and geostatistics (regression-kriging) to model the occupancy and density distribution of a threatened population of white-lipped peccaries *Tayassu pecari* in a Brazilian Atlantic forest. Locations (n = 45) within a protected area of the Serra-do-Mar state park were obtained from diurnal line transect census (233 km), camera-trapping (751 camera-trap days) and surveys (4626 km) conducted by park rangers.

Niche modelling (environmental niche-factor analysis and MAXENT) revealed a restricted niche compared with the available habitat as defined by seven environmental variables. From the occupancy model obtained from regression-kriging, we found that 72% of a 170KM^2 protected area is likely to be used by peccaries. We demonstrate that the distribution of large mammals can be restricted within continuous areas of Atlantic forest and therefore population estimates based on the size of protected areas can be overestimated. Our findings suggest that the generation of realized density distributions should become the norm rather than the exception to enable conservation managers and researchers to extrapolate abundance and density estimates across continuous habitats and protected areas.

Nunez-Perez, R. 2011. Estimating jaguar population density using camera-traps: a comparison with radio-telemetry estimates. JOURNAL OF ZOOLOGY 285(1):39-45.

Reliable data on jaguar population densities are needed to propose appropriate conservation and management strategies, and camera trapping may be effective for estimating the population density of secretive large cats. I determined the population density of jaguars in the Chamela-Cuixmala Biosphere Reserve along the coast of Jalisco, Mexico, through camera trapping and capture-recapture analysis during the dry season of March to June 2008. I applied the half mean maximum distance moved (1/2MMDM) to calculate the radius of the effectively sampled area, and compared this with estimates of the effectively sampled area based on existing data on mean home range of jaguars at the study site. I found that both methods of calculating the effectively sampled area produced similar population density estimates. The widely used 1/2MMDM based on camera-trapping data produced a population density of 5.3 jaguars/100KM^2, while calculation of the effectively sampled area based on mean home range produced a population density of 5 jaguars/100KM^2. Despite the small size of the 131-KM^2 Chamela-Cuixmala Biosphere Reserve, jaguar population density was relatively high,

suggesting that small, well-protected reserves can be important refuges for jaguars.

Nyiramana, A, Mendoza, I, Kaplin, BA, Forget, PM. 2011. Evidence for Seed Dispersal by Rodents in Tropical Montane Forest in Africa. BIOTROPICA 43(6):654-657.

Seed dispersal by rodents has been understudied in Africa. Based on seed-removal experiments, the presence of seeds in burrows and caches, cotyledon burial of seedlings, and images from camera traps, we provide evidence that rodents (*Cricetomys kivuensis*) remove and hoard large seeds of *Carapa grandiflora* in Nyungwe National Park, Rwanda.

O'Brien, TG, Kinnaird, MF. 2011. Density estimation of sympatric carnivores using spatially explicit capture-recapture methods and standard trapping grid. ECOLOGICAL APPLICATIONS 21(8):2908-2916.

Population density is an important state variable in ecology and monitoring of wildlife populations. In the study of large carnivores, traditional density estimation methods have relied on camera trapping to collect capture-recapture data using sampling designs suited to a single target species and ad hoc methods to calculate the effective trapping area. We describe an application of spatially explicit capture-recapture analysis to estimate density for four sympatric carnivore species using a standard spatial sampling grid, camera trap sampling, and maximum-likelihood estimation methods. We used camera traps deployed in four adjacent, sequential camera arrays to construct capture histories for leopard, aardwolf, spotted hyena, and striped hyena in an African savanna/scrub ecosystem. We considered two methods of constructing trapping histories: (1) a simultaneous layout in which all cameras are deployed and active for 21 trapping intervals of 24 h each; and (2) an incomplete layout in which

cameras are considered deployed for 84 sampling intervals, but with only a fraction of traps active for a given sampling interval. We estimated density and confidence or profile likelihood intervals for each species using a mean maximum distance moved method and maximum-likelihood estimation procedures with model averaging. Maximum-likelihood densities ranged from 4.93/100 KM^2 for spotted hyena to 12.03/100 KM^2 for leopard. Estimates did not differ between simultaneous and incomplete trap layouts. Our approach demonstrates the utility and cost effectiveness of using maximum-likelihood density estimation methods in studies of sympatric species that are individually recognizable.

Oleaga, A, Casais, R, Balseiro, A, Espi, A, Llaneza, L, Hartasanchez, A, Gortazar, C. 2011. New techniques for an old disease: Sarcoptic mange in the Iberian wolf. VETERINARY PARASITOLOGY 181(2-4):255-266.

Sarcoptic mange, a parasitic skin infection caused by the burrowing mite Sarcoptes scabiei, has been reported in over 100 mammals, including humans. In endangered species, mange causes conservation concerns because it may decimate isolated populations and contribute to extinction. The Iberian Peninsula still maintains one of the largest wolf (*Canis lupus*) populations in Europe. In Iberia, sarcoptic mange is endemic in red foxes (*Vulpes vulpes*) and the first confirmed wolf mange cases were recently reported. However, knowledge on S. scabiei in wolves is scarce because of the sampling difficulties inherent to research on scarce species. In order to describe wolf mange epidemiology and to infer conservation implications, this study combined traditional laboratory techniques with the revision of wolf carcass pictures taken by field biologists and original information obtained by camera trapping. A total of 125 necropsies and 8783 camera-trap days allowed insights into wolf mange epidemiology between 2003 and 2010. Living Sarcoptes mites were detected in 19% of the fresh carcasses. Alopecic (delayed) type IV hypersensitive response reactions were observed, while parakeratotic lesions were infrequent. The number of mites isolated per wolf ranged from 1 to 78, and had a negative correlation with the percentage of alopecic skin. No effect by sex on mange

prevalence was found. Yearlings showed a lower probability to present mange-compatible lesions than pups or adults. Wolves with mange-compatible lesions had a lower kidney fat index than apparently healthy ones. ELISA testing of 88 sera yielded an antibody prevalence of 20%. Photo-trapping recorded mange-compatible lesions since 2003 with a peak in 2008. The percentage of wolves with mange-compatible lesions registered in camera-traps during 1 year correlated with the percentage of red foxes with lesions in the previous year. This is the first large survey on sarcoptic mange in the Iberian wolf. Necropsy data, with alopecia as the main feature and a slight effect on body condition, and trends derived from camera trapping coincided in showing a rather low prevalence and an apparently stable situation of the disease and its host, suggesting that this parasite is currently not a major threat for this wolf population. However, more information is needed in order to assess the effect of mange on aspects such as pup survival.

Pagnucco, KS, Paszkowski, CA, Scrimgeour, GJ. 2011. Using cameras to monitor tunnel use by long-toed salamanders (*Ambystoma macrodactylum*): an informative, cost-efficient technique. HERPETOLOGICAL CONSERVATION AND BIOLOGY 6(2):277-286.

Wildlife crossing structures must be monitored to assess their ability to restore animal movement patterns. Although cameras have been used effectively to record use of crossing structures by mammals, they have not been used to document amphibian movements. We installed four amphibian tunnels in Waterton Lakes National Park, Alberta, Canada to reduce road mortality in a declining population of Long-toed Salamanders (*Ambystoma macrodactylum*). Our goal was to determine if cameras offer an alternative to pitfall traps for monitoring tunnels for amphibians. We installed digital cameras on the ceilings of tunnel entrances to monitor tunnel floors. Cameras were set to take motion-triggered images and timed-interval images (1 photograph/minute from 2100-0600). We installed one pitfall trap at each tunnel exit to capture amphibians travelling through tunnels and assess camera performance. From May through August 2009,

we captured 104 adult *A. macrodactylum* in traps, but only 58 crossings were documented by cameras, indicating that cameras missed at least 46 salamander crossings. *Ambystoma macrodactylum* failed to trigger motion detectors during 81.0% of the camera-documented tunnel crossings. Cameras revealed that salamanders moved slower at tunnel entrances than their average crossing speed, suggesting animals may have hesitated at entrances. Although cameras documented one case of snake predation, images indicated that tunnels were not significant predator traps for salamanders. Camera data revealed the same patterns of demographics and spatio-temporal variation in tunnel use for *A. macrodactylum* as did trapping; thus, cameras represent a novel, cost-efficient, noninvasive approach to monitoring amphibian tunnel use. However, we encourage managers to either augment motion-detection cameras or rely on images recorded at set time intervals to document tunnel use effectively by animals as small as, or smaller than, A. macrodactylum.

Paull, DJ, Claridge, AW, Barry, SC. 2011. There's no accounting for taste: bait attractants and infrared digital cameras for detecting small to medium ground-dwelling mammals. WILDLIFE RESEARCH 38(3):188-195.

Context. Reliable information about the occurrence and distribution of threatened forest-dwelling mammals is critical for developing effective conservation plans. To optimise limited resources, advances need to be made to the toolkit available for detecting rare and cryptic fauna.

Aims. We trialled three bait attractants (peanut butter with oats, live mealworms and black truffle oil) in combination with infrared digital cameras to determine whether detection rates of forest-dwelling native mammals in south-eastern Australia were influenced by: (1) bait type; (2) previous visits by conspecifics; (3) previous visits by *Rattus*; and (4) duration of bait deployment.

Methods. Bait attractants were set at 40 camera stations in combination with odourless controls. Over two fortnight-long deployments, 1327 images

were captured of 22 mammal and bird species. From these data, detailed statistical analyses were conducted of six mammal genera.

Key results. Peanut butter with oats was found to be a significantly better attractant than empty bait holders for *Antechinus*, *Isoodon*, *Perameles* and *Rattus*, but not for *Potorous* or *Pseudocheirus*. Truffle oil and mealworms were also significantly better attractants than the control for *Rattus* but not the other five genera. When *Antechinus*, *Isoodon*, *Potorous* or *Rattus* were detected at a bait station there was a significant likelihood they had been detected there during the previous 24 h. This was not the case for *Perameles* or *Pseudocheirus*. A prior visit by *Rattus* to a station had no significant influence on the detection probabilities of *Antechinus*, *Isoodon*, *Perameles*, *Potorous* and *Pseudocheirus* during the subsequent 24 h. Detection probabilities for *Isoodon* and *Rattus* declined significantly during the fortnight-long deployments but trends for the other genera were not significant.

Conclusions. Peanut butter with oats is an excellent general purpose bait for detecting small to medium-sized mammals. However, scope exists for using other baits to target species. For example, truffle oil baits may reduce by-catch of non-target *Rattus* in labour intensive cage trapping of bandicoots. Regardless of bait type, longer deployments are necessary to detect *Perameles*, *Potorous* or *Pseudocheirus* than *Antechinus*, *Isoodon* or *Rattus*.

Implications. Targeted detection of predominantly ground-dwelling mammals may be improved by better understanding the attraction of species to baits and required bait deployment times.

Pereira, JA, Di Bitetti, MS, Fracassi, NG, Paviolo, A, De Angelo, CD, Di Blanco, YE, Novaro, AJ. Population density of Geoffroy's cat in scrublands of central Argentina. JOURNAL OF ZOOLOGY 283(1):37-44.

We studied the density of a Geoffroy's cat *Leopardus geoffroyi* population in a semiarid scrubland of Argentina, by comparing density estimates obtained during camera-trapping surveys in a national park and in nearby

cattle ranches in 2006 and 2007-2008. Overall, we obtained 247 pictures of Geoffroy's cats. The density (mean ± se) of the species at the park ranged from 1.2 ± 0.3 to 2.9 ± 1.4 individuals km^{-2}, depending on the buffer applied, whereas density estimates at ranches were on average 32% lower. Only 11% of the Geoffroy's cats identified in 2006 could still be detected in the area 2 years later, indicating that there was a high turnover of individuals in this population. The sex ratio (M:F) estimated during both surveys at the park was 1:1.4, whereas at the ranches it was 1:0.8. The capture success of sympatric pampas cats Leopardus colocolo and jaguarundis *Puma yagouaroundi* was < 0.3 records per 100 trap-days, and no evidence of these species was found in the ranches. Geoffroy's cats seem to be tolerant to some degree of habitat alteration produced by livestock management, and the numerical response of this species in ranches could be largely the result of human persecution and the effects of livestock management on the habitat structure and prey base.

Pickles, RSA, McCann, NP, Holland, AP. 2011. Mammalian and avian diversity of the Rewa Head, Rupununi, Southern Guyana. BIOTA NEOTROPICA 11(3):237-251.

We report the results of a short expedition to the remote headwaters of the River Rewa, a tributary of the River Essequibo in the Rupununi, Southern Guyana. We used a combination of camera trapping, mist netting and spot count surveys to document the mammalian and avian diversity found in the region. We recorded a total of 33 mammal species including all 8 of Guyana's monkey species as well as threatened species such as lowland tapir (*Tapirus terrestris*), giant otter (*Pteronura brasiliensis*) and bush dog (*Speothos venaticus*). We recorded a minimum population size of 35 giant otters in five packs along the 95 km of river surveyed. In total we observed 193 bird species from 47 families. With the inclusion of Smithsonian Institution data from 2006, the bird species list for the Rewa Head rises to 250 from 54 families. These include 10 Guiana Shield endemics and two species recorded as rare throughout their ranges: the harpy eagle (*Harpia harpyja*) and crested eagle (*Morphnus guianensis*).

Reed, SE. 2011. Non-invasive methods toassess co-occurrurence of mammalian carnivores. SOUTHWESTERN NATURALIST 56(2):231-240.

During 2003-2005, I surveyed 82 sites on the North and South rims of Grand Canyon, Coconino County, Arizona, to test effectiveness of four non-invasive techniques for detecting carnivores and to assess patterns of co-occurrence among pairs of species. Techniques were not equally effective for detecting carnivores. Searches of transects for feces, tracks, and other evidence yielded the greatest number of detections; remotely triggered cameras and track plates had the greatest probabilities of detecting common species an 1 also produced detections of smaller and rarer carnivores; and hair traps generally were ineffective. Even after accounting for variation in probabilities of use of habitats by species due to characteristics of sites, two pairs of carnivores had limited co-occurrence. Coyotes (*Canis latrans*) and bobcats (*Lynx rafts*) did not co-occur at sites on the North Rim, and coyotes and gray foxes (*Urocyon cinereoargenteus*) co-occurred less than one-half as frequently as expected in the South Rim.

Reppucci, J, Gardner, B, Lucherini, M. 2011. Estimating detection and density of the Andean cat in the high Andes. JOURNAL OF MAMMALOGY 92(1):140-147.

The Andean cat (*Leopardus jacobita*) is one of the most endangered, yet least known, felids. Although the Andean cat is considered at risk of extinction, rigorous quantitative population studies are lacking. Because physical observations of the Andean cat are difficult to make in the wild, we used a camera-trapping array to photo-capture individuals. The survey was conducted in northwestern Argentina at an elevation of approximately 4,200 m during October-December 2006 and April-June 2007. In each year we deployed 22 pairs of camera traps, which were strategically placed. To estimate detection probability and density we applied models

for spatial capture-recapture using a Bayesian framework. Estimated densities were 0.07 and 0.12 individual/KM^2 for 2006 and 2007, respectively. Mean baseline detection probability was estimated at 0.07. By comparison, densities of the Pampas cat (*Leopardus colocolo*), another poorly known fetid that shares its habitat with the Andean cat, were estimated at 0.74-0.79 individual/KM^2 in the same study area for 2006 and 2007, and its detection probability was estimated at 0.02. Despite having greater detectability, the Andean cat is rarer in the study region than the Pampas cat. Properly accounting for the detection probability is important in making reliable estimates of density, a key parameter in conservation and management decisions for any species.

Rowcliffe, JM, Carbone, C, Jansen, PA, Kays, R, Kranstauber, B. 2011. Quantifying the sensitivity of camera traps: an adapted distance sampling approach. METHODS IN ECOLOGY AND EVOLUTION 2(5):464-476.

1. Abundance estimation is a pervasive goal in ecology. The rate of detection by motion-sensitive camera traps can, in principle, provide information on the abundance of many species of terrestrial vertebrates that are otherwise difficult to survey. The random encounter model (REM, Rowcliffe 2008) provides a means estimating abundance from camera trap rate but requires camera sensitivity to be quantified.

2. Here, we develop a method to estimate the area effectively monitored by cameras, which is one of the most important codeterminants of detection rate. Our method borrows from distance sampling theory, applying detection function models to data on the position (distance and angle relative to the camera) where the animals are first detected. Testing the reliability of this approach through simulation, we find that bias depends on the effective detection angle assumed but was generally low at less than 5% for realistic angles typical of camera traps.

3. We adapted standard detection functions to allow for the possibility of smaller animals passing beneath the field of view close to the camera,

resulting in reduced detection probability within that zone. Using a further simulation to test this approach, we find that detection distance can be estimated with little or no bias if detection probability is certain for at least some distance from the camera.

4. Applying this method to a 1-year camera trapping data set from Barro Colorado Island, Panama, we show that effective detection distance is related strongly positively to species body mass and weakly negatively to species average speed of movement. There was also a strong seasonal effect, with shorter detection distance during the wet season. Effective detection angle is related more weakly to species body mass, and again strongly to season, with a wider angle in the wet season.

5. This method represents an important step towards practical application of the REM, including abundance estimation for relatively small (< 1 kg) species.

Royle, JA, Magoun, AJ, Gardner, B, Valkenburg, P, Lowell, RE. 2011. Density Estimation in a Wolverine Population Using Spatial Capture-Recapture Models. JOURNAL OF WILDLIFE MANAGEMENT 75(3):604-611.

Classical closed-population capture-recapture models do not accommodate the spatial information inherent in encounter history data obtained from camera-trapping studies. As a result, individual heterogeneity in encounter probability is induced, and it is not possible to estimate density objectively because trap arrays do not have a well-defined sample area. We applied newly-developed, capture-recapture models that accommodate the spatial attribute inherent in capture-recapture data to a population of wolverines (*Gulo gulo*) in Southeast Alaska in 2008. We used camera-trapping data collected from 37 cameras in a 2,140-KM^2 area of forested and open habitats largely enclosed by ocean and glacial icefields. We detected 21 unique individuals 115 times. Wolverines exhibited a strong positive trap response, with an increased tendency to revisit previously visited traps.

Under the trap-response model, we estimated wolverine density at 9.7 individuals/1,000 KM^2 (95% Bayesian CI: 5.9-15.0). Our model provides a formal statistical framework for estimating density from wolverine camera-trapping studies that accounts for a behavioral response due to baited traps. Further, our model-based estimator does not have strict requirements about the spatial configuration of traps or length of trapping sessions, providing considerable operational flexibility in the development of field studies.

Rupf, R, Wyttenbach, M, Kochli, D, Hediger, M, Lauber, S, Ochsner, P, Graf, R. 2011. Assessing the spatio-temporal pattern of winter sports activities to minimize disturbance in capercaillie habitats. ECO MONT-JOURNAL ON PROTECTED MOUNTAIN AREAS RESEARCH AND MANAGEMENT 3(2):23-32.

Outdoor activities may have serious consequences for wildlife species that are sensitive to human disturbance. The pressure of outdoor activities on natural landscapes has increased dramatically in recent decades. However, we generally lack information on the spatial and temporal patterns of outdoor activities - a fact that makes it difficult to quantify the impact on wildlife and thus to implement and justify measures to constrain outdoor activities.

In the winter seasons 2008/2009 and 2009/2010, we equipped 303 recreationists in the Val Mustair Biosphere Reserve, eastern Swiss Alps, with GPS loggers to record their spatial and temporal pattern of landscape use. We then analysed how the resulting pattern of spatial use overlapped with the habitat of capercaillie Tetrao urogallus, an endangered woodland grouse species that is highly sensitive to disturbance. For our study we used the official capercaillie core winter habitats observed by the game wardens of the Canton Grisons.

The recorded 319 trips of 188 backcountry skiers and snowboarders and 231 trips of 115 snowshoers combined show an inhomogeneous use of

subareas in the region. With one exception, the trips are located in the main valley and the adjoining southern and northern slopes and peaks. The trips of snowshoers result in a dispersed use pattern across the main valley, while the trips of the backcountry skiers and snowboarders are concentrated more on official and popular routes. Rarely did recreationists trespass official wildlife sanctuaries or cross capercaillie habitat patches.

However, one official, very popular backcountry skiing route crosses one of the largest capercaillie habitats. Here the recorded trips show wide-ranging spatial use with many connectors to the main route. As a consequence, this capercaillie habitat patch is dissected into smaller undisturbed patches.

GPS logging in combination with camera trap data provides detailed information on the spatio-temporal land-use pattern of outdoor activities. Based on these data, we identified a conflict of interest in the Val Mustair Biosphere Reserve that has to be resolved by management in a joint participatory process with the main stakeholders.

Our methods and results could be transferred to other Alpine regions and be used for any land cover types. In this way we hope to contribute to mitigating conflicts between human outdoor activities and wildlife populations.

Sanchez-Cordero, V, Botello, F, Magana-Cota, G, Iglesias, J. 2011. Vampire bats, *Desmodus rotundus*, feeding on white-tailed deer, Odocoileus virginianus. MAMMALIA 75(1):91-92.

NO ABSTRACT

Sarmento, PB, Cruz, J, Eira, C, Fonseca, C. 2011. Modeling the occupancy of sympatric carnivorans in a Mediterranean ecosystem. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 57(1):119-131.

Site occupancy provides a reasonable estimate of population status and trends, and it also provides an unbiased, cost-effective alternative method for large-scale, multispecies monitoring programs. In this study, we used camera-trapping data to determine carnivoran occupancy and associated environmental factors in Serra da Malcata Nature Reserve, Portugal. The study was intended as a precursor of further long-term multispecies monitoring programs. We estimated carnivoran species occupancy using a likelihood-based method, using the software PRESENCE. The major conclusions of the study were (1) fox occupancy tends to be independent of environmental factors; (2) stone marten occupancy is related with habitat variables, landscape structure, and preys; (3) common genet occupancy is related to broad leaf formations and preys; and (4) mongoose occupancy is higher in extensive areas of shrub habitats. Methodologically, we demonstrated the importance of modeling detection probabilities for species with low or variable detection rates. In the future, monitoring programs could benefit from incorporating estimates of detection probabilities into their design and analysis.

Sathyakumar, S, Bashir, T, Bhattacharya, T, Poudyal, K. 2011. Assessing mammal distribution and abundance in intricate eastern Himalayan habitats of Khangchendzonga, Sikkim, India. MAMMALIA 75(3):257-268.

We assessed distribution and abundance of mammals in dense, rugged eastern Himalayan habitats of Khangchendzonga Biosphere Reserve (BR), Sikkim, India, from April 2008 to May 2010, using field methods and remote cameras under varying rain and snow conditions. We report the occurrence of 42 mammals including 18 species that have high global conservation significance. Three leopards (*Panthera uncia*, *Panthera pardus*, *Neofelis nebulosa*), Tibetan wolf (*Canis lupus chanco*), wild dog (*Cuon alpinus*), red panda (*Ailurus fulgens*), Asiatic black bear (*Ursus thibetanus*), and two musk deer species (*Moschus chrysogaster*, *M. fuscus*) were recorded. Species number decreased with increasing elevation, 22 were recorded in temperate habitats, 18 in sub-alpine and 11 in alpine. The yellow-throated marten (Martes flavigula) and black bear were found to

have the most diverse distribution extending from temperate to alpine. Red fox (*Vulpes vulpes*) was the most abundant carnivore (8.98 ± 2.31 photo capture/100 days) while goral (*Naemorhedus goral*) was the most abundant prey (9.14 ± 5.27). Camera trap detected most of the mammals of the intensive study area (35/39). Considering the benefits and limitations, we recommend application of camera trapping along with sign surveys for monitoring of mammals in Khangchendzonga BR for effective conservation.

Sharma, RK, Jhala, YV. 2011. Monitoring tiger populations using intensive search in a capture-recapture framework. POPULATION ECOLOGY 53(2):373-381.

Tigers (*Panthera tigris*) today face multiple threats to their survival in the form of habitat loss, poaching, depletion of wild prey through illegal hunting and loss of connectivity between populations. Monitoring of tigers is crucial to evaluate their status and react adaptively to management problems. Though camera traps are becoming increasingly popular with researchers enumerating cryptic and elusive animals, they have not been embedded in the regular management activities of tiger reserves. Tiger monitoring, though an important part of the management, is usually implemented using the unreliable pugmark approach. Camera trap-based studies are few, usually of short duration, and are generally conducted by individual scientists and organizations. In this study, we integrate photographic mark-recapture with the routine activity of searching and locating tigers for tourist viewing by the park management in meadows of Kanha Tiger Reserve which form a part of the tourism zone. We validate the density estimates from "tiger search approach" against those obtained from camera trapping and radio-telemetry conducted in conjunction in the same area. Tiger density ((D) over cap ($SE[(D)$ over cap]) per 100 KM^2 for camera traps and tiger search, respectively, was estimated at 12.0 (1.95) and 12.0 (1.76) when effective trapping area was estimated using the half mean maximum distance moved (1/2 MMDM), 7.6 (1.94) and 7.5 (1.97) using the home range radius, 7.3 (1.49) and 7.5 (1.97) with the full

MMDM, and 8.0 (3.0) and 6.88 (2.39) with the spatial likelihood method in Program DENSITY 4.1. Camera trapping, however, was five times more expensive than the tiger search method. Our study suggests that "tiger search approach" can be used as a regular monitoring tool in the tourism zones of tiger reserves, where often most of the source populations are located.

Sollmann, R, Furtado, MM, Gardner, B, Hofer, H, Jacomo, ATA, Torres, NM, Silveira, L. 2011. Improving density estimates for elusive carnivores: Accounting for sex-specific detection and movements using spatial capture-recapture models for jaguars in central Brazil. BIOLOGICAL CONSERVATION 144(3):1017-1024.

Owing to habitat conversion and conflict with humans, many carnivores are of conservation concern. Because of their elusive nature, camera trapping is a standard tool for studying carnivores. In many vertebrates, sex-specific differences in movements - and therefore detection by cameras - are likely. We used camera trapping data and spatially explicit sex-specific capture-recapture models to estimate jaguar density in Emas National Park in the central Brazilian Cerrado grassland, an ecological hotspot of international importance. Our spatially explicit model considered differences in movements and trap encounter rate between genders and the location of camera traps (on/off road). We compared results with estimates from a sex-specific non-spatial capture-recapture model. The spatial model estimated a density of 0.29 jaguars 100 km^{-2} and showed that males moved larger distances and had higher trap encounter rates than females. Encounter rates with off-road traps were one tenth of those for on-road traps. In the non-spatial model, males had a higher capture probability than females; density was estimated at 0.62 individuals 100 km^{-2}. The non-spatial model likely overestimated density because it did not adequately account for animal movements. The spatial model probably underestimated density because it assumed a uniform distribution of jaguars within and outside the reserve. Overall, the spatial model is preferable because it explicitly considers animal movements and allows incorporating site-specific and individual

covariates. With both methods, jaguar density was lower than reported from most other study sites. For rare species such as grassland jaguars, spatially explicit capture-recapture models present an important advance for informed conservation planning.

Sponchiado, J, Melo, GL, Caceres, NC. 2011. First record of the invasive alien species *Axis axis* (Erxleben, 1777) (Artiodactyla: Cervidae) in Brazil. BIOTA NEOTROPICA 11(3):403-406.

The exotic alien species *Axis axis* was introduced in the Americas at the beginning of last century and since then has established itself, expanding its distribution. This is the first record of this species in Brazil. In the extreme south of the country, an individual of *A. axis* was recorded with a camera trap in the Espinilho State Park. The area is close to the border of Uruguay and Argentina, countries where the species is established and from where this individual presumably originated. The Pampas biome is strongly disturbed by human activity in Brazil and since many native mammal species such as the Pampas deer *Ozotoceros bezoarticus* are threatened regionally. It is alarming that exotic populations can potentially rapidly expand their ranges in the region, as A. axis deer has done in Uruguay and Argentina. Possible consequences for this invasion are discussed.

Stein, AB, Fuller, TK, DeStefano, S, Marker, LL. 2011. Leopard population and home range estimates in north-central Namibia. AFRICAN JOURNAL OF ECOLOGY 49(3):383-387.

NO ABSTRACT

Stevens, K, Dehgan, A, Karlstetter, M, Rawan, F, Tawhid, MI, Ostrowski, S, Ali, JM, Ali, R. Large mammals surviving conflict in the eastern forests of Afghanistan. ORYX 45(2):265-271.

We used transect and camera-trap surveys and DNA identification of scat samples to provide the first update since 1977 of large mammals in the montane forests of the conflict-ridden province of Nuristan in eastern Afghanistan. Nuristan contains a range of habitats from oak *Quercus* spp. forests to treeless alpine steppes that historically hosted populations of markhor *Capra falconeri*, Asiatic black bear *Ursus thibetanus*, grey wolf *Canis lupus* and common leopard *Panthera pardus*, among others. Surveys conducted in 2006-2009 in an area of 1,100 KM^2 by the Wildlife Conservation Society confirmed the presence of some of these species, and also recorded the common palm civet *Paradoxurus hermaphroditus*, previously unknown from Afghanistan; this extends the westernmost boundary for this species. The most commonly recorded species, as determined by direct sightings, scat identification or camera-trap photographs, were the Indian crested porcupine *Hystrix indica*, red fox *Vulpes vulpes* and a canid (grey wolf or golden jackal *Canis aureus*). Despite indications of significant habitat loss and unsustainable hunting, globally important species persist in the area and targeted conservation programmes are required for the protection of these species, the forests they inhabit and the surrounding communities who depend on both for their survival.

Switalski, TA, Nelson, CR. 2011. Efficacy of road removal for restoring wildlife habitat: Black bear in the Northern Rocky Mountains, USA. BIOLOGICAL CONSERVATION 144(11):2666-2673.

Forest roads reduce habitat quality for wildlife, in part by increasing susceptibility to hunting and poaching. Road removal is an increasingly common strategy for restoring habitat; however, little is known about

responses of wildlife to road removal versus other methods of road closure. We assessed effects of different types of road closure (gated, barriered, and recontoured) on black bear (*Ursus americanus*) frequency and habitat on 18 open and closed road pairs in the western USA. Over 4 years, 44 bears were photographed during 3545 camera-trap days. Bear frequency was significantly higher (2.4 versus 0.6/100 days, respectively) and human frequency was significantly lower (2.4 versus 361.6/100 days, respectively) on closed than on open roads. Additionally, abundance of fall foods was higher (23.9% and 12.8%, respectively) and line-of-sight (a measure of habitat security) shorter (54.9 versus 69.4 m, respectively) on closed compared to open roads. Bears were detected on closed but not on open roads during daytime, suggesting avoidance of humans. Among-road-treatment differences included significantly higher frequency of bears on recontoured than on gated or barriered roads (4.6, 1.6, and 0.5/100 days, respectively), and significantly higher cover of fall bear foods on recontoured than on gated or barriered roads (39.3%, 12.1% and 16.4%, respectively). Frequency of bears was negatively correlated with frequency of humans and line-of-sight distance and positively correlated with abundance of fall foods and hiding cover. Results suggest that while all types of road closure benefit sensitive wildlife, removal by recontour may be the most effective strategy for restoring habitat.

Thorn, M, Green, M, Keith, M, Marnewick, K, Bateman, PW, Cameron, EZ, Scott, DM. 2011. Large-scale distribution patterns of carnivores in northern South Africa: implications for conservation and monitoring. ORYX 45(4)579-586.

Accurate assessment of carnivore population status is frequently hindered by insufficient distribution data. For northern South Africa we address this deficit by mapping new records from landscape-scale sign surveys, questionnaire interviews, problem animal records and camera trapping. The black-backed jackal *Canis mesomelas* and caracal *Caracal caracal* remain common and widespread. Ranges of the serval *Leptailurus serval* and brown hyaena *Hyaena brunnea* were much larger than previous

estimates, reducing the risk of simultaneous extirpation across all occupied locations. The proportion of range area occupied was larger for several species, notably the leopard *Panthera pardus*, cheetah *Acinonyx jubatus* and serval. We conclude that the serval continues to recover from historical threats and is expanding into new areas. A larger brown hyaena range and less fragmented pattern of occurrence probably confers greater resilience to threats than was suggested by previous data. Reduced extinction risk arising from the increased area occupied by the cheetah and leopard is tempered by probable local range contraction. Our maps provide baseline information for monitoring the distribution of these six species, which is essential in managing ecological issues that have a spatial component such as responses to changing land use. Our results also demonstrate the utility of detection/nondetection surveys in rapid assessment of carnivore populations at large spatial scales.

Towerton, AL, Penman, TD, Kavanagh, RP, Dickman, CR. 2011. Detecting pest and prey responses to fox control across the landscape using remote cameras. WILDLIFE RESEARCH 38(3):208-220.

Context. The red fox (*Vulpes vulpes*) is a widespread pest in southern Australia and is subject to control over large areas using poison baits to protect both agricultural and ecological assets. Foxes and their prey are often cryptic or in low densities, making it difficult to quantify the efficacy of control programs.

Aims. We explore the use of remote cameras to estimate the activity and spatial occupancy of foxes and potential mammalian and avian prey species before and after poison baiting in the Goonoo region, central New South Wales.

Methods. In the first of two studies, we set camera traps at 48 sites in forest and cleared areas, on and off tracks, during autumn 2009. In the second study, we placed camera traps in forest and cleared areas, on tracks only, at 100 sites covering an area of similar to 441 500 ha during winter

2009. We examined camera-trap rates of all species detected and the activity and site occupancy of a selected subset of species before and after poison baiting.

Key results. Camera traps indicated greater levels of fox activity on vehicular tracks than off them, with this difference being more marked in forest than in cleared agricultural land. Fox activity and occupancy were greater in agricultural land than in forest, with no effect of baiting detected at the landscape scale. Thirty-five other mammal and bird species were identified from photos, with activity for most being greater on than off tracks.

Conclusions. No clear effects of fox-baiting were detected on foxes or potential prey species in either study by either activity or occupancy. The lack of a baiting effect may reflect rapid recolonisation by foxes from unbaited areas, as bait placement is generally clustered in agricultural land, or the ready availability of alternative food (lambs or lamb carcasses) in some cleared areas.

Implications. Our results demonstrate that remote cameras provide a simple means of monitoring changes in fox activity and occupancy at the landscape level, and that these measures have great potential to quantify the success or otherwise of fox-control campaigns on both pest and prey species.

Triska, MD, Loughry, SC, Serfass, TL. 2011. Persistence of fishers in riparian forests in North Dakota, USA following a severe flood event. ACTA THERIOLOGICA 56(4):367-374.

Historically, the distribution of fishers (*Martes pennanti*) in North America included portions of eastern North Dakota, USA; however, the population was reported to have become extirpated by the early 1900s. Verified reports, road-killed and incidentally trapped individuals, indicate that fishers have been re-establishing populations in riparian forests (the only areas with substantive forest cover in the region) over the last 10 years. During

the summers of 2008 (16 Jun-1 Aug) and 2009 (1 Jun-18 Aug), we conducted presence-absence sampling using remote cameras and enclosed track-plates to determine the distribution of fishers along 237 km of the Red River of the North in North Dakota. Between sampling events, the Red River experienced an extreme flood with peak flooding above major flood stage, which inundated all riparian forests within the study area from approximately 23 Mar-22 May. Because of the severity of the flood, we anticipated that fishers could have perished or been displaced from much of the study area, resulting in lower detection rates in 2009 than 2008. However, fishers were detected throughout the study area during both years and, unexpectedly, detection rates were higher in 2009 than 2008 (28 out of 35 sites [80%] and 25 out of 57 sites [44%], respectively). Our study demonstrates that fishers existing in what traditionally would have been considered marginal habitat for the species were able to persist following a severe, multi-month flood that inundated >95% of the forest habitat.

Waldon, J, Miller, BW, Miller, CM. 2011. A model biodiversity monitoring protocol for REDD projects. TROPICAL CONSERVATION SCIENCE 4(3):254-260.

Emerging international standards for Reduced Emissions from Deforestation and Degradation (REDD) projects require a demonstrated biodiversity benefit and a biodiversity monitoring protocol. Guidance for an acceptable protocol is proposed specifically for tropical forests, focusing on technologies that are widely available, rigorous, and aimed at important indicator taxa for forest function. Two techniques, camera trapping for large and mesoscale mammals and acoustic monitoring for bats, are proposed as current technologies that meet the criteria for a model biodiversity monitoring protocol for REDD projects.

Wells, K, Lakim, MB, Schulz, S, Ayasse, M. 2011. Pitchers of *Nepenthes rajah* collect faecal droppings from both diurnal and nocturnal small

mammals and emit fruity odour. JOURNAL OF TROPICAL ECOLOGY 27:347-353.

The pitchers of *Nepenthes rajah*, a montane carnivorous plant species from Borneo, are large enough to capture small vertebrates such as rats or lizards, which occasionally drown therein. The interactions of *N. rajah* with vertebrates, however, are poorly understood, and the potential mechanisms that lure vertebrates to the pitchers are largely unknown. We observed frequent visits (average: one visit per 4.2 h) of both the diurnal tree shrew *Tupaia montana* and the nocturnal rat *Rattus baluensis* to pitchers by infrared sensor camera and video recording. Both mammalian species often licked the inner surface of the pitcher lid, which harbours numerous exudate-producing glands. Analysis of volatiles extracted from the secretions of the pitcher lids by gas chromatography coupled to mass spectrometry (GC/MS) revealed 44 volatile compounds, including hydrocarbons, alcohols, esters, ketones and sulphur-containing compounds, which are commonly present in sweet fruit and flower odours. The faeces of small mammals were repeatedly observed inside the pitcher, whereas we found the body of only one *Tupaia montana* drowned in the 42, vital and reasonably large, surveyed pitchers. Our findings suggest that the *N. rajah* pitcher makes use of the perceptual biases of rats and tree shrews by emitting volatiles known from fruits. The profits that the plant obtains from the repeated visits of two small mammals, together with the provision of exudates for the mammals, comprise an exceptional case of plant-vertebrate interaction.

Williams, BL, Holtfreter, RW, Ditchkoff, SS, Grand, JB. 2011. Trap Style Influences Wild Pig Behavior and Trapping Success. JOURNAL OF WILDLIFE MANAGEMENT 75(2):432-436.

Despite the efforts of many natural resource professionals, wild pig (*Sus scrofa*) populations are expanding in many areas of the world. Although

many creative techniques for controlling pig populations are being explored, trapping has been and still is the most commonly used method of population control for many public and private land managers. We conducted an observational study to examine the efficiency of 2 frequently used trap styles: a small, portable box-style trap and a larger, semi-permanent, corral-style trap. We used game cameras to examine patterns of trap entry by wild pigs around each style of trap, and we conducted a trapping session to compare trapping success between trap styles. Adult female and juvenile wild pigs entered both styles of trap more readily than did adult males, and adult males seemed particularly averse to entering box traps. Less than 10% of adult male visits to box traps resulted in entries, easily the least percentage of any class at any style of trap. Adult females entered corral traps approximately 2.2 times more often per visit than box traps and re-entered corral traps >2 times more frequently. Juveniles entered and re-entered both box and corral traps at similar rates. Overall (all-class) entry-per-visit rates at corral traps (0.71) were nearly double that of box traps (0.37). Subsequent trapping data supported these preliminary entry data; the capture rate for corral traps was >4 times that of box traps. Our data suggest that corral traps are temporally and economically superior to box traps with respect to efficiency; that is, corral traps effectively trap more pigs per trap night at a lower cost per pig than do box traps.

2010

Andrade-Nunez, MJ, Aide, TM. 2010. Effects of habitat and landscape characteristics on medium and large mammal species richness and composition in northern Uruguay. ZOOLOGIA 27(6):909-917

The increasing world population and demand for food and other products has accelerated the conversion of natural habitats into agricultural lands, plantations and urban areas. Changes in habitat and landscape characteristics due to land-use change can have a significant effect on species presence, abundance, and distribution. Multi-scale approaches have been used to determine the proper spatial scales at which species and communities are responding to habitat transformation. In this context, we evaluated medium and large mammal species richness and composition in gallery forest (n = 10), grassland (n = 10), and exotic tree plantation (n = 10) in a region where grasslands have been converted into exotic tree plantations. We quantified mammal species richness and composition with camera traps and track surveys. The composition of the mammal community was related with local habitat variables, and landscape variables measured at seven spatial scales. We found 14 mammal species in forest, 11 species in plantation, and 7 mammal species in grassland. Two species are exotics, the wild boar *Sus scrota* Linnaeus, 1758 and the European hare *Lepus europoeus* Pallas, 1778. The most common species are the crab-eating fox *Cerdocyon thous* Linnaeus, 1766, the nine-banded armadillo *Dasypus novemcinctus* Linnaeus, 1758 and the gray brocket deer *Mazama gouazoubira* G. Fischer, 1814 which are generalist species. Our results showed significant differences in mammal species richness and composition among the three habitat types. Plantations can have positive and negative effects on the presence of species restricted to grasslands. Positive effects are reflected in a wider local distribution of some forest species that rarely use grassland. The most important habitat and landscape variables that influenced mammal species richness and composition were vertical structure index, canopy cover, tree species diversity, percentage of grass, and the

percentage of forest and grassland at the landscape scale of 0.1 km. We advise the following important measures for conservation of this mammal community: 1) reduce logging and cattle grazing in gallery forest, and 2) increase grassland buffer zones between plantation and forest.

Anile, S, Bizzarri, L, Ragni, B. 2010. Estimation of European wildcat population size in Sicily (Italy) using camera trapping and capture-recapture analyses. ITALIAN JOURNAL OF ZOOLOGY 77(2):241-246

The wildcat is an elusive species that is threatened with extinction in many areas of its European distribution. In Sicily the wildcat lives in a wide range of habitats; this study was done on Mount Etna. In 2006, after an exploration of the study area, we used camera traps with the aim of obtaining photographs of the wildcat. After this pilot study we used the experience and data collected to develop a protocol to provide an estimation of the density of the wildcat's population using capture-recapture analyses and the natural coat-marking system to recognize different specimens. We placed two trapping lines adjacent to each other that were run in two consecutive data collection periods. Camera traps worked together for 671 trap-days and we obtained 27 pictures of wildcats, from which we were able to determine 9 different specimens. Then we constructed the history capture of each individual and we used the software CAPTURE to generate an estimation of the density of our study area (0.93 ± 0.13 wildcat per 100 ha). This value is higher than those calculated in other studies: many possible events could determine this high density in the wildcat population.

Bacon, MM, Boyce, MS. 2010. Scavenging of an Elk, *Cervus elaphus*, Carcass by Multiple Cougars, *Puma concolor*, in Southeastern Alberta. CANADIAN FIELD-NATURALIST 124(3):242-245.

We report the confirmed or suspected scavenging by six different Cougars, *Puma concolor*, on an Elk (*Cervus elaphus*) carcass, from January to April 2009, near Cypress Hills Interprovincial Park in southeastern Alberta, Canada. Visitations by Cougars were captured by a camera trap focused on the carcass; we were able to tentatively identify 6 individual Cougars by the presence of radio-collars, ear sizes and tail characteristics. Our photos are the first published event of >2 Cougars feeding on the same carcass.

Blake, JG, Mosquera, D, Guerra, J, Romo, D. 2010. New locality records and the first photographs of living *Echimys saturnus* (Dark tree rat, Echimyidae) from eastern Ecuador. ECOTROPICA 16(2):141-144.

NO ABSTRACT

Blake, JG, Guerra, J, Mosquera, D, Torres, R, Loiselle, BA, Romo, D. 2010. Use of Mineral Licks by White-Bellied Spider Monkeys (*Ateles belzebuth*) and Red Howler Monkeys (*Alouatta seniculus*) in Eastern Ecuador. INTERNATIONAL JOURNAL OF PRIMATOLOGY 31(3):471-483.

Geophagy occurs in all primate groups and is particularly common in species that consume greater quantities of plant material, i.e., leaves, fruit. The function of geophagy is not fully understood and likely varies over space and time, perhaps in connection with changes in diet. Central to a better understanding of geophagy in primate ecology is knowledge of the occurrence of such behavior among different species and seasons. We used camera traps triggered by heat and motion to document the use of mineral licks by primates over a 3-yr period at a lowland forest site in eastern Ecuador (Tiputini Biodiversity Station). Such mineral licks can be important sources of minerals, nutrients, and other compounds for a wide range of species in Amazonian forests. Although 10 species of primates are known from the study site, we obtained photographs of only 2 species,

Ateles belzebuth (white-bellied spider monkey) and *Alouatta seniculus* (red howler) at 2 of 4 saladeros surveyed. From late December 2004 through early January 2008, we recorded 192 photographs with a total of 318 *Ateles belzebuth* representing a parts per thousand separate visits. Comparable numbers for *Alouatta seniculus* were 80, 121, and 37. We recorded both species visiting a mineral lick at the same time on a parts per thousand occasions. Use of mineral licks varied across months; we recorded more visits from November through February, the drier period at Tiputini. Visits also varied by hour, with no visits before 0830 or after 1630; *Ateles belzebuth* showed a stronger mid-day peak in visits. Average visit length (calculated as the time between the first and last photographs of a given visit) was similar between the 2 species but median visit length was more than twice as long for *Ateles belzebuth* (15 min) as for *Alouatta seniculus* (6 min). Results indicate that mineral licks are important in the ecology of these species, but further studies are needed to determine the precise benefit(s) obtained and how benefits may vary with diet and other factors.

Brum, FT, Duarte, LD, Hartz, SM. 2010. Seed removal patterns by vertebrates in different successional stages of *Araucaria* forest advancing over southern Brazilian grasslands. COMMUNITY ECOLOGY 11(1):35-40.

Seed dispersal is a limiting factor in the maintenance and distribution of plant communities, especially in rainforest ecosystems where a major proportion of plant species are dispersed by animals. Knowledge of seed removal by terrestrial mammals (particularly small mammals) in *Araucaria* forest patches scattered in Campos grassland is relatively sparse. In this study, we assessed: (1) whether the removal rate of *Araucaria angustifolia* seeds differs in different successional stages of *Araucaria* forest advancing over grassland, and (2) the importance of small mammals and others vertebrates for seed removal rates in each environment type. We used seed removal experiments and camera trapping to answer these questions. Our results showed that seed removal was higher in more-forested sites than in open ones and in control treatment in 2006, we found an interaction

between successional stage and treatment in 2007 and, in 2008, only treatments differed significantly. Our photographic records were mostly of small cricetid rodents. Seed-removal increment as a function of forested area suggests increased use of these sites by terrestrial mammals as patches develop in grassland. The use of large patches by mammals may increase the probability of mammal-dispersed plants colonizing patches as they attain a given structural development, which might determine to some degree the future patch nucleation dynamics.

Burki, S, Roth, T, Robin, K, Weber, D. 2010. Lure sticks as a method to detect pine martens *Martes martes*. ACTA THERIOLOGICA 55(3):223-230.

Marten species are usually surveyed by trapping, snow tracking or camera-trapping with baits on trees. While testing the efficiency of a monitoring scheme for wildcats *Felis silvestris silvestris* in north-western Switzerland, we noticed that martens are attracted by lure sticks scented with valerian. On these sticks, the animals leaved some hairs that allowed us to identify the genus *Martes* by microscopic analysis. Additionally, the animal can be identified on pictures made by a camera trap posed close to the lure stick. In this paper, we compared the efficiency of different methods to find the most appropriate one in order to survey the pine marten *Martes martes* (Linnaeus, 1758) in Switzerland. For the method of valerian lure sticks we estimated a detectability of 0.08 per 14 days during the whole year. The detectability raised, when we applied American Hawbaker's marten lure instead of the valerian tincture. In addition, the detectability was higher during the period April to June (p = 0.2) compared to the whole year. If we identified the pine marten on the lure stick with pictures from the camera traps we reached a detectability of 0.21 during the whole year. Using only camera traps with baits on trees we could not take any picture of a pine marten.

Chapman, S, Balme, G. 2010. An estimate of leopard population density in a private reserve in KwaZulu-Natal, South Africa, using camera-traps and capture-recapture models. SOUTH AFRICAN JOURNAL OF WILDLIFE RESEARCH 40(2):114-120.

Camera-trap surveys, when combined with capture recapture models, are an accurate and cost-effective method for estimating the abundance of individually identifiable carnivore species such as leopards, *Panthera pardus*. Reliable population estimates for leopards are particularly useful as they enable informed conservation and management decisions for a species that, although widespread, is heavily persecuted. Here we present the results of a camera-trap survey that estimated the population density of leopards in Zululand Rhino Reserve (ZRR) in northern KwaZulu-Natal, South Africa. We divided our study area in half and subsampled each section for 40 days using 34 paired camera-trap stations. The combined data yielded captures of six individual leopards (3 male, 3 female) photographed on 19 occasions. Using the program CAPTURE, population abundance was estimated according to two models; one that assumes homogeneous capture probabilities among individual leopards (M(o)) and one that allows for heterogeneity in capture probabilities between individuals (M(h)). For model M(o), the resultant capture probability was 0.317 and estimated abundance was 6 ± 0.390 (6-6, 95% CI). For model M(h), the resultant capture probability was 0.112 and estimated abundance was 17 ± 6.37 (10-37, 95% CI). The area effectively sampled by the camera-traps was 234 KM^2. Therefore, the estimated population density of leopards in the reserve was 2.5 ± 0.195 leopards per 100 KM^2 according to model M(o), and 7.00 ± 2.64 leopards per 100 KM^2 according to model M(h). When compared with the results of similar surveys conducted in nearby reserves, our findings suggest that the leopard population in the ZRR is below carrying capacity. To encourage population recovery, we recommend that no trophy hunting of leopards be conducted in the reserve, that measures be introduced to reduce retaliatory killing of leopards by livestock owners in surrounding areas, and that the illegal trade in leopard skins be addressed.

Clements, R, Rayan, DM, Zafir, AWA, Venkataraman, A, Alfred, R, Payne, J, Ambu, L, Sharma, DSK. 2010. Trio under threat: can we secure the future of rhinos, elephants and tigers in Malaysia? BIODIVERSITY AND CONSERVATION 19(4):SI1115-1136.

Three of Malaysia's endangered large mammal species are experiencing contrasting futures. Populations of the Sumatran rhino (*Dicerorhinus sumatrensis*) have dwindled to critically low numbers in Peninsular Malaysia (current estimates need to be revised) and the state of Sabah (less than 40 individuals estimated). In the latter region, a bold intervention involving the translocation of isolated rhinos is being developed to concentrate them into a protected area to improve reproduction success rates. For the Asian elephant (*Elephas maximus*), recently established baselines for Peninsular Malaysia (0.09 elephants/KM^2 estimated from one site) and Sabah (between 0.56 and 2.15 elephants/KM^2 estimated from four sites) seem to indicate globally significant populations based on dung count surveys. Similar surveys are required to monitor elephant population trends at these sites and to determine baselines elsewhere. The population status of the Malayan tiger (*Panthera tigris jacksoni*) in Peninsular Malaysia, however, remains uncertain as only a couple of scientifically defensible camera-trapping surveys (1.66 and 2.59 tigers/100 KM^2 estimated from two sites) have been conducted to date. As conservation resources are limited, it may be prudent to focus tiger monitoring and protection efforts in priority areas identified by the National Tiger Action Plan for Malaysia. Apart from reviewing the conservation status of rhinos, elephants and tigers and threats facing them, we highlight existing and novel conservation initiatives, policies and frameworks that can help secure the long-term future of these iconic species in Malaysia.

De Bondi, N, White, JG, Stevens, M, Cooke, R. 2010. A comparison of the effectiveness of camera trapping and live trapping for sampling terrestrial small-mammal communities. WILDLIFE RESEARCH 37(6):456-465.

Context. There is an increasing reliance on the use of camera-trap technologies for surveys of medium to large terrestrial mammals. Camera trapping may, however, also have significant applications for broad-scale surveys of small mammals.

Aims. The present study aims to compare results from camera-trapping surveys to those of the more traditional live-trapping techniques. Specifically, it aims to test the effectiveness of the techniques for detecting species, and the cost effectiveness of both approaches.

Methods. Surveys were conducted across 36 sites in the Grampians National Park, Victoria, Australia, between April and July 2009. At each site, independent surveys were conducted for small mammals by using a combination of Elliot and cage trapping, then camera trapping. Results for the two different approaches were compared for both their ability to generate small-mammal presence data and their cost effectiveness.

Key results. Camera-trapping surveys of 36 sites in the Grampians National Park compared favourably with those of live-trapping surveys. Similar species were detected across the sites, and camera trapping was a considerably more cost effective than live trapping.

Conclusions. Camera-trapping surveys of small terrestrial mammals may provide a new and cost-effective technique for surveying terrestrial small mammals. This is particularly the case when presence data are the main requirement of the survey, with no requirement to capture and tag animals.

Implications. Given the cost-effective nature of camera trapping, there is potential to use this approach to increase the level of replication and spatial coverage of small-mammal surveys. Improving the replication and spatial coverage of studies has the potential to significantly increase the scope of research questions that can be asked, thus providing the potential to improve wildlife management.

Di Bitetti, MS, De Angelo, CD, Di Blanco, YE, Paviolo, A. 2010. Niche partitioning and species coexistence in a Neotropical felid assemblage.

Carnivores have been used as a model to understand the effects of competition in community structure Behavioral mechanisms that facilitate species coexistence have been poorly explored and may explain the lack of community-wide morphological character displacement in some carnivore assemblages. We use the results of large-scale and intensive camera-trap surveys conducted in the Atlantic Forest of NE Argentina between 2003 and 2008 to describe the spatial patterns of detection and the daily pattern of records of the six wild cat species present in the region (jaguar *Panthera onca*, puma *Puma concolor*, ocelot *Leopardus pardalis*, jaguarundi *Puma yagouaroundi*, margay *Leopardus wiedii*, and oncilla *Leopardus trigrinus*) We use these patterns to generate hypotheses about behavioral differences that may facilitate species coexistence. The larger species were more frequently recorded in the better-protected areas, probably as a result of anthropogenic effects (poaching of cats and their prey). Competitive release from ocelots and jaguarundis may explain why the oncilla and the margay showed the opposite pattern Morphologically similar species had the most contrasting activity patterns, the margay was exclusively nocturnal and the jaguarundi diurnal The other species were cathemeral, but alternated their peaks of activity in relation to the relative order of their body weights The contrasting temporal patterns observed and the ability of pumas and oncillas to adjust their activity patterns to local conditions may facilitate the coexistence of these cat species and explain the lack of character displacement in this assemblage.

Dobson, A, Nowak, K. 2010. Does this photo make my range look big? ANIMAL CONSERVATION, 13(4):347-349.

NO ABSTRACT

Ford, AT, Clevenger, AP. 2010. Validity of the Prey-Trap Hypothesis for Carnivore-Ungulate Interactions at Wildlife-Crossing Structures. CONSERVATION BIOLOGY. 24(6):1679-1685.

Wildlife-exclusion fencing and wildlife-crossing structures (e.g., underpasses and overpasses) are becoming increasingly common features of highway projects around the world. The prey-trap hypothesis posits that predators exploit crossing structures to detect and capture prey. The hypothesis predicts that predation events occur closer to a highway after the construction of fences and crossing structures and that prey species' use of crossings increases the probability that predators will attack prey. We examined interactions between ungulates and large carnivores at 28 wildlife crossing structures along 45 km of the Trans-Canada Highway in Banff National Park, Alberta. We obtained long-term records of locations where ungulates were killed (kill sites) before and after crossing structures were built. We also placed remote, motion-triggered cameras at two crossing structures to monitor predator behavior following ungulate passage through the structure. The proximity of ungulate kill sites to the highway was similar before and after construction of fencing and crossing structures. We found only five kill sites near crossing structures after more than 32,000 visits over 13 years. We found no evidence that predator behavior at crossing structures is affected by prey movement. Our results suggest that interactions between large mammals and their prey at wildlife-crossing structures in Banff National Park are not explained by the prey-trap hypothesis.

Foster, RJ, Harmsen, BJ, Doncaster, CP. 2010. Habitat Use by Sympatric Jaguars and Pumas Across a Gradient of Human Disturbance in Belize. BIOTROPICA 42(6):724-731

Jaguars (*Panthera onca*) and pumas (*Puma concolor*) are sympatric across the entire jaguar range, where they coexist in increasingly fragmented

landscapes under threat of persecution mainly in response to livestock predation. Pumas are known to inhabit a greater variety of natural habitats than jaguars, but little is known about the influence of anthropogenic factors on the coexistence of these two similar-sized cats. This study compares habitat use of jaguars and pumas in Belize, Central America, using 1380 jaguar and puma photo captures from 3 yr of camera trapping, comprising 64-74 individual jaguars and an unknown number of pumas. Jaguars and pumas did not differ in their use of a large block of relatively homogenous secondary rain forest. However, pumas were scarce outside this forest block, whereas jaguars were detected throughout the human-influenced landscape. Reasons for this discrepancy may include differential tolerance to human disturbance, and resource limitation for pumas outside the forest block. Intra-specific variation in jaguar activity in the form of sex-dependent habitat use was detected across the landscape. Male jaguars were detected at more locations than female jaguars and more frequently at each location, with a declining difference from a 50-fold greater detection in the protected forest, through forest buffer, savannah, pastures, to negligible difference in the disturbed forest.

Fusco-Costa, R, Ingberman, B, do Couto, HTZ, Nakano-Oliveira, E, Monteiro, ELD. 2010. Population density of a coastal island population of the ocelot in Atlantic Forest, southeastern Brazil. MAMMALIAN BIOLOGY 75(4):358-362.

NO ABSTRACT

Gardner, B, Royle, JA, Wegan, MT, Rainbolt, RE, Curtis, PD. 2010. Estimating Black Bear Density Using DNA Data From Hair Snares. JOURNAL OF WILDLIFE MANAGEMENT 74(2):318-325

DNA-based mark-recapture has become a methodological cornerstone of research focused on bear species. The objective of such studies is often to estimate population size; however, doing so is frequently complicated by movement of individual bears. Movement affects the probability of detection and the assumption of closure of the population required in most models. To mitigate the bias caused by movement of individuals, population size and density estimates are often adjusted using ad hoc methods, including buffering the minimum polygon of the trapping array. We used a hierarchical, spatial capture-recapture model that contains explicit components for the spatial-point process that governs the distribution of individuals and their exposure to (via movement), and detection by, traps. We modeled detection probability as a function of each individual's distance to the trap and an indicator variable for previous capture to account for possible behavioral responses. We applied our model to a 2006 hair-snare study of a black bear (*Ursus americanus*) population in northern New York, USA. Based on the microsatellite marker analysis of collected hair samples, 47 individuals were identified. We estimated mean density at 0.20 bears/KM^2. A positive estimate of the indicator variable suggests that bears are attracted to baited sites; therefore, including a trap-dependence covariate is important when using bait to attract individuals. Bayesian analysis of the model was implemented in WinBUGS, and we provide the model specification. The model can be applied to any spatially organized trapping array (hair snares, camera traps, mist nests, etc.) to estimate density and can also account for heterogeneity and covariate information at the trap or individual level.

Gardner, B, Reppucci, J, Lucherini, M, Royle, JA. 2010. Spatially explicit inference for open populations: estimating demographic parameters from camera-trap studies. ECOLOGY 91(11):3376-3383

We develop a hierarchical capture-recapture model for demographically open populations when auxiliary spatial information about location of capture is obtained. Such spatial capture-recapture data arise from studies based on camera trapping, DNA sampling, and other situations in which a

spatial array of devices records encounters of unique individuals. We integrate an individual-based formulation of a Jolly-Seber type model with recently developed spatially explicit capture-recapture models to estimate density and demographic parameters for survival and recruitment. We adopt a Bayesian framework for inference under this model using the method of data augmentation which is implemented in the software program WinBUGS. The model was motivated by a camera trapping study of Pampas cats *Leopardus colocolo* from Argentina, which we present as an illustration of the model in this paper. We provide estimates of density and the first quantitative assessment of vital rates for the Pampas cat in the High Andes. The precision of these estimates is poor due likely to the sparse data set. Unlike conventional inference methods which usually rely on asymptotic arguments, Bayesian inferences are valid in arbitrary sample sizes, and thus the method is ideal for the study of rare or endangered species for which small data sets are typical.

Gerber, B, Karpanty, SM, Crawford, C, Kotschwar, M, Randianantenaina, J. 2010. An assessment of carnivore relative abundance and density in the eastern rainforests of Madagascar using remotely-triggered camera traps. ORYX 44(2):219-222.

Despite major efforts to understand and conserve Madagascar's unique biodiversity, relatively little is known about the island's carnivore populations We therefore deployed 43 camera-trap stations in Ranomafana National Park, Madagascar during June-August 2007 to evaluate the efficacy of this method for studying Malagasy carnivores and to estimate the relative abundance and density of carnivores in the eastern rainforest A total of 755 camera-trap nights provided 1,605 photographs of four endemic carnivore species (fossa *Cryptoprocta ferox*, Malagasy civet *Fossa fossana*, ring-tailed mongoose *Galidia elegans* and broad-striped mongoose *Galidictus fasciata*), the exotic Indian civet *Viverricula indica* and the domestic dog *Canis familiaris*. We Identified 38 individual *F fossana* and 10 individual *C ferox*. We estimated density using both capture-recapture analyses, with a buffer of full mean-maximum-distance-

moved, and a spatially-explicit maximum-likelihood method (*F fossana* 3.03 and 2.23 km^{-2}, respectively, *C. ferox* 0.15 and 0.17 km^{-2}, respectively). Our estimated densities of *C ferox* in rainforest are lower than published estimates for conspecifics in the western dry forests. Within Ranomafana National Park species richness of native carnivores did not vary among trail systems located in secondary, selectively-logged and undisturbed forest. These results provide the first assessment of carnivore population parameters using camera-traps in the eastern rainforests of Madagascar.

Ghoddousi, A, Hamidi, AK, Ghadirian, T, Ashayeri, D, Khorozyan, I. 2010. The status of the Endangered Persian leopard *Panthera pardus saxicolor* in Bamu National Park, Iran. ORYX 44(4):551-557.

We describe the use of camera-trapping with capture-recapture, occupancy and visitation rate modelling to study the size, demographic structure and distribution of the Persian leopard *Panthera pardus saxicolor* in Bamu National Park, southern Iran. A total sampling effort of 1,012 trap-nights yielded photo-captures of four adults, two subadult individuals and a cub over 21 sampling occasions. The leopard population size estimated by the M(h) model and jackknife estimator was 6.00 ± SE 0.24 individuals. This gives a density of 1.87 ± SE 0.07 leopards per 100 KM^2. Detection probability was constant and low and, as a result, estimated occupancy rate was significantly higher than that predicted from photographic capture sites alone. Occupancy was 56% of the protected area and visitation rates were 0.01-0.05 visits per day. The most imminent threats to leopards in Bamu are poaching and habitat fragmentation.

Gopal, R, Qureshi, Q, Bhardwaj, M, Singh, RKJ, Jhala, YV. 2010. Evaluating the status of the Endangered tiger *Panthera tigris* and its prey in Panna Tiger Reserve, Madhya Pradesh, India. ORYX 44(3):383-389.

We evaluated the status of tigers *Panthera tigris* and their prey in Panna Tiger Reserve using occupancy surveys, camera-trap mark-recapture population estimation, and distance sampling along foot transects, in 2006. Forest Range tiger occupancy in the Panna landscape (3,500 KM^2) estimated by 1,077 surveys of 5 km each was 29% ± SE 1. Within occupied Ranges of the Reserve a mean of 68% ± SE 7 of forest Beats had tiger signs. A total of 800 camera-trap nights yielded 24 captures of seven individual adult tigers within an effective trap area of 185.0 ± SE 15.8 km^{-2}. The best model incorporating individual heterogeneity (M(h)) estimated the tiger population to be 9 ± SE 2. Tiger density was 4.9 ± SE 1.5 per 100 KM^2 and was lower than that reported in 2002 (6.49 tigers per 100 KM^2). Both occupancy and density indicated a decline of the tiger population in the Reserve. Mean ungulate density was 42.4 ± SE 8.4 km^{-2} and comparable to other tiger reserves. Since our survey in 2006 tiger status in Panna has deteriorated further because of poaching. Panna was occupied by dacoits in late 2006 and anti-insurgent activities caused further disturbances. In late 2008 there was a single male tiger left in Panna but he has not been seen since January 2009. The Madhya Pradesh Forest department has reintroduced three tigers to Panna from neighbouring tiger reserves. Panna, along with Sariska Tiger Reserve, exemplifies the vulnerability of small, isolated tiger populations to local extinctions caused by poaching, even in areas with suitable habitat and sufficient prey.

Grunewald, C, Breitbach, N, Bohning-Gaese, K. 2010. Tree visitation and seed dispersal of wild cherries by terrestrial mammals along a human land-use gradient. BASIC AND APPLIED ECOLOGY 11(6):532-541.

The role of terrestrial mammals as seed dispersers of fleshy-fruited plants has only rarely been investigated in temperate regions although recent studies underline the importance of these animals for long-distance seed dispersal Here we examine the potential role of mammals as seed dispersers of wild cherry (*Prunus avium* L) along a gradient of human land-use intensity We placed camera traps at 21 wild cherry trees to identify the mammal species that visited the trees We conducted feeding trials to test if

the recorded species were legitimate seed dispersers or seed predators and to assess gut passage times We tested the influence of human land-use intensity by quantifying habitat and landscape structure around the study trees at different spatial scales and analyzing its influence on visitation rates of tree visitors Red fox (*Vulpes vulpes*), roe deer (*Capreolus capreolus*), wild boar (*Sus scrofa*), marten (*Martes* spp) and badger (*Meles meles*) were identified as seed dispersers of wild cherry, of which wild boar was largely a seed predator Habitat and landscape structure at local spatial scales (70 m, 500 m radius) had no effect on the total visitation rates of mammals At larger spatial scales (1 0-10 0 km radius) total visitation rates increased with increasing proportion of extensively used farmland and seminatural habitat in the area The proportion of forest had no influence on visitation rates The results suggest that high proportions of extensively used farmland and seminatural habitat increase the visitation and seed dispersal rates of large mammals Comparing gut passage times with home range sizes and daily travel distances suggests that these mammals have the potential to disperse seeds over long distances and can provide gene flow in fragmented agricultural landscapes

Guil, F, Agudin, S, El-Khadir, N, Fernandez-Olalla, M, Figueredo, J, Dominguez, FG, Garzon, P, Gonzalez, G, Munoz-Igualada, J, Oria, J, Silvestre, F. 2010. Factors conditioning the camera-trapping efficiency for the Iberian lynx (*Lynx pardinus*). EUROPEAN JOURNAL OF WILDLIFE RESEARCH 56(4):633-640.

Camera trapping is the most used method for surveying medium-sized carnivores in Spain. The main target for these surveys has been the Iberian lynx, the most endangered cat in the world. The Iberian lynx conservation program has received the largest EU LIFE projects grant. So, efficiency is a key goal for managing this grant. During 2003 and 2007, we have applied these funds to the survey of the Iberian lynx in Eastern Sierra Morena (Spain). Using two different techniques, we have studied both to see which is the most efficient. The survey developed in active latrines resulted more efficient than that of scent stations and live prey camera

trapping throughout the years, although there has been a variation between years. Otherwise, the live prey method has been the one providing the greatest speed and number of pictures per entrance. We suggest that camera-trapping surveys can be improved in terms of efficiency for a wide range of species, or at least for the Iberian lynx. To improve the results, cameras might be placed in relation to breeding territories. With this determinant, camera-trapping surveys would be shorter than 120 days. Finally, we suggest how those surveys for medium carnivores should be designed.

Harihar, A, Ghosh, M, Fernandes, M, Pandav, B, Goyal, SP. 2010. Use of photographic capture-recapture sampling to estimate density of Striped Hyena (*Hyaena hyaena*): implications for conservation. MAMMALIA 74(1):83-87.

NO ABSTRACT

Hariyadi, AR, Setiawan, R, Daryan, AY, Purnama, H. 2010. Preliminary behaviour observations of the Javan rhinoceros (*Rhinoceros sondaicus*) based on video trap surveys in Ujung Kulon National Park. PACHYDERM 47:93-99.

The behaviours of ten critically endangered Javan rhinoceros (*Rhinoceros sondaicus*) were observed using video camera traps on the peninsula of Ujung Kulon National Park (06 degrees 38'30'-06 degrees 52'30' south and 105 degrees 12'00'-105 degrees 37'30' east), and were organized as descriptive lists of activities (ethogram). Behavioural data were analyzed by examining the length of time each individual rhino displayed a specific activity (duration). Duration of each activity was calculated as a proportion within a total observation time (length of rhino observation in video recording). In addition to duration, the frequency of each activity was

recorded. A quantitative analysis summarizing duration and frequency of activities will be used as baseline information about Javan rhino behaviours that can enrich our knowledge of this reclusive species. The results from this study suggest that the use of video trap equipment for quantifying the behaviour of Javan rhinoceros is promising.

Harmsen, BJ, Foster, RJ, Gutierrez, SM, Marin, SY, Doncaster, CP. 2010. Scrape-marking behavior of jaguars (Panthera onca) and pumas (Puma concolor). JOURNAL OF MAMMALOGY 91(5):1225-1234

Marking behaviors of jaguars (*Panthera onca*) and pumas (*Puma concolor*) were investigated by linking sign from transect surveys to species, sex, and individual detected by camera traps along trails in the Cockscomb Basin Wildlife Sanctuary, Belize. The most commonly encountered big-cat signs were scrape marks. These were produced by cats raking the ground with their feet. Scrapes were associated more strongly with presence of male pumas than with female pumas or jaguars of either sex. Scats found in scrapes were genotyped to species level and indicated that jaguars produced larger scrapes than pumas and that pumas were more likely to scrape with their hind feet than with front feet. Scrapes were spatially clustered along trails, indicating that individuals scrape in response to other scrapes in the same area. High scraping frequencies were not associated with the presence of specific individuals, suggesting that scrape-marking behavior does not signal dominance in this area.

Harmsen, BJ, Foster, RJ, Silver, S, Ostro, L, Doncaster, CP. 2010. Differential Use of Trails by Forest Mammals and the Implications for Camera-Trap Studies: A Case Study from Belize. BIOTROPICA 42(1):126-133.

Relative abundance indices are often used to compare species abundance between sites. The indices assume that species have similar detection probabilities, or that differences between detection probabilities are known and can be corrected for. Indices often consist of encounter frequencies of footprints, burrows, markings or photo captures along trails or transect lines, but the assumption of equal detection probabilities is rarely validated. This study analyzes detection probabilities of a range of Neotropical mammals on trails in dense secondary forests, using camera-trap and track data. Photo captures of the two large cats, jaguars (*Panthera onca*) and pumas (*Puma concolor*), were correlated solely with trail variables, while photo captures of their potential prey species had no correlation or negative correlation with trail variables. The Neotropical mammals varied greatly in their tendency to follow or cross trails based on footprints surveys. This indicates that camera locations on trails will have varying detection probability for these Neotropical mammals. Even the two similar-sized jaguars and pumas, occupying relatively similar niches, differed subtly in their use of trails. Pumas followed trails more completely while jaguars were more likely to deviate from trails. The ecological significance of these findings is that jaguars seem to be more willing to use the forest matrix away from trails than do pumas. We conclude that trail-based indices, such as photographic captures or tracks along trails, are not appropriate for comparison between Neotropical species, and not even between relatively similar species like jaguars and pumas.

Hughson, DL, Darby, NW, Dungan, JD. 2010. Comparison of motion-activated cameras for wildlife investigations. CALIFORNIA FISH AND GAME 96(2):101-109.

Motion-triggered cameras are useful in wildlife investigations but quantitative metrics derived from photographs potentially include substantial error. We compared six models of cameras placed side-by-side at a small spring in Mojave National Preserve, California, for 63 days in the spring of 2006, and for 40 days in the fall of 2007. Total number of different species detected varied by camera from 2 to 14 in the first trial and from 1

to 6 in the second. Total number of wildlife photographs taken by each camera ranged from 18 to 348 in the first trial and from 0 to 95 in the second. Photographic rates of a single species, mule deer (*Odocoileus hemionus*), differed by as much as 100% between two units of the same camera model. We did find, however, that the distribution of time intervals between photographs of mule deer was similar for different cameras. These results indicate that photographic rates and number of species detected by motion-triggered cameras can vary significantly even for identical models placed side by side, and have important implications regarding the interpretation of such data across areas.

Ilemin, Y, Gurkan, B. 2010. Status and activity patterns of the Caracal, *Caracal caracal* (Schreber, 1776), in Datca and Bozburun Peninsulas, southwestern Turkey. ZOOLOGY IN THE MIDDLE EAST 50:3-10.

We were able to document the presence of the Caracal, *Caracal caracal* (Schreber, 1776), in southwestern Turkey in the course of a survey carried out in Datca and Bozburun Peninsulas between December 2007 and August 2008 with the help of camera traps. The Caracal was found to occur mainly (72% of the records) in pine woodlands with high habitat heterogeneity. 28% of the records are from mamas vegetation and this may be related to the high abundance of wild goats in this habitat, especially at the end of the winter season. However, no Caracal records were obtained from low scrub (phrygana) vegetation. Caracals were active during both day and night except for late morning and around midnight. Altogether, 13 medium-sized and large mammal species were detected during the camera trap survey.

Kawanishi, K, Sunquist, ME, Eizirik, E, Lynam, AJ, Ngoprasert, D, Shahruddin, NW, Rayan, DM, Sharma, DSK, Steinmetz, R. 2010. Near fixation of melanism in leopards of the Malay Peninsula. JOURNAL OF ZOOLOGY 282(3):201-206.

Melanistic leopards *Panthera pardus* are common in south-east Asian forests but the exact frequency of this variant phenotype is difficult to assess. Records from camera-trapping studies conducted at 22 locations in Peninsular Malaysia and southern Thailand between 1996 and 2009 show that only melanistic leopards were present in samples south of the Isthmus of Kra. During 42 565 trap-nights, we collected 445 photos of melanistic leopards and 29 photos of the spotted or non-melanistic morph. All 29 photos of spotted leopards came from study sites north of the Isthmus. These results indicate that this recessive trait may be nearly fixed in P. pardus populations of the Malay Peninsula, suggesting a unique evolutionary history of leopards in the region. Assuming a very small effective population size (N(e)=100) and a high initial allelic frequency, at least 1000 years would be expected to elapse until a neutral allele became fixed. The severe bottleneck implied by this scenario provides a testable hypothesis that can be addressed using molecular markers and evidence of past glacioeustatic changes across the region. Although natural selection might lead to rapid fixation of melanism within Malayan leopards, had their effective population size been much larger (e.g. N(e)=5000) and stable, with a lower allelic frequency, the fixation would require a longer time span (e.g. 20 000 years) if induced by genetic drift alone.

Kitamura, S, Thong-Aree, S, Madsri, S, Poonswad, P. 2010. Mammal diversity and conservation in a small isolated forest of southern Thailand. RAFFLES BULLETIN OF ZOOLOGY 58(1):145-156.

Knowledge of the presence and distribution of species is crucial for designing and evaluating conservation strategies within a region. We conducted a camera-trapping survey of terrestrial mammal and bird diversity in a small isolated forest of southern Thailand over 3 yr. A total of 15 camera traps, which accumulated 11,106 camera-days, were set in three forest types: primary, logged, and hill forests. Despite its small size, isolation, and surrounding agricultural areas, a total of 35 mammal

species, eight bird species, and one reptile species were recorded in the forest system. The total number of species photographed was similar among forest types (26-30 species), and rarefaction curves of each forest did not indicate any differences in the relationship between sampling effort and recorded species richness. As the activity period of these animals does not appear to be affected by human activities, we believe that the effect of direct poaching on large mammals in the study area is negligible. Although we did not observe any previously unrecorded animals in our study site, our findings are very valuable and point to the importance of biodivcrsity conservation efforts in these small fragmented and human-modified forest landscapes.

Kolowski, JM, Alonso, A. 2010. Density and activity patterns of ocelots (*Leopardus pardalis*) in northern Peru and the impact of oil exploration activities. BIOLOGICAL CONSERVATION 143(4):917-925.

The western Amazon is experiencing unprecedented levels of oil and gas exploration, a trend of particular concern given the high levels of biodiversity found in this relatively pristine and unstudied region. Despite the widespread use of seismic reflection technology for exploration, no studies have investigated the response of wildlife populations to this disturbance in the tropics. We conducted a trail camera survey inside a large oil concession (Block 39) in the Peruvian Amazon near the Ecuador border with ongoing 2D seismic explorations to investigate its effects on ocelot (*Leopardus pardalis*) activity and abundance The estimated size of the ocelot population within our 22 KM2 study area was the same before (control period. 34 ± 69 ocelots) and during exploration operations (disturbance period, 34 ± 46 ocelots) and we detected no change in activity patterns between the two periods Ocelot capture rate was unaffected by the presence of seismic crews, and distance to the nearest seismic line was not correlated with capture rate at individual stations Our density estimates (ocelots/100 KM^2) from the control (75.2) and disturbance period (94.7) include the highest reported for the species, and represent the first ocelot density estimates from the northwest Amazon forest

These high values conform to recent research showing a positive association between ocelot density, annual rainfall, and proximity to the equator (this study >2500 mm annual rainfall; <200 km from equator) We discuss the potential short- and long-term environmental impacts of seismic operations, particularly as they relate to large mammal populations.

Kuprewicz, EK, Garcia-Robledo, C. 2010. Mammal and insect predation of chemically and structurally defended *Mucuna holtonii* (Fabaceae) seeds in a Costa Rican rain forest. JOURNAL OF TROPICAL ECOLOGY 26:263-269.

To prevent seed losses from predation. plants have developed protective strategies. Seeds may utilize chemical or structural defences to deter predators. *Mucuna holtonii* (Fabaceae) has large seeds containing a toxic amino acid. L-dopa. and covered with a hard seed coat. Our study assessed the effectiveness of chemical and mechanical seed defences against vertebrate and invertebrate seed predators within Estacion Biologica La Selva, Costa Rica. Pre-dispersal insect and fungus attack of *M. holtonii* seeds was low (95.7% of 1493 seeds were undamaged). Camera traps monitoring 90 marked *M. holtonii* seeds showed that the collared peccary (*Pecari tajacu*) consumed 98.6% of 69 removed seeds over 16 d. Field experiments involving 100 seeds with intact and 100 with opened seed coats found that only opened seeds had endosperm removed by *Sericomyrmex amabilis* ants (0.5-100% of endosperm removed). Shade-house experiments showed that seeds with high amounts of endosperm removed by ants resulted in low germination success and low seedling biomass production. Although *M. holtonii* seeds are rich in L-dopa, this compound is not an effective chemical defence against mammals that possess foregut fermentation. The seed coat of *M. holtonii* is an effective structural defence against invertebrate seed predators, preventing endosperm removal and enhancing seedling survival.

Lau, MWN, Fellowes, JR, Chan, BPL. 2010. Carnivores (Mammalia: Carnivora) in South China: a status review with notes on the commercial trade. MAMMAL REVIEW 40(4):247-292

Evidence from the literature, interviews, market surveys, general rapid field surveys and camera trapping was reviewed to infer the regional status of 33 recorded carnivores in South China (Guangxi, Guangdong, Hainan, Hong Kong and Macau). The carnivore fauna in South China is among the most depleted for any continental area in the world. The tiger *Panthera tigris*, leopard *Panthera pardus*, grey wolf *Canis lupus* and binturong *Arctictis binturong* are probably extirpated. The dhole *Cuon alpinus*, Asiatic golden cat *Catopuma temmincki* and clouded leopard *Neofelis nebulosa* are at great risk of regional extirpation, as are the more ecologically adaptable red fox *Vulpes vulpes*, raccoon dog *Nyctereutes procyonoides*, Asian badger *Meles leucurus*, Eurasian otter *Lutra lutra*, Oriental small-clawed otter *Aonyx cinereus* and large Indian civet *Viverra zibetha*. Though more widely reported, the Asiatic black bear *Ursus thibetanus*, yellow-throated marten *Martes flavigula*, hog badger *Arctonyx collaris* and Siberian weasel *Mustela sibirica* are at regional risk. The status of the Burmese ferret-badger *Melogale personata*, stripe-backed weasel *Mustela strigidorsa*, smooth-coated otter *Lutrogale perspicillata*, large-spotted civet *Viverra megaspila* and Owston's palm civet *Chrotogale owstoni* is uncertain due to inadequate information. Five carnivore species - the Chinese ferret-badger *Melogale moschata*, masked palm civet *Paguma larvata*, yellow-bellied weasel *Mustela kathiah*, small Indian civet *Viverricula indica* and leopard cat *Prionailurus bengalensis* - are relatively secure (though not common) in the region, along with the Asian palm civet *Paradoxurus hermaphroditus* and the Javan mongoose *Herpestes javanicus* in some areas, while the spotted linsang *Prionodon pardicolor* and crab-eating mongoose *Herpestes urva* may have been under-reported. The main threats have been habitat destruction and unsustainable exploitation. Only in Hong Kong, where enforcement of protection legislation has been stronger, are the surviving carnivore species easily encountered. Improved enforcement and monitoring are essential to retaining the remainder of

South China's carnivores. Support could be boosted by conservation education and better research.

Li, S, Wang, DJ, Gu, XD, McShea, WJ. 2010. Beyond pandas, the need for a standardized monitoring protocol for large mammals in Chinese nature reserves. BIODIVERSITY AND CONSERVATION 19(11):3195-3206

Monitoring programs are important for effective conservation and management programs. However, most of these programs rely on indirect sign surveys of elusive animals that often leave cryptic signs of their presence. In Sichuan Province, China, sign surveys are oriented mainly toward giant panda (*Ailuropoda melanoleuca*) populations but also are used to track other nationally listed species. We have developed and tested a monitoring system based on camera-trapping that can detect a wide range of large, terrestrial mammal and bird species within the reserves of Sichuan. This system is embedded within current protected area patrolling activities and relies on a partnership of management agencies, universities and international organizations. The international organizations and national universities primarily provide the training and assist with study design and data analysis. Data management and access is controlled at the regional level by the appropriate state agencies. Limitations to this system include the need for additional training and support to less developed reserves and the long-term availability of funds to support field staff. However, the potential return on investment is a consistent tracking of multiple species across diverse set of reserves, facilitating comparative analysis of results that will assist in adaptive management throughout the region.

Linkie, M, Guillera-Arroita, G, Smith, J, Rayan, DM. 2010. Monitoring tigers with confidence. INTEGRATIVE ZOOLOGY 5(4):342-350.

With only 5% of the world's wild tigers (*Panthera tigris* Linnaeus, 1758) remaining since the last century, conservationists urgently need to know whether or not the management strategies currently being employed are effectively protecting these tigers. This knowledge is contingent on the ability to reliably monitor tiger populations, or subsets, over space and time. In the this paper, we focus on the 2 seminal methodologies (camera trap and occupancy surveys) that have enabled the monitoring of tiger populations with greater confidence. Specifically, we: (i) describe their statistical theory and application in the field; (ii) discuss issues associated with their survey designs and state variable modeling; and, (iii) discuss their future directions. These methods have had an unprecedented influence on increasing statistical rigor within tiger surveys and, also, surveys of other carnivore species. Nevertheless, only 2 published camera trap studies have gone beyond single baseline assessments and actually monitored population trends. For low density tiger populations (e.g. < 1 adult tiger/100 km^2) obtaining sufficient precision for state variable estimates from camera trapping remains a challenge because of insufficient detection probabilities and/or sample sizes. Occupancy surveys have overcome this problem by redefining the sampling unit (e.g. grid cells and not individual tigers). Current research is focusing on developing spatially explicit capture-mark-recapture models and estimating abundance indices from landscape-scale occupancy surveys, as well as the use of genetic information for identifying and monitoring tigers. The widespread application of these monitoring methods in the field now enables complementary studies on the impact of the different threats to tiger populations and their response to varying management intervention.

Mazzolli, M. 2010. Mosaics of Exotic Forest Plantations and Native Forests as Habitat of Pumas. ENVIRONMENTAL MANAGEMENT 46(2):237-253.

There is a general lack of information on the impact of forest plantations and the presence of urban settlements on populations of resource-demanding species such as large felids. To partially address this problem, a project study was conducted to find out whether mosaics of forest

plantations and native vegetation can function as an adequate habitat for pumas (*Puma concolor*) in southern Brazil. The study was conducted within a 1255-KM^2 area, managed for planted stands of *Pinus* spp. and *Eucalyptus* spp. Individual identification of pumas was carried out using a combination of track-matching analysis (discriminant analysis) and camera-trapping. Both techniques recorded closely similar numbers of individual pumas, either total (9-10 individuals) or resident (5-6 individuals). A new approach, developed during this study, was used to individualize pumas by their markings around the muzzle. The estimated density varied from 6.2 to 6.9 individuals/100 KM^2, ranking among the highest across the entire puma range and indicating a potential total population of up to 87 individuals in the study site. In spite of the availability of extensive areas without human disturbance, a radio-tracked female used a core home range that included forest plantations, an urbanized village, and a two-lane paved road with regular vehicular traffic. The high density of pumas and the species' intensive use of modified landscapes are interpreted here as deriving from conditions rarely found near human settlements: mutual tolerance by pumas and humans and an adequate habitat (regardless of plantations) largely due to the inhibition of invasions and hunting and maintenance of sizable extents of native forest patches. More widely, it suggests the potential of careful management in forestry operations to provide habitat conditions for resource-demanding species such as the puma. Furthermore, it highlights the importance of curbing invasions and hunting, in this case provided by the presence of company employees, for the maintenance of wildlife populations.

McCarthy, JL, McCarthy, KP, Fuller, TK, McCarthy, TM. 2010. Assessing Variation in Wildlife Biodiversity in the Tien Shan Mountains of Kyrgyzstan Using Ancillary Camera-trap Photos. MOUNTAIN RESEARCH AND DEVELOPMENT 30(3):295-301.

During the summer and fall of 2005 while documenting snow leopard (*Panthera uncia*) abundance (McCarthy et al 2008), we collected ancillary camera-trap photos taken in the Tien Shan Mountains of Kyrgyzstan and

assessed their usefulness for biodiversity surveys of larger animal species. The study was conducted in 2 separate areas; one that had been declared a strictly protected national park, and a second that had no formal protection but was used as a hunting reserve by foreign interests. By using 22-24 pairs of cameras placed for 49 days in both areas, we photographed 9 of 13 probably occurring large (> 1 kg) mammal species identified in a country-wide review. Of the 9 species that appeared in photographs, 4 also were identified genetically from simultaneously collected scat samples. Two species identified by the genetic sample were not photographed. Photo rates differed between areas and corresponded to independent abundance estimates for snow leopards (from fecal genetic individual identification), and for argali (*Ovus ammon*) and Siberian ibex (*Capra ibex*; both from visual surveys). The photo rates of ungulates were highest, and those for large carnivores were lowest, in the "strictly protected area," which suggested an effect from illicit control of predators by occupants of the surrounding villages. In contrast, in the unprotected area, where hunting was managed and local residents and visitors were few, the species diversity and photo rates for most species were higher. Our use of ancillary camera-trap photos was valuable for authenticating species presence and, sometimes, for documenting differences in species abundances between areas with different conservation histories. In addition, this study indicates the importance of continued outreach and collaboration with villagers to ensure effective wildlife conservation within Kyrgyz national parks.

Michalski, F. 2010. The bush dog *Speothos venaticus* and short-eared dog *Atelocynus microtis* in a fragmented landscape in southern Amazonia. ORYX 44(2):300-303.

The bush dog *Speothos venaticus* and the short-eared dog *Atelocynus microtis* are categorized as Near Threatened on the IUCN Red List I document the occurrence of these two little known canids in a fragmented landscape in southern Amazonia (around Alta Floresta, Mato Grosso state, Brazil) using interviews and two extensive camera-trapping surveys. From a

total of 144 interviews conducted during 2001-2002 in forest fragments and continuous forest sites, bush and short-eared clogs were confirmed in only eight (5.6%) and 14 (9.7%) forest sites, respectively Two camera-trapping surveys, conducted in 2003-2004 and 2007-2008, with a total of 6,721 camera-trap days, recorded two photographs of bush dogs and seven of short-eared dogs, in three continuous forest sites. On the basis of the large sampling effort it appears that these two elusive species occur at low densities in the study region. The continued presence of these species in an agricultural frontier with high deforestation rates makes this information of relevance for long-term conservation initiatives in this region and in other Neotropical agricultural frontiers.

Miller, CS, Hebblewhite, M, Goodrich, JM, Miquelle, DG. 2010. Review of research methodologies for tigers: Telemetry. INTEGRATIVE ZOOLOGY 5(4):378-389.

Over the past half century, wildlife research has relied on technological advances to gain additional insight into the secretive lives of animals. This revolution started in the 1960s with the development of radio telemetry and continues today with the use of Global Positioning System (GPS)-based research techniques. In the present paper we review the history of radio telemetry from its origins with grizzly bears in Yellowstone to its early applications in tiger research and conservation in Asia. We address the different types of data that are available using radio telemetry as opposed to using other research techniques, such as behavioral observations, camera trapping, DNA analysis and scat analysis. In the late 1990s, the rapid development of GPS collar technology revolutionized wildlife research. This new technology has enabled researchers to dramatically improve their ability to gather data on animal movements and ecology. Despite the ecological and conservation benefits of radio telemetry, there have been few telemetry studies of tigers in the wild, and most have been on the Bengal or Amur subspecies. We close with an assessment of the current tiger conservation efforts using GPS technology and discuss how this new information can help to preserve tigers for future generations.

Murray, LG, Seed, R. 2010. Determining whether catch per unit effort is a suitable proxy for relative crab abundance. MARINE ECOLOGY PROGRESS SERIES 401:173-182.

Stock assessments of crabs commonly rely on catch per unit effort (CPUE) data derived from catches in baited traps. Baited traps have been used for many years to estimate the relative abundance of predators in the marine environment. However, traps may result in biased estimates due to inter- and intra-species variations in physiology and behaviour. The aim of this study was to determine the suitability of CPUE as a proxy for the relative abundance of *Carcinus amends*. Crab abundance estimates were obtained using underwater camera surveys. The study was conducted on commercial mussel beds in the Menai Strait, United Kingdom. CPUE data were obtained from the local *C. maenas* fishery operating over the mussel beds. The influence of temperature-dependent feeding rates on CPUE was predicted from the number of mussels consumed at different experimental temperatures in laboratory aquaria. Both CPUE and estimated abundance showed marked seasonal variation. Abundance maxima preceded temperature maxima by 2 mo. CPUE increased with temperature up to 15 C, while relative crab abundance based on visual surveys exhibited a strong positive correlation with day-length. CPUE appears not to be a suitable proxy for the relative abundance of *C. maenas* because of the effects of temperature on crab activity levels and thus catches.

Negroes, N, Sarmento, P, Cruz, J, Eira, C, Revilla, E, Fonseca, C, Sollmann, R, Torres, NM, Furtado, MM, Jacomo, ATA, Silveira, L. 2010. Use of Camera-Trapping to Estimate Puma Density and Influencing Factors in Central Brazil. JOURNAL OF WILDLIFE MANAGEMENT 74(6):1195-1203.

We used remotely triggered cameras to collect data on Puma (*Puma concolor*) abundance and occupancy in an area of tropical forest in Brazil where the species' status is poorly known. To evaluate factors influencing puma occupancy we used data from 5 sampling campaigns in 3 consecutive years (2005 to 2007) and 2 seasons (wet and dry), at a state park and a private forest reserve. We estimated puma numbers and density for the 2007 sampling data by developing a standardized individual identification method. We based individual identification on 1) time-stable parameters (SP; physical features that do not change over time), and 2) time-variable parameters (VP; marks that could change over time such as scars and botfly marks). Following individual identification we established a capture-recapture history and analyzed it using closed population capture-mark-recapture models. Puma capture probability was influenced by camera placement (roads vs. trails), sampling year, and prey richness. Puma occupancy was positively associated with species richness and there was a correlation between relative puma and jaguar (Panthera onca) abundance. Identifications enabled us to generate 8 VP histories for each photographed flank, corresponding to 8 individuals. We estimated the sampled population at 9 pumas (SE = 1.03, 95% CI = 8-10 individuals) translating to a density of 3.40 pumas/100 KM^2. Information collected using camera-traps can effectively be used to assess puma population size in tropical forests. As habitat progressively disappears and South American felines become more vulnerable, our results support the critical importance of private forest reserves for conservation.

Nichols, JD. 2010. The wildlife picture index, monitoring and conservation. Animal Conservation 13(4):344-346.

NO ABSTRACT

Norris, D, Michalski, F, Peres, CA. 2010. Habitat patch size modulates terrestrial mammal activity patterns in Amazonian forest fragments. JOURNAL OF MAMMALOGY 91(3):351-560.

Understanding how environmental change influences the behavior of organisms is central for both ecological understanding and species conservation. We used camera traps to monitor the diurnal variation in activity of 3 ubiquitous terrestrial mammals in Neotropical forests-nine-banded armadillos (*Dasypus novemcinctus*), common opossums (*Didelphis marsupialis*), and red-rumped agoutis (*Dasyprocta leporina*) across a fragmented forest landscape of the southern Brazilian Amazon. Results from a total of 3,086 camera-trap days distributed across 21 forest patches (ranging in size from 2 to 14,480 ha) and 2 undisturbed continuous forest areas were used to test the effects of a series of abiotic and forest disturbance variables on species activity. An information theoretic analysis revealed significant predictors of the temporal distribution of activity that varied among species. Habitat fragmentation affected the activity of both nocturnal species, but effects of habitat patch area depended on interactions with disturbance variables for the common opossum. Of the 3 species investigated, *D. novemcinctus* exhibited the greatest variation in activity in relation to forest patch size. Armadillos were strictly nocturnal in forest areas >1,000 ha, whereas their foraging activity switched to a cathemeral pattern, with up to 60% of all photos recorded during the day in smaller forest patches (<1,000 ha). In contrast, the time since forest patches had been isolated was the only significant predictor of activity patterns for agoutis, a diurnal species exhibiting a bimodal activity pattern. Our results

support the hypothesis that behavioral plasticity is an important determinant of species persistence in small forest remnants dominated by edge effects.

Obbard, ME, Howe, EJ, Kyle, CJ. 2010. Empirical comparison of density estimators for large carnivores. JOURNAL OF APPLIED ECOLOGY 47(1):76-84.

1. Population density is a critical ecological parameter informing effective wildlife management and conservation decisions. Density is often estimated by dividing capture-recapture (C-R) estimates of abundance ((N) over cap) by size of the study area, but this relies on the assumption of geographic closure - a situation rarely achieved in studies of large carnivores. For geographically open populations (N) over cap is overestimated relative to the size of the study area because animals with only part of their home range on the study area are available for capture. This bias ('edge effect') is more severe when animals such as large carnivores range widely. To compensate for edge effect, a boundary strip around the trap array is commonly included when estimating the effective trap area ((A) over cap). Various methods for estimating the width of the boundary strip are proposed, but (N) over cap/(A) over cap estimates of large carnivore density are generally mistrusted unless concurrent telemetry data are available to define (A) over cap. Remote sampling by cameras or hair snags may reduce study costs and duration, yet without telemetry data inflated density estimates remain problematic.

2. We evaluated recently developed spatially explicit capture-recapture (SECR) models using data from a common large carnivore, the American black bear *Ursus americanus*, obtained by remote sampling of 11 geographically open populations. These models permit direct estimation of population density from C-R data without assuming geographic closure. We compared estimates derived using this approach to those derived using conventional approaches that estimate density as (N) over cap/(A) over cap.

3. Spatially explicit C-R estimates were 20-200% lower than densities estimated as (N) over cap/(A) over cap. AIC(c) supported individual heterogeneity in capture probabilities and home range sizes. Variable home range size could not be accounted for when estimating density as (N) over cap/(A) over cap.

4. Synthesis and applications. We conclude that the higher densities estimated as (N) over cap/(A) over cap compared to estimates from SECR models are consistent with positive bias due to edge effects in the former. Inflated density estimates could lead to management decisions placing threatened or endangered large carnivores at greater risk. Such decisions could be avoided by estimating density by SECR when bias due to geographic closure violation cannot be minimized by study design.

O'Brien, TG. 2010. Wildlife picture index and biodiversity monitoring: issues and future directions. ANIMAL CONSERVATION 13(4):350-352.

NO ABSTRACT.

O'Brien, TG, Baillie, JEM, Krueger, L, Cuke, M. 2010. The Wildlife Picture Index: monitoring top trophic levels. ANIMAL CONSERVATION 13(4):335-343.

Although recent biodiversity loss has been compared with cataclysmic mass extinctions, we still possess few indicators that can assess the extent or location of biodiversity loss on a global scale. The Convention on Biological Diversity (CBD) has mandated development of indicators that can meet the needs of monitoring biodiversity by 2010. To date, many indicators rely on unwarranted assumptions, secondary data, expert opinion and retrospective time series. We present a new biodiversity indicator, the Wildlife Picture Index (WPI) that targets medium and large-sized terrestrial birds and mammals in forested and savannah ecosystems that. The WPI is a

composite indicator based on the geometric mean of relative occupancy estimates derived from camera trap sampling at a landscape scale. It has been designed to meet the needs of a CBD indicator while avoiding many of the pitfalls that characterize some CBD indicators. We present an example using 8 years of camera trap data from Bukit Barisan Selatan National Park, Indonesia to show that the WPI is capable of detecting changes in the rate of loss of biodiversity, a key requirement of a CBD indicator. We conclude that the WPI should be effective at monitoring top trophic levels in forest and savannah ecosystems using primary data and can fill the gap in knowledge about trends in tropical biodiversity.

Odden, M, Wegge, P, Fredriksen, T. 2010. Do tigers displace leopards? If so, why? ECOLOGICAL RESEARCH 25(4):875-881

We investigated predictions concerning the competitive relationships between tigers *Panthera tigris* and leopards *Panthera pardus* in Bardia National Park, Nepal, based on spatial distributions of scats and territorial markings (sign), analyses of scat content and census of wild ungulate prey. Medium-sized ungulates, in particular chital Axis axis, was the main food of both predators, but leopards consumed significantly larger proportions of domestic animals, small mammals, and birds than tigers. Tiger sign were never found outside the park, while leopard sign occurred both inside and outside, and were significantly closer to the park border than tiger sign. Significantly higher prey densities at locations of tiger sign than that of leopards were mainly due to a preference of the latter species for the park border areas. Our results imply that interference competition–and not competition for food–was a limiting factor for the leopard population, whose distribution was restricted to the margins of the tiger territories. We suggest that the composition of the prey base is a key factor in understanding the different results and interpretations reported in studies on tiger/leopard coexistence. There are two potential mechanisms that link interference competition and prey: (1) low abundance of large ungulate prey decreases foraging efficiency of tigers, leading to increased energetic stress and aggression towards leopards; and (2) increased diet overlap due

to scarcity of large prey leads to increased encounter rates and increased levels of interference competition.

Oliveira-Santos, LGR, Machado, LCP, Tortato, MA, Brusius, L. 2010. Influence of extrinsic variables on activity and habitat selection of lowland tapirs (*Tapirus terrestris*) in the coastal sand plain shrub, southern Brazil. MAMMALIAN BIOLOGY 75(3):219-226.

The objectives of this research were to: 1. evaluate the circadian activity patterns of lowland tapirs (*Tapirus terrestris*) throughout the seasons and 2. study the influence of moonlight, temperature and rainfall on the activity patterns and habitat selection of this species, in the coastal sand shrub in southern Brazil. From June 2005 to June 2006, eight tapirs were monitored in a large enclosure containing open and vegetation-covered areas, using four camera traps. Differences in activity patterns within seasons were found. Tapir predominately presented nocturnal-crepuscular activity; however, they differed in the winter, with cathemeral activity patterns. Covered areas were mostly used during periods of extreme temperatures, with less diurnal and more nocturnal activities within these areas, on hotter days. Activity in open areas mainly occurred during periods of intermediate temperatures, both during the day and in the night. Moonlight intensity did not influence nocturnal activities. On days of precipitation of 34 mm or more, there was no record of open-area activities, despite constant activity in covered-area.

Oliveira-Santos, LGR, Zucco, CA, Antunes, PC, Crawshaw, PG. 2010. Is it possible to individually identify mammals with no natural markings using camera-traps? A controlled case-study with lowland tapirs. MAMMALIAN BIOLOGY 75(4):375-378.

NO ABSTRACT

Ordenana, MA, Crooks, KR, Boydston, EE, Fisher, RN, Lyren, LM, Siudyla, S, Haas, CD, Harris, S, Hathaway, SA, Turschak, GM, Miles, AK, Van Vuren, DH. 2010. Effects of urbanization on carnivore species distribution and richness. JOURNAL OF MAMMALOGY 91(6):1322-1331.

Urban development can have multiple effects on mammalian carnivore communities. We conducted a meta-analysis of 7,929 photographs from 217 localities in 11 camera-trap studies across coastal southern California to describe habitat use and determine the effects of urban proximity (distance to urban edge) and intensity (percentage of area urbanized) on carnivore occurrence and species richness in natural habitats close to the urban boundary. Coyotes (*Canis latrans*) and bobcats (*Lynx rufus*) were distributed widely across the region. Domestic dogs (*Canis lupus fatniliaris*), striped skunks (*Mephitis mephitis*), raccoons (*Procyon lotor*), gray foxes (*Urocyon cinereoargenteus*), mountain lions (*Puma concolor*), and Virginia opossums (*Didelphis virginiana*) were detected less frequently, and long-tailed weasels (*Mustela.frenata*), American badgers (*Taxidea taxi's*), western spotted skunks (*Spilogale gracilis*), and domestic cats (*Felis catus*) were detected rarely. Habitat use generally reflected availability for most species. Coyote and raccoon occurrence increased with both proximity to and intensity of urbanization, whereas bobcat, gray fox, and mountain lion occurrence decreased with urban proximity and intensity. Domestic dogs and Virginia opossums exhibited positive and weak negative relationships, respectively, with urban intensity but were unaffected by urban proximity. Striped skunk occurrence increased with urban proximity but decreased with urban intensity. Native species richness was negatively associated with urban intensity but not urban proximity, probably because of the stronger negative response of individual species to urban intensity.

Pei, KJC, Lai, YC, Corlett, RT, Suen, KY. 2010. The Larger Mammal Fauna of Hong Kong: Species Survival in a Highly Degraded Landscape. ZOOLOGICAL STUDIES 49(2): 253-264.

We spent 3 yr (2000-2003) surveying the status of larger mammals (> 0.5 kg) in the highly fragmented and degraded landscape of Hong Kong using 373 camera-trap sites distributed in 43 terrestrial wildlife habitat patches. In total, 20 mammal species were recorded including 15 larger mammals. The Malayan porcupine (*Hystrix brachyura*) and red muntjac (*Muntiacus muntjak*) were apparently the most abundant species, while the crab-eating mongoose (Herpestes urva), Chinese pangolin (*Manis pentadactyla*), small Indian mongoose (*Herpestes javanicus*), and yellow-bellied weasel (*Mustela kathiah*) were the least abundant. The red muntjac, small Indian civet (Viverricula indica), and Malayan porcupine had the widest distributions, while the Chinese pangolin, small Indian mongoose, and yellow-bellied weasel were most restricted. Many species were absent from Lantau I., despite its relatively large size (144 KM^2) and lower current human disturbance, suggesting past extirpations. The key management need for larger mammals in Hong Kong is the protection and enhancement of habitat links between adjacent protected areas, especially the cross-border corridor between the National Forest Park in Shenzhen, Guangdong Province and the Country Park system in Hong Kong.

Pettorelli, N, Lobora, AL, Msuha, MJ, Foley, C, Durant, SM. 2010. Carnivore biodiversity in Tanzania: revealing the distribution patterns of secretive mammals using camera traps. ANIMAL CONSERVATION 13(2):131-139.

Biodiversity monitoring is critical to assess the effectiveness of management activities and policy change, particularly in the light of accelerating impacts of environmental change, and for compiling national responses to international obligations and agreements. Monitoring methods able to identify species most likely to be affected by environmental change, and pinpoint those changes with the strongest impacts, will enable managers to target efforts towards vulnerable species and significant threats. Here we take a new approach to carnivore monitoring, combining camera-trap

surveys with ecological niche factor analysis to assess distribution and patterns of habitat use of mammalian carnivore assemblages across northern Tanzania. We conducted 11 surveys over 430 camera-trap stations and 11 355 trap-days. We recorded 23 out of 35 carnivore species known to occur in Tanzania and report major extensions to the known distribution of the bushy-tailed mongoose Bdeogale crassicauda, previously thought to be rare. Carnivore biodiversity tended to be higher in national parks than in game reserves and forest reserves. We explored habitat use for seven species for which we had sufficient information. All species tended to be found near rivers and southern *Acacia commiphora* woodlands (except one mongoose species), and avoided deciduous shrubland, favouring deciduous woodland and/or open grassland. All species tended to avoid croplands suggesting that habitat conversion to agriculture could have serious implications for carnivore distribution. Our study provides a first example where camera-trap data are combined with niche analyses to reveal patterns in habitat use and spatial distribution of otherwise elusive and poorly known species and to inform reserve design and land-use planning. Our methodology represents a potentially powerful tool that can inform national and site-based wildlife managers and policy makers as well as international agreements on conservation.

Prasad, S, Pittet, A, Sukumar, R. 2010. Who really ate the fruit? A novel approach to camera trapping for quantifying frugivory by ruminants. ECOLOGICAL RESEARCH 25(1):225-231.

Tropical forest ruminants disperse several plants; yet, their effectiveness as seed dispersers is not systematically quantified. Information on frequency and extent of frugivory by ruminants is lacking. Techniques such as tree watches or fruit traps adapted from avian frugivore studies are not suitable to study terrestrial frugivores, and conventional camera traps provide little quantitative information. We used a novel time-delay camera-trap technique to assess the effectiveness of ruminants as seed dispersers for *Phyllanthus emblica* at Mudumalai, southern India. After being triggered by animal movement, cameras were programmed to take pictures every 2 min for the

next 6 min, yielding a sequence of four pictures. Actual frugivores were differentiated from mere visitors, who did not consume fruit, by comparing the number of fruit remaining across the time-delay photograph sequence. During a 2-year study using this technique, we found that six terrestrial mammals consumed fallen *P. emblica* fruit. Additionally, seven mammals and one bird species visited fruiting trees but did not consume fallen fruit. Two ruminants, the Indian chevrotain *Moschiola indica* and chital *Axis axis*, were *P. emblica's* most frequent frugivores and they accounted for over 95% of fruit removal, while murid rodents accounted for less than 1%. Plants like *P. emblica* that are dispersed mainly by large mammalian frugivores are likely to have limited ability to migrate across fragmented landscapes in response to rapidly changing climates. We hope that more quantitative information on ruminant frugivory will become available with a wider application of our time-delay camera-trap technique.

Rao, M, Htun, S, Zaw, T, Myint, T. 2010. Hunting, Livelihoods and Declining Wildlife in the Hponkanrazi Wildlife Sanctuary, North Myanmar. ENVIRONMENTAL MANAGEMENT 46(2):143-153.

The Hponkanrazi Wildlife Sanctuary, North Myanmar and three contiguous protected areas, comprise some of the largest expanses of natural forest remaining in the region. Demand for wildlife products has resulted in unsustainable exploitation of commercially valuable species resulting in local extirpation of vulnerable species. Camera trap, track and sign, and questionnaire-based surveys were used to examine (a) wildlife species targeted by hunters, (b) the importance of wild meat for household consumption, and (c) the significance of hunting as a livelihood activity for resident villages. Certain commercially valuable species highly preferred by hunters were either completely absent from hunt records (tiger, musk deer and otter) or infrequently obtained during actual hunts (bear, pangolin). Species obtained by hunters were commonly occurring species such as muntjacs with low commercial value and not highly preferred by hunters. Fifty eight percent of respondents (n = 84) indicated trade, 27% listed subsistence use and 14% listed human-wildlife conflict as the main reason

for hunting (n = 84). Average amount of wild meat consumed per month is not significantly higher during the hunting season compared to the planting season (paired t-test, P > 0.05). Throughout the year, the average amount of fish consumed per month was higher than livestock or wild meat (Friedman test, P < 0.0001). Hunting is driven largely by trade and wild meat, while not a critical source of food for a large number of families could potentially be an important, indirect source of access to food for hunting families. Findings and trends from this study are potentially useful in helping design effective conservation strategies to address globally prevalent problems of declining wildlife populations and dependent human communities. The study provides recommendations to reduce illegal hunting and protect vulnerable species by strengthening park management through enforcement, increasing the opportunity costs of poaching, establishing no-take zones and research to determine the economic significance of hunting for livelihoods.

Romero-Munoz, A, Maffei, L, Cuellar, E, Noss, AJ. 2010. Temporal separation between jaguar and puma in the dry forests of southern Bolivia. JOURNAL OF TROPICAL ECOLOGY 26:303-311.

Despite the potential importance of temporal separation for the coexistence of competing species, no study has found significant segregation at the circadian level between jaguar (*Panthera onca*) and puma (*Puma concolor*) in sympatry. Using data from camera trap surveys (wet and dry seasons), we have evaluated the activity patterns of both species and their potential prey at four areas in the dry forest of the Bolivian Chaco. We tested if temporal separation existed between these two species, and if their activity was related to that or a particular prey. At most sites, activity patterns or jaguar and puma did not vary significantly between seasons, except for puma at one site. There were no differences between sexes for any cat species at any site. At three sites we found statistically significant differences in the activity patterns of jaguar and puma. as they showed a clear temporal segregation. None of them followed the activity patterns of any particular prey species across sites. The latter suggests that segregation

is influenced by avoidance behaviour between the two felid species. Therefore, temporal separation may be an important behavioural factor promoting the coexistence of jaguar and puma in some areas of this dry forest.

Sarmento, PB, Cruz, JP, Eira, CI, Fonseca, C. 2010. Habitat selection and abundance of common genets *Genetta genetta* using camera capture-mark-recapture data. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 56(1):59-66.

Using camera-trapping techniques, the present study, conducted from 2005 to 2007, provides common genet abundance estimates in Serra da Malcata Nature Reserve (central-eastern Portugal). We estimated genet abundance using the software CAPTURE. It was possible to obtain a capture success of 1.49 captures/100 trap-nights. Considering the heterogeneity model (M-h), which presents higher biological significance, the estimated density varied between 0.50 (95% CI = 0.43-0.56 genets/KM^2) to 0.92 (95% CI = 0.87-0.97 genets/KM^2) genets/KM^2 with an average density value of 0.70 genets/KM^2 (95% CI = 0.58-0.82 genets/KM^2). These estimates emphasized this technique as a reliable method for assessing average genet density over large spatial scales and for monitoring future changes in genet numbers. In terms of habitat selection, genets selected *Quercus rotundifolia* and *Arbutus unedo* woodlands and avoided *Erica* spp. and *Cistus ladanifer* scrubland and Eucalyptus stands. Considering the landscape heterogeneity outside the reserve, our study emphasizes the importance of the protected area for small carnivore conservation.

Seufert, V, Linden, B, Fischer, F. 2010. Revealing secondary seed removers: results from camera trapping AFRICAN JOURNAL OF ECOLOGY 48(4):914-922.

This paper reports the results of the first study on secondary seed removal of seeds dispersed by Sykes' monkeys (*Cercopithecus albogularis*) using camera traps in Africa. Patterns of primary seed dispersal are often superimposed by secondary conveyance, emphasising the need to study these secondary processes carefully. As the agents and mechanisms of seed dispersal are often concealed, being carried out by cryptic or nocturnal animals in dense vegetation, camera trapping was deemed a viable means to investigate secondary removal of seeds disseminated by *C. albogularis* in the Western Soutpansberg, South Africa. Camera traps were established at preferred feeding trees of the focal Sykes' monkey group to identify animal species that remove seeds and fruits spat and dropped to the forest floor and seed removal observations were carried out. This method proved to be effective in identifying seed removers and also allowed to get indications about the quantities of seeds removed. Ten animal species were recorded visiting the trees, of which eight were observed removing seeds and fruits. Overall seed and fruit removal rates were high, indicating that the foraging behaviour of *C. albogularis* attracts many terrestrial frugivores.

Sharma, RK, Jhala, Y, Qureshi, Q, Vattakaven, J, Gopal, R, Nayak, K. 2010. Evaluating capture-recapture population and density estimation of tigers in a population with known parameters. ANIMAL CONSERVATION 13(1):94-103.

Conservation strategies for endangered species require accurate and precise estimates of abundance. Unfortunately, obtaining unbiased estimates can be difficult due to inappropriate estimator models and study design. We evaluate population-density estimators for tigers *Panthera tigris* in Kanha Tiger Reserve, India, using camera traps in conjunction with telemetry (n=6) in a known minimum population of 14 tigers. An effort of 462 trap nights over 42 days yielded 44 photographs of 12 adult tigers. Using closed population estimators, the best-fit model (program capture) accounted for individual heterogeneity (M(h)). The least biased and precise

population estimate ((n) over cap (SE) [(n) over cap]) was obtained by the M(h) Jackknife 1 (JK1) [14 (1.89)] in program care-2. Tiger density ((D) over cap (SE) [(D) over cap]) per 100 KM^2 was estimated at 13 (2.08) when the effective trapping area was estimated using the half mean maximum distance moved (1/2 MMDM), 8.1 (2.08), using the home-range radius, 7.8 (1.59), with the full MMDM and 8.0 (3.0) with the spatial likelihood method in program density 4.1. The actual density of collared tigers (3.27 per 100 km^2) was closely estimated by home-range radius at 3.9 (0.76), full MMDM at 3.48 (0.81) and spatial likelihood at 3.78 (1.54), but overestimated by 1/2 MMDM at 6 (0.81) tigers per 100 KM^2. Sampling costs (Rs. 450 per camera day) increased linearly with camera density, while the precision of population estimates leveled off at 25 cameras per 100 KM^2. At simulated low tiger densities, a camera density of 50 per 100 KM^2 with an effort of 8 trap nights km^{-2} provided 95% confidence coverage, but estimates lacked precision.

Silva-Rodriguez, EA, Verdugo, C, Aleuy, OA, Sanderson, JG, Ortega-Solis, GR, Osorio-Zuniga, F, Gonzalez-Acuna, D. 2010. Evaluating mortality sources for the Vulnerable pudu *Pudu puda* in Chile: implications for the conservation of a threatened deer. ORYX 44(1):97-103.

We assessed the importance of potential Sources of mortality for the Vulnerable southern pudu *Pudu puda* in southern Chile using the clinical records of wildlife rehabilitation centres, necropsies of animals found in the field and a review of the diet of potential predators. To assess whether the identified mortality sources operate in nominally protected areas, we conducted a camera-trap survey in two areas to determine the presence of pudus and their potential predators. Predation by domestic dogs *Canis lupus familiaris* and car collisions were the commonest causes of pudu admissions to rehabilitation centres (35 of 44) and of deaths of animals encountered opportunistically in the field (seven of 14). Field data suggest that poaching could also be an important threat to pudus. Pudus were detected in both areas surveyed, accounting for 15.6% of mammal detections. Dogs accounted for 47.8% of all detections of potential predator

species, followed by pumas *Puma concolor* (17.4%), guignas *Leopardus guigna* (17.4%) and chilla foxes *Lycalopex griseus* (17.4%). The literature survey implicated only pumas as important pudu predators among native carnivores. Our data suggest that, aside from forest loss, dogs, road kills and probably poaching are important concerns for pudu conservation. Our frequent detections of free-ranging dogs associated with roads within nominally protected areas suggest that long-term efforts to conserve pudu will require not only the protection of remnant native forest but also substantive environmental education to modify dog management near protected areas.

Silveira, L, Jacomo, ATA, Astete, S, Sollmann, R, Torres, NM, Furtado, MM, Marinho, J. 2010. Density of the Near Threatened jaguar *Panthera onca* in the caatinga of north-eastern Brazil. ORYX 44(1):104-109.

We report the first estimate of jaguar density in the semi-arid caatinga biome of north-eastern Brazil. During August-October 2007, in the Serra da Capivara National Park, we used camera traps to identify and count jaguars. Jaguar abundance and density were calculated using mark-recapture models. In a sampling effort of 1,249 camera-trap-nights we identified 12 adult jaguars and estimated an 2 abundance of 14 ± 3.6 jaguars in an area of 524 KM^2, i.e. a density of 2.67 ± 1.00 jaguars per 100 KM^2. This estimate is higher than in most other Brazilian biomes and indicates Serra da Capivara National Park as an important reserve for protecting jaguars in north-eastern Brazil.

Singh, P, Gopalaswamy, AM, Karanth, KU. 2010. Factors influencing densities of striped hyenas (*Hyaena hyaena*) in arid regions of India. JOURNAL OF MAMMALOGY 91(5):1152-1159.

The striped hyena (*Hyaena hyaena*), despite being a threatened species, frequently occurs in human-dominated landscapes of India's Rajasthan State. We estimated hyena densities using photographic capture recapture sampling to identify key ecological factors influencing hyena abundances in such areas. Our 2 study sites (307 KM^2 in Kumbhalgarh Wildlife Sanctuary and 218 KM^2 in Esrana Forest Range) had different topographies and levels of human disturbances. We proposed explicit hypotheses regarding effects of livestock densities and topographic features on hyena abundances. We tested these hypotheses by examining the correspondence of estimated hyena densities to food availability in the form of livestock carcasses and potential refugia offered by hilly terrain. Sampling efforts of 548 and 538 camera-trap nights were invested in Kumbhalgarh and Esrana, respectively. Density estimates (hyenas/100 KM^2) based on capture recapture sampling were higher (6.5 ± 2.6 SE) for Kumbhalgarh than Esrana (3.67 ± 0.3 SE). Our results supported the prediction that denning refugia in hilly terrain sustain higher hyena densities, but the prediction that higher livestock densities maintain higher hyena densities was not supported. Because the striped hyena is a threatened species for which few data exist, our findings have major potential utility for range-wide conservation of the species.

Soria-Diaz, L, Monroy-Vilchis, O, Rodriguez-Soto, C, Zarco-Gonzalez, MM, Urios, V. 2010. Variation of abundance and density of *Puma concolor* in zones of high and low concentration of camera traps in Central Mexico. ANIMAL BIOLOGY 60(4):361-371.

Little is known about the status of *Puma concolor* populations in Central and South America. Due to this reason, the present study contributes to the knowledge on puma populations providing information on abundance and density in Sierra Nanchititla, Mexico, as well as comparing recorded values against those obtained from zones of high and low concentration of camera traps. The sampling was carried out during a period of 30 months, which were divided into 3-month independent blocks. For the 8 first blocks, ten camera traps were set in an area where the separation among cameras

was 1.6 km, and in the 2 last blocks 17 camera traps were set in an area where the separation was 4.6 km. The abundance was estimated between 2 and 5 individuals for the area with the highest concentration of cameras, lower than the abundance obtained in the area with the lowest concentration of cameras, i.e., 6 individuals. The density of the area with the highest camera concentration had a variation between 2.74 and 6.86 individuals/100 KM^2 in an effective survey area of 72.8 KM^2 and for the area of lowest concentration it was 1.21 individual/100 KM^2 in an effective survey area of 492.6 KM^2.

Stein, AB, Erckie, B, Fuller, TK, Marker, L. 2010. Camera trapping as a method for monitoring rhino populations within the Waterberg Plateau Park, Namibia. PACHYDERM 48:67-70.

For species with unique markings, camera trapping has been used as a non-invasive method for generating population estimates and monitoring the fate of particular individuals. Rhinos-both black (*Diceros bicornis*) and white (*Ceratotherium simum*)-have unique horn sizes, shapes and scarring, making camera trapping a monitoring technique that could be useful. Over a 7-week period during 2006 in the Waterberg Plateau Park (WPP) in Namibia, we obtained 125 photos of rhinos from 11 camera stations during 545 camera nights, about half of which were useful in identifying 18 individual black rhinos and 13 white rhinos. Additional coverage of the Park could lead to more complete counts that would complement ongoing monitoring efforts.

Tonini, JFR, Carao, LD, Pinto, ID, Gasparini, JL, Leite, YLR, Costa, LP. 2010. Non-volant tetrapods from Reserva Biologica de Duas Bocas, State of Espirito Santo, Southeastern Brazil. BIOTA NEOTROPICA 10(3):339-351.

Reserva Biologica de Duas Bocas (2,910 ha) is one of the largest Atlantic forest remnants in the State of Espirito Santo, Southeastern Brazil. We recorded non-volant tetrapods in this area from May 2007 through April 2008, using pitfalls, live traps, camera traps, and diurnal and nocturnal opportunistic searches. In addition, we compiled available museum and literature records from this area. We documented 52 species of amphibians, 24 species of non-avian reptiles, and 39 species of non-volant mammals. Out of these 115 species, 47 are new records for this area and six other species had their geographic ranges expanded with the present study. Furthermore, we present the record of predation of the tree frog *Hypsiboas faber* by the snake *Chironius bicarinatus*. Out of the species listed, five species are listed as threatened with extinction in the State of Espirito Santo, and many others have uncertain conservation status. Reserva Biologica de Duas Bocas is an important wildlife refuge, especially considering the expansion of urban areas in its surroundings.

Treves, A, Mwima, P, Plumptre, AJ, Isoke, S. 2010. Camera-trapping forest-woodland wildlife of western Uganda reveals how gregariousness biases estimates of relative abundance and distribution. BIOLOGICAL CONSERVATION 143(2):521-528.

Camera traps are increasingly used to estimate relative abundance and distribution of wildlife. These methods are powerful and efficient ways to inventory multiple species simultaneously and count rare, secretive individuals across landscapes. However the estimation methods demand assumptions about relative capture probability that may not hold well for gregarious animals. We present results from the first systematic, camera-trap study in forest-wood land, western Uganda. Within a landscape of seven protected areas with globally important biodiversity, we detected >36 species of large mammals and birds in 8841 camera-trap days. Species photographed in groups of two or more individuals produced higher estimates of relative abundance and wider distribution than species photographed as single individuals. We propose these findings reflect higher detectability for animals that forage or travel in groups. We discuss

how capture-recapture theory should be adapted to account for both non-independence among individuals in groups and for the interaction between individual and temporal variation in capture probability. We also identify several species that deserve greater conservation attention in Uganda and beyond. Among them, leopards were unexpectedly rare, especially when compared to the sympatric African golden cat. We recommend against a recent policy on leopard trophy hunting, at least in western Uganda.

Wrege, PH, Rowland, ED, Thompson, BG, Batruch, N. 2010. Use of Acoustic Tools to Reveal Otherwise Cryptic Responses of Forest Elephants to Oil Exploration. CONSERVATION BIOLOGY 24(6):1578-1585

Most evaluations of the effects of human activities on wild animals have focused on estimating changes in abundance and distribution of threatened species; however, ecosystem disturbances also affect aspects of animal behavior such as short-term movement, activity budgets, and reproduction. It may take a long time for changes in behavior to manifest as changes in abundance or distribution. Therefore, it is important to have methods with which to detect short-term behavioral responses to human activity. We used continuous acoustic and seismic monitoring to evaluate the short-term effects of seismic prospecting for oil on forest elephants (*Loxodonta cyclotis*) in Gabon, Central Africa. We monitored changes in elephant abundance and activity as a function of the frequency and intensity of acoustic and seismic signals from dynamite detonation and human activity. Elephants did not flee the area being explored; the relative number of elephants increased in a seasonal pattern typical of elsewhere in the ecosystem. In the exploration area, however, they became more nocturnal. Neither the intensity nor the frequency of dynamite blasts affected the frequency of calling or the daily pattern of elephant activity. Nevertheless, the shift of activity to nocturnal hours became more pronounced as human activity neared each monitored area of forest. This change in activity pattern and its likely causes would not have been detected through standard monitoring methods, which are not sensitive to behavioral changes over short time scales (e.g., dung transects, point counts) or cover a limited area (e.g., camera traps). Simultaneous

acoustic monitoring of animal communication, human, and environmental sounds allows the documentation of short-term behavioral changes in response to human disturbance.

Xu, F, Ma, M, Wu, Y. 2010. Recovery of Snow Leopard *Uncia uncia* in Tomur National Nature Reserve of Xinjiang, Northwestern China. PAKISTAN JOURNAL OF ZOOLOGY 42(6):825-827

Tomur National Nature Reserve (TNNR) is one of the biggest reserves in northwestern China containing the endangered snow leopards. But only a few snow leopard signs were found here by Schaller in 1988. And it was reported that more than 10 snow leopards were illegally killed by local herders the next year after Schaller's survey, so the snow leopard was assumed to have nearly disappeared in this nature reserve. From October to November 2004 and October to December 2005, we conducted snow leopard sign surveys in four major valleys in TNNR using the Snow Leopard Information Management System (SLIMS). We ran 69 transects covering c. 39.7 km and located 56 sites with 131 snow leopard signs. Combined with the results of previous snow leopard sign surveys and camera trapping studies in Muzart valley of TNNR, we conclude that snow leopards appear to have re-inhabited the nature reserve. But conflict between snow leopard and herders still exist in this area and we are far from resolving it.

Yamada, F, Kawauchi, N, Nakata, K, Abe, S, Kotaka, N, Takashima, A, Murata, C, Kuroiwa, A. 2010. Rediscovery after thirty years since the last capture of the critically endangered Okinawa spiny rat *Tokudaia muenninki* in the northern part of Okinawa Island. MAMMAL STUDY 35(4):243-255.

The Okinawa spiny rat, *Tokudaia muenninki*, is a critically endangered species endemic to the northern part of Okinawa Island and may be extinct in the wild as there have been no recent sightings of the animal in its natural habitat. We initiated the present search to determine whether the spiny rat still exists in the northern part of Okinawa Island. Sensor cameras and traps were distributed across areas in which past studies had identified the location of occurrence of spiny rats. From a total of 1,276 camera-nights and 2,096 trap-nights from 2007 to 2009, we captured 24 spiny rats; however, we were only successful in identifying spiny rats in the northernmost of the areas sampled, with no indications of the spiny rat in the more southerly areas. The area in which the spiny rats were still present was estimated to be only 1-3 KM^2 and is comprised of forest dominated by Castanopsis sieboldii, Lithocarpus edulis, Distylium racemosum and Schima wallichii. The trees range in age from about 30 to more than 100 years old, and have an average height of 12 m (range 7 m-16 m). Our rediscovery of the spiny rat in 2008 comes after an interval of 30 years since the previous trapping study in 1978 and seven years since indirect survey evidence from analysis of feral cat feces 2001. Measures for conservation of the location of the spiny rats are urgently required.

2009

Anile, S, Bizzarri, L, Ragni, B. 2009. Camera trapping the European wildcat (*Felis silvestris silvestris*) in Sicily (southern Italy): preliminary results. HYSTRIX-ITALIAN JOURNAL OF MAMMALOGY 20(1):55-60.

The wildcat is an elusive species that is threatened with extinction in many parts of its range. In Sicily it still lives in a wide range of habitats. During 2006, camera traps were used to investigate the distribution of the wildcat over a 660 ha wide area on the south-western slope of Mount Etna (NE Sicily). Twelve out of 18 trapping stations provided a total of 24 photographs. Nine different individuals were identified using morphological criteria. Our work confirms the suitability of camera trapping for monitoring elusive carnivores.

Balme, GA, Slotow, R, Hunter, LTB. 2009. Impact of conservation interventions on the dynamics and persistence of a persecuted leopard (*Panthera pardus*) population. BIOLOGICAL CONSERVATION 142(11):2681-2690.

There is an extraordinary assortment of technical approaches to conserving carnivore populations, but the effectiveness of conservation activities is rarely evaluated. Accordingly, we initiated a study to assess the impact of several conservation interventions on the dynamics and persistence of a leopard (*Panthera pardus*) population in Phinda Private Game Reserve, South Africa. These included revisions of the statutory systems that regulate problem animal control and trophy hunting, and we instituted a program intended to reduce human-leopard conflict in the region. We compared demographic rates of radiocollared leopards from two sampling periods: a pre-treatment period prior to intervention, and a treatment period after intervention. The average annual mortality rate of the population decreased

from 0.401 ± 0.070 to 0.134 ± 0.016, with fewer leopards killed by humans and in intraspecific clashes after intervention. The overall reproductive output of the population increased in the treatment period, although annual cub production was higher in the pre-treatment period. This was mainly due to larger litter sizes prior to intervention, which may have been a strategy used by female leopards to offset high levels of infanticide. Results from camera-trap surveys and a Leslie-matrix model indicated an increase in annual population growth rate (lambda) of 14-16% after the implementation of conservation measures. Our findings highlight the importance of addressing both the numerical and functional components of population dynamics when managing large carnivores exposed to hunting or persecution.

Balme, GA, Hunter, LTB, Slotow, R. 2009. Evaluating Methods for Counting Cryptic Carnivores. JOURNAL OF WILDLIFE MANAGEMENT 73(3):433-441.

Numerous techniques have been proposed to estimate carnivore abundance and density, but few have been validated against populations of known size. We used a density estimate established by intensive monitoring of a population of radiotagged leopards (*Panthera pardus*) with a detection probability of 1.0 to evaluate efficacy of track counts and camera-trap surveys as population estimators. We calculated densities from track counts using 2 methods and compared performance of 10 methods for calculating the effectively sampled area for camera-trapping data. Compared to our reference density (7.33 ± 60.44 leopards/100 KM^2), camera-trapping generally produced more accurate but less precise estimates than did track counts. The most accurate result (6.97 ± 61.88 leopards/ 100 KM^2) came from camera-trap data with a sampled area buffered by a boundary strip representing the mean maximum distance moved by leopards outside the survey area (MMDMOSA) established by telemetry. However, contrary to recent suggestions, the traditional method of using half the mean maximum distance moved from photographic recaptures did not result in gross overestimates of population density (6.56

± 61.92 leopards/100 KM^2) but rather displayed the next best performance after MMDMOSA. The only track-count method comparable to reference density employed a capture-recapture framework applied to data when individuals were identified from their tracks (6.45 ± 61.43 leopards/100 KM^2) but the underlying assumptions of this technique limit more widespread application. Our results demonstrate that if applied correctly, camera-trap surveys represent the best balance of rigor and cost-effectiveness for estimating abundance and density of cryptic carnivore species that can be identified individually.

Barlow, ACD, McDougal, C, Smith, JLD, Gurung, B, Bhatta, SR, Kumal, S, Mahato, B, Tamang, DB. 2009. Temporal variation in tiger (*Panthera tigris*) populations and its implications for monitoring. JOURNAL OF MAMMALOGY 90(2):472-478.

Tigers (*Panthera tigris*) are endangered wild felids whose elusive nature and naturally low densities make them notoriously difficult to count. We present 7 years of camera trapping, tracking, and observational data on a local tiger population in Chitwan National Park, Nepal, to quantify changes in abundance of demographic groups and to identify underlying causes. Mean abundance in the 100-KM^2 study area was 18 tigers, but there was high variance among years. Transients were generally recorded at low levels, but there were large oscillations in numbers of tiger offspring, driven by infanticide perpetrated by male tigers taking over territories. The number of breeding animals in the study area remained relatively stable, with about 6 breeding females and 1 or 2 breeding males. The high density of breeding adults in Chitwan National Park highlights the region as a potential stronghold for tigers. Concentrating on counting breeding animals increases the power of monitoring programs to detect change over time. An alternative approach is to carry out surveys on a scale large enough to encompass sufficient territories to compensate for the local impacts of periodic turnover of adult males on total abundance.

Can, OE, Togan, I. 2009. Camera trapping of large mammals in Yenice Forest, Turkey: local information versus camera traps. ORYX 43(3):427-430

Information on large mammals in Turkey is limited, and widely applicable, reliable field methods need to be used to gather appropriate data for conservation and management. To evaluate local information on mammal species we conducted interview and ground surveys, followed by a camera trap survey, during January-May 2006 in Yenice Forest, a globally important and intact region for mammals in Turkey. Interviews with local people provided information on the occurrence of wolf *Canis lupus*, brown bear *Ursus arctos*, wild cat *Felis silvestris*, red fox *Vulpes vulpes*, Eurasian badger *Meles meles*, pine marten *Martes martes*, roe deer *Capreolus capreolus*, wild boar *Sus scrofa* and Eurasian lynx *Lynx lynx*. The ground and camera trap surveys confirmed the presence of all these species except lynx. In addition, the camera trap survey documented the presence of jackal *Canis aureus* and brown hare *Lepus europaeus*, signs of which were not found in the ground survey and whose presence was not known by local people. Local information on wildlife is important but management and conservation initiatives should not solely depend on such information and, as our study indicates, inter-view surveys cannot replace field research. The Turkish Ministry of Environment and Forestry needs to consider the establishment of a protected area large enough to secure the future of the large mammals of Yenice Forest.

Chen, MT, Tewes, ME, Pei, KJ, Grassman, Ll. 2009. Activity patterns and habitat use of sympatric small carnivores in southern Taiwan. MAMMALIA 73(1):20-26.

Camera-trapping was used to examine the activity patterns and habitat use of a small carnivore community in southern Taiwan from March 1998 to February 2001. Six small carnivore species occurred in disturbed and successional stage forests in southern Taiwan. The small carnivore

community was mainly composed of four species, including small Indian civet *Viverricula indica*, masked palm civet *Paguma larvata*, crab-eating mongoose *Herpestes urva*, and ferret badger *Melogale moschata*. There were no significant differences of occurrence between dry and wet seasons for small Indian civet, masked palm civet, and ferret badger (p > 0.05), whereas occurrence of crab-eating mongoose during the dry season was significantly higher than during the wet season (p < 0.02). Small Indian civet were closely correlated to disturbed and mosaic secondary forests and seemed restricted to certain elevations, whereas the distribution of the masked palm civet, crab-eating mongoose, and ferret badger could occur from low to moderate elevations. These results show segregation of temporal distribution and habitat use among these four sympatric carnivore species.

Dematteo, KE, Rinas, MA, Sede, MM, Davenport, B, Arguelles, CF, Lovett, K, Parker, PG. 2009. Detection Dogs: An Effective Technique for Bush Dog Surveys. JOURNAL OF WILDLIFE MANAGEMENT 73(8):1436-1440.

Detailed ecological data on the bush dog (*Speothos venaticus*) have been lacking, since standard field techniques, such as camera traps, have had little success recording their presence. This study eliminates dependence on visitation rate and switches the focus to locating evidence (e.g., olfactory) associated with the species' natural behavior and movement patterns. Over a 3-month period, a detection dog located multiple (n = 11, 4 confirmed and 7 potential) bush dog areas in Upper Parana Atlantic Forest of Misiones Argentina. These positive results demonstrate that detection dogs can provide species-specific data on the bush dog despite the rugged terrain and dense forest vegetation they may occupy. The ecological data collected using this technique allow effective conservation strategies to be developed, wildlife corridors and biological crossings to be designed, and species distributions to be examined.

Di Bitetti, MS, Di Blanco, YE, Pereira, JA, Paviolo, A, Perez, IJ. 2009. Time partitioning favors the coexistence of sympatric crab-eating foxes (*Cerdocyon thous*) and Pampas foxes (*Lycalopex gymnocercus*). JOURNAL OF MAMMALOGY 90(2):479-490.

Crab-eating foxes (*Cerdocyon thous*) and pampas foxes (*Lycalopex gymnocercus*) are very similar in body size and food habits, with distributional ranges that overlap extensively in South America. We used camera-trap records of both species obtained at the Ibera Nature Reserve (INR), northeastern Argentina, to test the hypothesis that, when living in sympatry, they reduce competition by using different habitats and by being active at different times. Camera-trap records obtained at 2 additional sites inhabited by only 1 of these species, the Atlantic Forest of Misiones (AF) and Lihue Calel National Park (LCNP), were used to determine the activity patterns of these foxes when living alone. At INR, we set 41 camera-trap stations in 2 habitats (shrubland forest and flooded grassland), and in 2 treatments per habitat (with or without cattle). Three stations also were set in gallery forests. We obtained 540 photographs of crab-eating foxes (289 records) and 175 photographs of pampas foxes (115 records) in 1,521 camera-trap days. At LCNP, 27 camera-trap stations (1,002 camera-trap days) provided 109 records of pampas foxes. At AF, 195 camera-trap stations (11,689 camera-trap days) provided 103 records of crab-eating foxes. At INR, crab-eating foxes were more frequently recorded in forest habitats, whereas pampas foxes preferred opened grasslands. However, both species were found ill all habitats and their recording rates were not negatively correlated. At INR, crab-eating foxes were nocturnal, with peaks of activity after dusk and before dawn, a pattern similar to that observed at AF and elsewhere. At INR, pampas foxes showed a peak of activity between 0000 and 0400 h and another between 1000 and 1300 h, a pattern that differed from that observed at LCNP and other places, where the species is mostly nocturnal. At INR, pampas foxes reduced their activity at times when activity of presumably dominant crab-eating foxes was high, which may facilitate their coexistence.

Efford, MG, Dawson, DK, Borchers, DL. 2009. Population density estimated from locations of individuals on a passive detector array. ECOLOGY 90(10):2676-2682.

The density of a closed population of animals occupying stable home ranges may be estimated from detections of individuals on an array of detectors, using newly developed methods for spatially explicit capture-recapture. Likelihood-based methods provide estimates for data from multi-catch traps or from devices that record presence without restricting animal movement ("proximity" detectors such as camera traps and hair snags). As originally proposed, these methods require multiple sampling intervals. We show that equally precise and unbiased estimates may be obtained from a single sampling interval, using only the spatial pattern of detections. This considerably extends the range of possible applications, and we illustrate the potential by estimating density from simulated detections of bird vocalizations on a microphone array. Acoustic detection can be defined as occurring when received signal strength exceeds a threshold. We suggest detection models for binary acoustic data, and for continuous data comprising measurements of all signals above the threshold. While binary data are often sufficient for density estimation, modeling signal strength improves precision when the microphone array is small.

Farhadinia, MS, Mahdavi, A, Hosseini-Zavarei, F. 2009. Reproductive ecology of the Persian Leopard, *Panthera pardus saxicolor*, in Sarigol National Park, northeastern Iran (Mammalia: Felidae). ZOOLOGY IN THE MIDDLE EAST 48(13):13-16.

According to our surveys carried out between April 2005 and March 2008 in the Sarigol National Park, northeastern Iran, the mating season of the Persian Leopard, *Panthera pardus saxicolor*, extends from mid-January to a peak in mid-February. Males and females associate briefly, and just after the short mating period they separate. We never found the leopards to

raise more than two cubs. Most observations on leopard families were made in areas of high prey density. Our data, verified by camera trapping, indicate that track size alone is not reliable for the accurate identification of leopard age/sex categories.

Garcia-Robledo, C, Kuprewicz, EK. 2009. Vertebrate Fruit Removal and Ant Seed Dispersal in the Neotropical Ginger *Renealmia alpinia* (Zingiberaceae). BIOTROPICA 41(2):209-214.

Plants frequently display fruit characteristics that support multiple seed-dispersal syndromes. These ambiguous characteristics may reflect the fact that seed dispersal is usually a complex process involving multiple dispersers. This is the case for the Neotropical ginger *Renealmia alpinia* (Zingiberaceae). It was originally suggested that the aromatic fruits of *R. alpinia* located at the base of the plant are adapted for terrestrial mammal seed dispersal. However, the dark-purple coloration of the fruits and bright orange aril surrounding the seeds suggest that birds may play a role in *R. alpinia* seed dispersal. At La Selva Biological Station, Costa Rica, we used camera traps to record vertebrate visits to infructescences of *R. alpinia*. Most visitors were toucans and aracaris (Ramphastidae). However fruits were also removed by terrestrial mammals (coatis and armadillos). In addition to vertebrate fruit removal, some of the fruits dehisce and the seeds that fall on the ground are dispersed by ants. Fruitfall traps showed that 77 percent of fruits are removed by vertebrates. However, 15 percent of fruits fall to the base of parent plants to be potentially dispersed by ants. Experiments using a laboratory ant colony showed that ants are effective seed dispersers of *R. alpinia*. Ant seed manipulation increased germination success and reduced time to germination. In conclusion, primary seed dispersal in the Neotropical ginger *R. alpinia* is mostly performed by birds, additionally ants are effective dispersers at short distances. Seed dispersal in *R. alpinia* is a complex process involving a diverse array of dispersal agents.

Galetti, M, Bovendorp, RS, Fadini, RF, Gussoni, COA, Rodrigues, M, Alvarez, AD, Guimaraes, PR, Alves, K. 2009. Hyper abundant mesopredators and bird extinction in an Atlantic forest island. ZOOLOGIA 26(2):288-298.

Islands can serve as model systems for understanding how biological invasions affect native species. Here we examine the negative effects of mesopredator mammals on bird richness at Anchieta Island, an 826 ha offshore island in the coast of Brazil. Anchieta Island has the highest density of mammals of the entire Atlantic forest, especially nest predators such as marmosets and coatis, introduced more than 20 years ago. This indiscriminate introduction of mammals may have affected directly the bird community, nowadays represented by 100 species comprised mainly by water-crossing birds, being 73 forest-dwelling species. A small component of these remnant bird species nests in tree holes and on the forest floor, null model analysis suggest that birds within these two nest types are under-represented on Anchieta Island. All guilds were affected negatively, but "opportunist insectivorous/omnivorous". Experiments using artificial nests showed a predation of 73% of nests on the floor while only 26% on the mainland. Camera traps recorded predation by coatis, agoutis, and opossums. The restoration of the bird community on this island is highly constrained by the high density of hyper abundant nest predators.

Galvez, D, Kranstauber, B, Kays, RW, Jansen, PA. 2009. Scatter hoarding by the Central American agouti: a test of optimal cache spacing theory. ANIMAL BEHAVIOUR 78(6):1327-1333.

Optimal cache spacing theory predicts that scatter-hoarding animals store food at a density that balances the gains of reducing cache robbery against the costs of spacing out caches further. We tested the key prediction that cache robbery and cache spacing increase with the economic value of food: the ratio of food to consumer abundance. We quantified cache

pilferage and cache spacing by the Central American agouti, *Dasyprocta punctata*, in the tropical forest of Barro Colorado Island, Panama, across 10 1 ha plots that encompassed a more than 100-fold range in the availability of *Astrocaryum* palm seeds, the agouti's principal food. We found that caches were pilfered at higher rates in plots with lower seed availability, and that agoutis cached seeds further away and into lower densities where seed availability was lower. Food scarcity apparently increased the pressure of food competitors on caches, stimulating agoutis to put more effort into caching seeds to create lower cache densities, fully consistent with theory. We conclude that the optimal cache density depends not only on the nutritional value of food but also on the economic value, which may vary in space as well as time.

Goulart, FVB, Caceres, NC, Graipel, ME, Tortato, MA, Ghizoni, IR, Oliveira-Santos, LR. 2009. Habitat selection by large mammals in a southern Brazilian Atlantic Forest. MAMMALIAN BIOLOGY 74(3):184-192.

Habitat selection, which is mainly a consequence of competition and predation, allows species to coexist. The present study was conducted in two reserves in an Atlantic Forest area in Santa Catarina State, Southern Brazil, and provided information on several large mammal species through photographic records. Records were related to certain environmental parameters, such as width of passages (trails and roads), vegetation density and proximity to water. in order to assess the relationship between each mammal species and its microhabitat. Thirty-two camera trap stations were placed during 17 months for 150.8 (+/- 62.2) days on average. Terrestrial mammals tended to use different habitats: *Puma concolor* used mainly dirt roads and open areas; *Leopardus pardalis*, *Cerdocyon thous* and *Nasua nasua* used more large trails and intermediate-forested sites; and *Cuniculus paca*, *Dasaypus novemcinctus*, *Leopardus tigrinus*, *Eira barbara* and *Leopardus wiedii* were recorded more often on narrow trails and in densely forested sites. Some of these forest species, such as *D. novemcinctus*, *C. paca* and *L. pardalis*, also showed relationships with watercourses. Information on habitat selection allows more effort to be addressed to the

habitat associated with focal species, and indicates the significance of environmental heterogeneity, which makes it possible for species to coexist.

Gucu, AC, Sakinan, S, Ok, M. 2009. Occurrence of the critically endangered Mediterranean Monk Seal, *Monachus monachus*, at Olympos-Beydaglari National Park, Turkey (Mammalia: Phocidae). ZOOLOGY IN THE MIDDLE EAST 46(3):3-8.

The coast of Antalya, despite being acknowledged as an important Monk Seal (*Monachus monachus* Hermann, 1779) habitat, has never been studied systematically for the occurrence of the species. The rocky cliff-bound coast of Antalya Olympos-Beydaglari National Park, where human disturbance appears minimal compared to the rest in the area, was surveyed between June and November 2008. Of the 39 caves discovered, both along mainland and island coasts, only 8 were considered suitable for placing photo-traps and a total of 11 automatic cameras was deployed. The caves were periodically visited to retrieve recorded digital images. 4 individual seals (2 adults, 2 juveniles) were photo-identified in 3 caves. The National Park provides suitable habitat for breeding. Human disturbance was very high throughout the Monk Seal habitats, and the most serious pressure appeared to be the human intruders in the caves. From the conservation point-of-view, three sites in the surveyed area, Ucadalar, Olympos and Adrasan, were noted as significant and so require strict protection.

Harihar, A, Pandav, B, Goyal, SP. 2009. Subsampling photographic capture-recapture data of tigers (*Panthera tigris*) to minimize closure violation and improve estimate precision: a case study. POPULATION ECOLOGY 51(4):471-479.

Most studies using photographic capture-recapture methodology estimate parameters of interest with ecological and sampling uncertainties. However, the effect of sampling effort on assumption violation and estimate precision has seldom been described using empirical data in studies estimating population size of tigers (*Panthera tigris tigris*). In this study, we evaluate the influence of trap effort (trap area, mean cell area and trap density) on the assumption of geographic closure and their relationship with estimated capture probability. We do this by sub-sampling capture histories obtained for tigers from 30 trapping stations within the Chilla range of Rajaji National Park, India. We assessed the importance of trapping effort on geographic closure by estimating fidelity ((F) over cap) and immigration (f) over cap under the Pradel model. Estimate precision (CV% [(N) over cap) was evaluated based on estimates of capture probability ((p) over cap). Results of the Pradel analysis suggested that larger trap area (TA) ensured geographic closure, while high trap densities (TD) exhibited sex-specific heterogeneity in recapture probabilities p. Simulation results suggested a significant positive correlation between estimates of ((p) over cap) and TD. With increase in estimated capture probability, estimate precision (CV% [(N) over cap]) also improved sharply. Comparison of prior studies towards optimizing sampling strategies is often compromised due to the difference in scale and methods of sampling. Therefore, we -urge that subsampling within a dataset as illustrated in our study may prove to be an advantageous step towards standardizing photographic capture-recapture sampling methodology for management objectives.

Harihar, A, Pandav, B, Goyal, S. 2009. Responses of tiger (*Panthera tigris*) and their prey to removal of anthropogenic influences in Rajaji National Park, India. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 55(2):2-27.

Presence of human settlements in most protected areas has forced tigers (*Panthera tigris*) to share space with humans. Creation of inviolate space for tigers in areas with high human densities is often daunting and requires hard political sacrifices. We conducted this study from 2004 to 2007 in the Chilla range of Rajaji National Park, along the northwestern portion of the

Terai-Arc Landscape in the Indian subcontinent. Our objective was to document the recovery of prey and tiger populations following the resettlement of 193 gujjar (pastoralists with large buffalo holdings) families. We used distance sampling to estimate density of wild ungulate prey and camera traps to estimate tiger density. The study area supported similar to 66 ungulates/KM^2, with chital (*Axis axis*) and sambar (*Cervus unicolor*) contributing >91%. While prey densities did not vary across 3 years, an increase in proportion of chital fawns was observed following the near complete removal of livestock. We also documented an increase in the density ((D) over cap) of tigers (from three to five tigers per 100 KM^2), probably due to immigrating tigers from nearby Corbett Tiger Reserve. A high turnover of individual tigers was observed during the study. With photographic evidence of breeding tigers in Chilla range, we believe that this area could serve as a source population from where tigers can colonize adjoining forests across River Ganga. It is therefore concluded that securing the connectivity between forests on the east and west bank of Ganga through the tenuous Chilla-Motichur corridor assumes significance for long-term persistence of tigers within this landscape.

Harihar, A, Pandav, B, Goyal, SP. 2009. Density of leopards (*Panthera pardus*) in the Chilla Range of Rajaji National Park, Uttarakhand, India. MAMMALIA

73(1):1-68.

NO ABSTRACT

Harmsen, BJ, Foster, RJ, Silver, SC, Ostro, LET, Doncaster, CP. 2009. Spatial and temporal interactions of sympatric jaguars (*Panthera onca*) and pumas (*Puma concolor*) in a Neotropical forest. JOURNAL OF MAMMALOGY 90(3):612-620.

We used extensive camera-trap surveys to study interindividual interactions among individually recognizable jaguars (*Panthera onca*) and plain-colored pumas (*Puma concolor*). Timed location data from a network of 119 trap stations in the Cockscomb Basin of Belize provide the 1st evidence of interspecific avoidance calibrated against intraspecific interactions among jaguars. Camera trapping has advantages over radiotelemetry in its potential to provide data on the complete array of individuals within the study area. The 23 individually identified male jaguars showed high levels of overlap in ranges, with up to 5 different males captured at the same location in the same month. Low levels of avoidance between individuals and a high flux of individuals contributed to low consistency in home-range ownership over the long term (3 months to 2 years). Jaguars and pumas had similar nocturnal activity schedules. Both species used similar habitats within the Cockscomb Basin, indicated by a high correlation in capture rates per location between species. Apart from their overall spatial similarities, jaguars and pumas avoided using the same location at the same time. This interspecific segregation was detectable over and above the spatial and temporal segregation of individual jaguars.

Hiby, L, Lovell, P, Patil, N, Kumar, NS, Gopalaswamy, AM, Karnath, KU. 2009. A tiger cannot change its stripes: using a three-dimensional model to match images of living tigers and tiger skins. BIOLOGY LETTERS 5(3):383-386.

The tiger is one of many species in which individuals can be identified by surface patterns. Camera traps can be used to record individual tigers moving over an array of locations and provide data for monitoring and studying populations and devising conservation strategies. We suggest using a combination of algorithms to calculate similarity scores between pattern samples scanned from the images to automate the search for a match to a new image. We show how using a three-dimensional surface model of a tiger to scan the pattern samples allows comparison of images that differ widely in camera angles and body posture. The software, which is free to download, considerably reduces the effort required to maintain an

image catalogue and we suggest it could be used to trace the origin of a tiger skin by searching a central database of living tigers' images for matches to an image of the skin.

Jennelle, CS, Samuel, MD, Nolden, CA, Berkley, EA. 2009. Deer Carcass Decomposition and Potential Scavenger Exposure to Chronic Wasting Disease. JOURNAL OF WILDLIFE MANAGEMENT 73(5):655-662.

Chronic wasting disease (CWD) is a transmissible spongiform encephalopathy afflicting the Cervidae family in North America, causing neurodegeneration and ultimately death. Although there are no reports of natural cross-species transmission of CWD to noncervids, infected deer carcasses pose a potential risk of CWD exposure for other animals. We placed 40 disease-free white-tailed deer (*Odocoileus virginianus*) carcasses and 10 gut piles in the CWD-affected area of Wisconsin (USA) from September to April in 2003 through 2005. We used photos from remotely operated cameras to characterize scavenger visitation and relative activity. To evaluate factors driving the rate of carcass removal (decomposition), we used Kaplan-Meier survival analysis and a generalized linear mixed model. We recorded 14 species of scavenging mammals (6 visiting species) and 14 species of scavenging birds (8 visiting species). Prominent scavengers included American crows (*Corvus brachyrhynchos*), raccoons (*Procyon lotor*), and Virginia opossums (*Didelphis virginiana*). We found no evidence that deer consumed conspecific remains, although they visited gut piles more often than carcasses relative to temporal availability in the environment. Domestic dogs, cats, and cows either scavenged or visited carcass sites, which could lead to human exposure to CWD. Deer carcasses persisted for 18 days to 101 days depending on the season and year, whereas gut piles lasted for 3 days. Habitat did not influence carcass decomposition, but mammalian and avian scavenger activity and higher temperatures were positively associated with faster removal. Infected deer carcasses or gut piles can serve as potential sources of CWD prions to a variety of scavengers. In areas where surveillance for CWD exposure is

practical, management agencies should consider strategies for testing primary scavengers of deer carcass material.

Johnson, A, Vongkhamheng, C, Saithongdam, T. 2009. The diversity, status and conservation of small carnivores in a montane tropical forest in northern Laos. ORYX 43(4):626-633.

Laos harbours globally significant populations of small carnivores, including mustelids and viverrids of conservation concern and felids that are relatively rare or unknown from other parts of Asia. However, few have received conservation attention as managers still lack basic information on the status and distribution of even the most common species. We conducted the country's first systematic camera-trap monitoring of carnivores in the Nam Et-Phou Louey National Protected Area on the Laos-Vietnam border, with intensive sampling across 500 KM^2 from 543 to 2,288 m altitude for 8,499 camera-trap days during 2003-2006. Surveys detected 14 species of small carnivores, including the first record of Owston's civet *Chrotogale owstoni* for Laos. Preliminary occupancy estimates for the seven most common species ranged from 11% for marbled cat *Pardofelis marmorata* to 42% for Asian golden cat *Pardofelis temminckii*. Activity patterns of viverrids were primarily nocturnal whereas mustelids, except for hog badger *Arctonyx collaris*, were diurnal. Leopard cat *Prionailurus bengalensis* was largely nocturnal, marbled cat primarily diurnal and Asian golden cat as likely detected during the day as at night. Our results led to the establishment of a contiguous 3,000-KM^2 protected area core zone and regulations that protect threatened species and control harvest of managed species.

Lucherini, M, Reppucci, JI, Walker, RS, Villalba, ML, Wurstten, A, Gallardo, G, Iriarte, A, Villalobos, R, Perovic, P. 2009. Activity patterns segregation of carnivores in the high Andes. JOURNAL OF MAMMALOGY 90(6):1404-1409.

Intraguild competition may be reduced if ecologically similar species segregate temporally. Using data from 1,596 camera-trap photos, we present the 1st quantitative analyses of the activity patterns of Andean cats (*Leopardus jacobita*), Pampas cats (*Leopardus colocolo*), culpeos (*Lycalopex culpaeus*), and pumas (*Puma concolor*) in high-altitude deserts of the Andes. We compared daily activity patterns for these carnivores with those of mountain vizcachas (*Lagidium viscacia*), the main prey of Andean cats. Activity patterns of all species were positively skewed toward night. Pampas cats displayed the greatest proportion of nocturnal activity, whereas Andean cats were the most diurnal. Activity of Andean cats differed significantly only from that of Pampas cats; Pampas cats also differed from pumas. Activity of Andean cats was generally similar to that of mountain vizcachas. The dissimilar activity patterns of Andean and Pampas cats support the hypothesis of temporal niche segregation of these felids.

Lynam, A, Rabinowitz, A, Myint, T, Maung, M, Latt, K, Po, S. 2009. Estimating abundance with sparse data: tigers in northern Myanmar POPULATION ECOLOGY 51(1):115-121.

As part of a national strategy for recovering tiger populations, the Myanmar Government recently proposed its first and the world's largest tiger reserve in the Hukaung Valley, Kachin State. During November 2002-June 2004, camera-traps were used to record tigers, identify individuals, and, using capture-recapture approaches, estimate density in the reserve. Despite extensive (203 trap locations, 275-558 KM2 sample plots) and intensive (> 4,500 trap nights, 9 months of sampling) survey efforts, only 12 independent detections of six individual tigers were made across three study sites. Due to the sparse data, estimates of tiger abundance generated by Program CAPTURE could not be made for all survey sites. Other approaches to estimating density, based on numbers of tigers caught, or derived from borrowed estimates of detection probability, offer an alternative to capture-recapture analysis. Tiger densities fall in the range of

0.2-2.2 tigers/100 KM^2, with 7-71 tigers inside a 3,250 KM^2 area of prime tiger habitat, where efforts to protect tigers are currently focused. Tiger numbers might be stabilized if strict measures are taken to protect tigers and their prey from seasonal hunting and to suppress illegal trade in wildlife. Efforts to monitor abundance trends in the tiger population will be expensive given the difficulty with which tiger data can be obtained and the lack of available surrogate indices of tiger density. Monitoring occupancy patterns, the subject of a separate ongoing study, may be more efficient.

Marks, BK, Duncan, RS. 2009. Use of Forest Edges by Free-ranging Cats and Dogs in an Urban Forest Fragment. SOUTHEASTERN NATURALIST 8(3):427-436.

Free-ranging *Felis catus* (Domestic Cat) and *Canis familiaris* (Domestic Dog) can greatly impact native prey populations, but little is known about their occurrence in urban forest fragments. In this study, we used camera traps to photograph (capture) cats, dogs, and native wildlife in a 409-ha urban forest in Birmingham, AL from Jan-Apr 2007. Habitat treatments included forest interior and forest edges by industrial lands, neighborhoods with higher house values, and neighborhoods with lower house values. We employed both conservative (n = 31) and liberal (n = 64) methods of tallying the number of individual dogs, cats, and native mammals captured. Dogs and cats combined comprised 19% (conservative) and 26% (liberal) of all photographic captures. *Procyon lotor* (Raccoon) were the most abundant of the 7 native species at 32% (conservative) and 53% (liberal) of all captures. Dogs were more abundant in neighborhood edges, and cats were more abundant in the forest interior. Cats and dogs combined were 75% (conservative) and 86% (liberal) of captures from the forest interior. Captures of native species were far more frequent in neighborhood edges (conservative = 86.9%, and liberal = 92.3%) than in other treatments. These findings demonstrate that exotic predators can be an important ecological presence in certain portions of urban forest fragments, and more extensive studies of their impact are needed.

McShea, WJ, Stewart, C, Peterson, L, Erb, P, Stuebing, R, Giman, B. 2009. The importance of secondary forest blocks for terrestrial mammals within an *Acacia*/secondary forest matrix in Sarawak, Malaysia. BIOLOGICAL CONSERVATION 142(12):3108-3119

With the rapid conversion of tropical forests in Asia to plantation forests for timber or biofuel production there is a need to determine if these forests serve any viable role in wildlife conservation. We used infrared trip cameras to survey for large terrestrial mammals within an *Acacia*/secondary forest matrix being created for pulpwood production in Sarawak, Malaysia. We detected at least 27 species of mammals within the matrix and 18 species were detected in both Acacia and secondary forest. Using occupancy modeling to determine important covariates for seven mammal species within the project area, six of these species were sensitive to forest type, and most were sensitive to the amount of secondary forest within I km of the sample point. For four species (sun bear, *Helarctos melayanus*; common porcupine, *Hystrix brachyura*; mousedeer, *Tragulus* spp.; and pig-tailed macaque, *Macaca nemestrina*), the mean distance of detection from large secondary forest blocks was significantly closer than expected from the distribution of sample points. Most species used *Acacia* forest less frequently than secondary forest, possibly for transit or foraging, with the exception of bearded pigs (*Sus barbatus*), sambar (*Rucervus unicolor*), and civets which were more common in *Acacia* stands. The amount of secondary forest preserved within forest plantations seems to be the best measure of conservation potential for these industrial forests. Forest plantations can provide a conservation value if managed properly and those retaining significant amounts of secondary forest should be eligible for a base level of certification as they comprise a significant portion of the landscape in this region.

Mondol, S, Karanth, KU, Kumar, NS, Gopalaswamy, AM, Andheria, A, Ramakrishnan, U. 2009. Evaluation of non-invasive genetic sampling

methods for estimating tiger population size. BIOLOGICAL CONSERVATION 142(10):2350-2360.

There is often a conservation need to estimate population abundances of elusive, low-density, wide-ranging carnivore species. Because of logistical constraints, investigators often employ non-invasive 'captures' that may involve 'genetic' or 'photographic' sampling in such cases. Established capture-recapture (CR) methods offer a powerful analytical tool for such data. In this paper, we developed a rigorous combination of captive, laboratory and field-based protocols for identifying individual tigers (*Panthers tigris*) from fecal DNA. We explored trade-offs between numbers of microsatellite loci used for reliable individual identifications and the need for higher capture rates for robust analyses. Our field surveys of scats were also specifically designed for CR analyses, enabling us to test for population closure, estimate capture probabilities and tiger abundance. Consequently, we could compare genetic capture estimates to results of a 'photographic capture' study of tigers at the same site. The estimates using the heterogeneity model (M-h-Jackknife) for fecal DNA survey were [Mt+1 = 26; p = 0.09 and (N) over cap (S (E) over cap[(N) over cap])=66 (12.98)] in close agreement with those from the photographic survey [(Mt+1 = 29; p = 0.04 and (N) over cap (S (E) over cap[(N) over cap]) = 66 (13.8)]. Our results revealed that designing field surveys of scats explicitly for CR data analyses generate reliable estimates of capture probability and abundance for elusive, low density species such as tigers. The study also highlights the importance of rigorous field survey and laboratory protocols for reliable abundance estimation in contexts where other approaches such as camera-trapping or physical tagging of animals may not be practical options.

Monroy-Vilchis, O, Rodriguez-Soto, C, Zarco-Gonzalez, M, Urios, V. 2009. Cougar and jaguar habitat use and activity patterns in central Mexico. ANIMAL BIOLOGY 59(2):145-157.

In this study the habitat use and activity patterns of the two of the largest cats of the Americas in central Mexico were studied. Three ways to detect felid presence were employed from August 2002 to May 2006: interviews, signs, and camera-traps. 478 records were obtained, from which 441 were from cougar and 37 from jaguar. These records included positive response in 118 of 140 interviews and 236 records of signs (mainly tracks and scats), and 124 photographs. Both felids preferred pine-oak forest habitats, with altitudes higher than 1800 m, distances between 3509 and 4377 m from roads, between 2329 and 4650 rn from settlements, and distances to very steep slopes between 1048 and 2059 m, for jaguar, and for cougar lower than 1047 m. Jaguar activity was recorded mainly during nighttimes, between 0:00 and 6:00, whereas cougar was active between 4:00 and 6:00 and between 18:00 and 22:00 hours, avoiding the jaguar's principal activity period.

Monterroso, P, Brito, JC, Ferreras, P, Alves, PC. 2009. Spatial ecology of the European wildcat in a Mediterranean ecosystem: dealing with small radio-tracking datasets in species conservation. JOURNAL OF ZOOLOGY 279(1):27-35.

Despite some populations of European wildcat *Felis silvestris* in central Europe are stable or increasing, the Iberian subpopulation is in decline and is listed as 'vulnerable'. In Portugal, little is known about wildcat populations, making conservation policies extremely difficult to define. Furthermore, the secretive behaviour of these mammals, along with low population densities, make data collection complicated. Thus, it is crucial to develop efficient analytical tools to interpret existing data for this species. In this study, we determine the home-range size and environmental factors related to wildcat spatial ecology in a Mediterranean ecosystem using a combined analysis of habitat selection and maximum entropy (Maxent) modelling. Simultaneously, we test the feasibility of using radio-tracking locations to construct an ecologically meaningful distribution model. Six wildcats were captured and tracked. The average home-range size (MCP95) was 2.28 KM^2 for females and 13.71 KM^2 for one male. The

Maxent model built from radio-tracking locations indicated that the abundance of the European rabbit Oryctolagus cuniculus and limited human disturbance were the most important correlates of wildcat presence. Habitat selection analysis revealed that wildcats tend to use scrubland areas significantly more than expected by chance. A mosaic of scrublands and agricultural areas, with a higher proportion of the former, benefits wildcat presence in the study area; however, species distribution is mainly constrained by availability of prey and resting sites. The Maxent model validation with camera-trapping data indicated that highly adequate model performance. This technique may prove useful for recovering small radio-tracking datasets as it provides a new alternative for handling data and maximizing the ecological information on a target population, which can then be used for conservation planning.

Nielsen, CK, McCollough, MA. 2009. Considerations on the Use of Remote Cameras to Detect Canada Lynx in Northern Maine. NORTHEASTERN NATURALIST 16(1):153-157.

We used remote Cameras to detect *Lynx canadensis* (Canada Lynx) in northern Maine during July-October 2005. A total of 1680 animal images was collected in 2512 camera-days of effort. Forty-five lynx detections were recorded, at a detection rate of 2 animals/100 camera-days of effort. Our analysis provides baseline detection rates for lynx in northern Maine and recommendations regarding survey design for other biologists. We suggest remote cameras are useful to survey lynx occurrence in an occupancy-estimation and -modeling framework, and in areas where snow-tracking surveys are not practical.

Paviolo, A, Di Blanco, YE, De Angelo, CD, Di Bitetti, MS. 2009. Protection affects the abundance and activity patterns of pumas in the Atlantic Forest. JOURNAL OF MAMMALOGY 90(4):926-934.

Knowing the factors that affect the abundance and activity patterns of pumas (*Puma concolor*) in South American forests may help in their conservation. Using camera traps, we conducted 4 surveys in 3 areas with different levels of protection against poaching and logging within the biggest continuous fragment of the Upper Parana Atlantic Forest. We used capture-mark-recapture population models to estimate the density of pumas for each area. The core area of Iguazu National Park, with low poaching pressure and no logging for >60 years, had the highest density of pumas (between 1.55 and 2.89 individuals/100 KM^2). Yaboti Biosphere Reserve, an area with the highest poaching and logging pressure, showed the lowest density (between 0.3 and 0.74 individuals/100 KM^2). Areas with intermediate levels of poaching and logging pressure had densities between 0.66 and 2.19 individuals/100 KM^2. Puma activity peaked during the 1st hours of morning in the most protected area, but became more crepuscular and nocturnal in areas with less protection. The lower abundance of pumas in the more degraded areas may be related to lower prey abundance. Differences in activity patterns of pumas among areas with different poaching pressures may be a direct response to poaching or to changes in the availability and activity patterns of primary prey. Conservation efforts should focus on decreasing poaching and logging pressures within protected areas to benefit pumas and other endangered species in the Atlantic Forest.

Rayan, DM, Mohamad, SW. 2009. Short Communication The importance of selectively logged forests for tiger *Panthera tigris* conservation: a population density estimate in Peninsular Malaysia. ORYX 43(1):48-51.

To obtain information on density of tiger *Panthera tigris* in selectively logged forest, a 9-month camera-trapping survey was conducted over elevations of 190-850 in in lowland and hill/upper dipterocarp and lower montane forests in Gunung Basor Forest Reserve, Peninsular Malaysia. Capture-recapture sampling methods were used to estimate tiger population density in the Reserve. The number of individual tigers captured was six. Using the M(h) jackknife estimator the average capture probability per

sampling occasion was 0.28 and the corresponding estimate of population size 8 ± SE 1.89. The overall probability of photo-capturing a tiger present in the sampled area was 0.75. Using an approach based on distances between photo-captures, a buffer width of 3.22 kin and an effectively sampled area of 308 KM^2 was estimated. This resulted in a density estimate of 2.59 ± SE 0.71 adult tigers per 100 KM^2. The results indicate that selectively logged forests such as Gunung Basor Forest Reserve have the potential to accommodate a high density of tigers. Decision makers and conservation planners should not therefore perceive selectively logged forests to have limited conservation value. Further research on the ecology of tigers and their prey in selectively logged forests is urgently needed. Such research would enable conservationists to recommend tiger-friendly management guidelines for sustainable forest management and thereby significantly contribute to tiger conservation in Malaysia.

Ridout, MS, Linkie, M. 2009. Estimating Overlap of Daily Activity Patterns From Camera Trap Data. JOURNAL OF AGRICULTURAL BIOLOGICAL AND ENVIRONMENTAL STATISTICS 14(3):322-337.

Data from camera traps that record the time of day at which photographs are taken are used widely to study daily activity patterns of photographed species. It is often of interest to compare activity patterns, for example, between mates and females of a species or between a predator and a prey species. In this article we propose that the similarity between two activity patterns may be quantified by a measure of the extent to which the patterns overlap. Several methods of estimating this overlap measure are described and their comparative performance for activity data is investigated in a simulation study. The methods are illustrated by comparing activity patterns of three sympatric felid species using data from camera traps in Kerinci Seblat National Park, Sumatra.

Rovero, F, Marshall, AR. 2009. Camera trapping photographic rate as an index of density in forest ungulates. JOURNAL OF APPLIED ECOLOGY 46(5):1011-1017.

1. Calibrating indices of animal abundance to true densities is critical in wildlife studies especially when direct density estimations are precluded by high costs, lack of required data or model parameters, elusiveness and rarity of target species. For studies deploying camera traps, the use of photographic rate (photographs per sampling time) as an index of abundance potentially applies to the majority of terrestrial mammals where individual recognition, and hence capture-recapture analysis, are unfeasible. The very few studies addressing this method have either been limited by lack of independence between trapping rates and density estimations, or because they combined different species, thus introducing potential bias in camera trap detection rates. This study uses a single model species from several sites to analyse calibration of trapping rates to independently derived estimations of density. The study also makes the first field test of the method by Rowcliffe et al. (2008) for density derivation from camera trapping rates based on modelling animal-camera contacts.

2. We deployed camera traps along line transects at six sites in the Udzungwa Mountains of Tanzania and correlated trapping rates of Harvey's duiker *Cephalophus harveyi* with densities estimated from counts made along the same transects.

3. We found a strong, linear relationship (R^2 = 0.90) between trapping rate and density. Sampling precision analysis indicates that camera trapping rates reach satisfactory precision when trapping effort amounts to 250-300 camera days. Density estimates using Rowcliffe et al.'s (2008) gas model conversion are higher than from transect censuses; we discuss the possible reasons and stress the need for more field tests.

4. Synthesis and applications. Subject to rigorous and periodic calibration, and standardization of sampling procedures in time and over different sites, camera trapping rate is shown to be, in this study, a valid index of density in the target species. Comparative data indicate that this may also apply to

forest ungulates in general. The method has great potential for standardizing monitoring programmes and reducing the costs of wildlife surveys, especially in remote areas.

Royle, JA, Karanth, KU, Gopalaswamy, AM, Kumar, NS. 2009. Bayesian inference in camera trapping studies for a class of spatial capture-recapture models. ECOLOGY (11):3233-3244.

We develop a class of models for inference about abundance or density using spatial capture-recapture data from studies based on camera trapping and related methods. The model is a hierarchical model composed of two components: a point process model describing the distribution of individuals in space (or their home range centers) and a model describing the observation of individuals in traps. We suppose that trap- and individual-specific capture probabilities are a function of distance between individual home range centers and trap locations. We show that the models can be regarded as generalized linear mixed models, where the individual home range centers are random effects. We adopt a Bayesian framework for inference under these models using a formulation based on data augmentation. We apply the models to camera trapping data on tigers from the Nagarahole Reserve, India, collected over 48 nights in 2006. For this study, 120 camera locations were used, but cameras were only operational at 30 locations during any given sample occasion. Movement of traps is common in many camera-trapping studies and represents an important feature of the observation model that we address explicitly in our application.

Royle, JA, Nichols, JD, Karanth, KU, Gopalaswamy, AM. 2009. A hierarchical model for estimating density in camera-trap studies JOURNAL OF APPLIED ECOLOGY 46(1):118-127.

Estimating animal density using capture-recapture data from arrays of detection devices such as camera traps has been problematic due to the movement of individuals and heterogeneity in capture probability among them induced by differential exposure to trapping.

We develop a spatial capture-recapture model for estimating density from camera-trapping data which contains explicit models for the spatial point process governing the distribution of individuals and their exposure to and detection by traps.

We adopt a Bayesian approach to analysis of the hierarchical model using the technique of data augmentation.

The model is applied to photographic capture-recapture data on tigers *Panthera tigris* in Nagarahole reserve, India. Using this model, we estimate the density of tigers to be 14.3 animals per 100 KM^2 during 2004.

Synthesis and applications. Our modelling framework largely overcomes several weaknesses in conventional approaches to the estimation of animal density from trap arrays. It effectively deals with key problems such as individual heterogeneity in capture probabilities, movement of traps, presence of potential 'holes' in the array and ad hoc estimation of sample area. The formulation, thus, greatly enhances flexibility in the conduct of field surveys as well as in the analysis of data, from studies that may involve physical, photographic or DNA-based 'captures' of individual animals.

Sarmento, P, Cruz, J, Eira, C, Fonseca, C. 2009. Spatial colonization by feral domestic cats *Felis catus* of former wildcat Felis silvestris silvestris home ranges. ACTA THERIOLOGICA 54(1):31-38.

Presently, wildcat *Felis silvestris silvestris* Schreber, 1777 populations are fragmented and rapidly declining in most of Europe. Although habitat destruction possibly constitutes the most serious threat to wildcat survival, hybridisation with feral domestic cats is also a critical problem. However, the mechanisms that allow domestic cats to colonise former wild cat home

ranges are yet unclear. The present paper describes the decrease of typical phenotypic wildcats and the increase of phenotypic domestic cats in a remote wild area of Portugal (Serra da Malcata). A field survey using box-traps and radio-tracking between 1998 and 2001 revealed that wildcats were widespread in the study area and no domestic cats were present. A second survey using camera traps between 2005 and 2007 revealed only one wildcat whereas four typical domestic phenotype individuals were photographed. The present study clearly emphasizes the need for urgent measures aimed at preserving wildcat populations. These measures should include a national census of the species and an extensive monitoring of genetic integrity of wildcat populations, followed by the elaboration of a wildcat conservation action plan.

Sarmento, P, Cruz, J, Monterroso, P, Tarroso, P, Ferreira, C, Negroes, N, Eira, C. 2009. Status survey of the critically endangered Iberian lynx *Lynx pardinus* in Portugal. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 55(3):247-253.

A survey of the Iberian lynx was conducted in Portugal between January 2002 and November 2003 in order to define lynx status and distribution baselines. Intensive search for lynx scats, scat DNA analysis, and camera trapping were used in areas of potential lynx presence. Over 4,200 km were investigated during a global searching effort of 1,975 man-hours. DNA obtained from 168 scats was analyzed, producing no positive lynx amplifications. Camera trapping represented a total effort of 5,647 camera-days in three potential lynx areas, producing no positive detections. Although results cannot confirm the species' extinction, the scenario is rather pessimistic and the Iberian lynx is probably no longer present in Portugal. Presently, considering the Portuguese lynx's historical range, the only significantly suitable areas for the species are located in the southeastern part of the country bordering Andalusia where no recent evidence of lynx presence was recorded.

Sarmento, P, Cruz, J, Eira, C, Fonseca, C. 2009. Evaluation of Camera Trapping for Estimating Red Fox Abundance. JOURNAL OF WILDLIFE MANAGEMENT 73(7):1207-1212.

The nature reserve Serra da Malcata, Portugal, was recently considered a site for Iberian lynx (*Lynx pardinus*) reintroduction. Because of potential disease risk posed by red foxes (*Vulpes vulpes*) in the area, a reliable estimate of fox abundance was critical for a dependable reintroduction program. We adapted camera-trapping techniques for estimating red fox abundance in the reserve. From July 2005 to August 2007, we conducted 7 camera-trapping sessions, allowing for individual identification of foxes by physical characteristics. We estimated abundance using the heterogeneity (Mh) model of the software program CAPTURE. Estimated density ranged from 0.91 ± 0.12 foxes/KM^2 to 0.74 ± 0.02 foxes/KM^2. By estimating red fox density, it is possible to define the number of foxes that must be sampled to assess the presence of potential fox-transmitted diseases that may affect lynx reintroduction.

Sparklin, BD, Mitchell, MS, Hanson, LB, Jolley, DB, Ditchkoff, SS. 2009. Territoriality of Feral Pigs in a Highly Persecuted Population on Fort Benning, Georgia. JOURNAL OF WILDLIFE MANAGEMENT 73(4):497-502

We examined home range behavior of female feral pigs (*Sus scrofa*) in a heavily hunted population on Fort Benning Military Reservation in west-central Georgia, USA. We used Global Positioning System location data from 24 individuals representing 18 sounders (i. e., F social groups) combined with mark-recapture and camera-trap data to evaluate evidence of territorial behavior at the individual and sounder levels. Through a manipulative experiment, we examined evidence for an inverse relationship between population density and home range size that would be expected for territorial animals. Pigs from the same sounder had extensive home

range overlap and did not have exclusive core areas. Sounders had nearly exclusive home ranges and had completely exclusive core areas, suggesting that female feral pigs on Fort Benning were territorial at the sounder level but not at the individual level. Lethal removal maintained stable densities of pigs in our treatment area, whereas density increased in our control area; territory size in the 2 areas was weakly and inversely related to density of pigs. Territorial behavior in feral pigs could influence population density by limiting access to reproductive space. Removal strategies that 1) match distribution of removal efforts to distribution of territories, 2) remove entire sounders instead of individuals, and 3) focus efforts where high-quality food resources strongly influence territorial behaviors may be best for long-term control of feral pigs.

Srbek-Araujo, AC, Scoss, LM, Hirsch, A, Chiarello, AG. 2009. Records of the giant-armadillo *Priodontes maximus* (Cingulata: Dasypodidae) in the Atlantic Forest: are Minas Gerais and Espirito Santo the last strongholds of the species? ZOOLOGIA 26(3):461-468.

We report 20 records of *Priodontes maximus* (Kerr, 1792) collected between 1990 and 2009 in three nature reserves located in forested areas of southeastern Brazil within the Atlantic Forest biome. Seventeen records were collected in Parque Estadual do Rio Doce (PERD), state of Minas Gerais, two in Reserva Biologica de Sooretama and one in Reserva Natural Vale, both located in the state of Espirito Santo. The records were burrows (n = 11), photographs from camera-traps (n = 6), sightings (n = 2) and carcass (n = 1). Given the higher number of records, the PERD seems to maintain the largest population among the three study areas. We searched the literature and found no other recent evidence of the species' presence in the Atlantic forest of Brazil. There are few Museum specimens and a general lack of information on the presence of the species in this biome as a whole. These facts suggest that the conservation status of the giant armadillo is extremely critical in the Atlantic Forest.

Thorn, M, Scott, DM, Green, M, Bateman, PW, Cameron, EZ. 2009. Estimating brown hyaena occupancy using baited camera traps. SOUTH AFRICAN JOURNAL OF WILDLIFE RESEARCH 39(1):1-10.

Conservation and management of brown hyaenas (*Hyaena brunnea*) is hampered by a lack of information on abundance and distribution, which is difficult and labour-intensive to obtain. However, occupancy surveys offer a potentially efficient and robust means of assessing brown hyaena populations. We evaluate the efficacy of camera trapping for estimating brown hyaena occupancy, and the effect of environmental variables and lures on detection probability. We estimated population density in Pilanesberg National Park, South Africa, at 2.8/100 KM^2, occupancy at 1.0 and model-averaged detection probability at 0.1. Using a fish lure increased detection probability to 0.2 and significantly increased encounter rates. We also found that brown hyaenas are more likely to be detected in areas of scrub or woodland rather than grassland. Our results suggest that 13 camera sites would be needed to achieve an occupancy estimate with S.E. of 0.05, and a minimum of 16-34 sampling occasions (with and without the fish lure) should be used in comparable study areas. We conclude that camera trapping is a viable method of estimating brown hyaena occupancy at local and landscape scales and capture-recapture analysis is also possible at a local scale.

Tobler, MW, Carrillo-Percastegui, SE, Powell, G. 2009. Habitat use, activity patterns and use of mineral licks by five species of ungulate in south-eastern Peru. JOURNAL OF TROPICAL ECOLOGY 25:261-270

We studied the habitat use, activity patterns and use of mineral licks by five species of Amazonian ungulate using data from four 60-d camera trap surveys at two different sites in the lowland rain forest of Madre de Dios, Peru. Camera traps were set out in two regular grids with 40 and 43 camera stations covering an area of 50 and 65 KM^2, as well at five

mineral licks. Using occupancy, analysis we tested the hypothesis that species are spatially separated. The results showed that the grey brocket deer (*Mazama gouazoubria*) occurred almost exclusively in terra firme forests, and that the while-lipped peccary (*Tayussu pecari*) used floodplain forest more frequently during some surveys. All other species showed no habitat preference and we did not lind any spatial avoidance of species. The white-lipped peccary, the Collared peccary (*Pecari tajacu*) as well its the grey brocket deer were strictly diurnal while the lowland tapir (*Tapirus terrestris*) was nocuturnal. The red brocket deer (*Mazama americana*) was active day and night. The tapir was the species With the highest number of visits to mineral licks (average 52.8 visits per 100 d) followed by the white-lipped peccary (average 16.1 visits per 100 d) and the red brocket deer (average 17.1 visits per 100 d). The collared peccary was only recorded on three occasions and the grey brocket deer was never seen at a lick. Our results suggest that resource partitioning takes place mainly at the diet level and less at it spatial level: however differences in small-scale habitat use are still possible.

Velho, N, Datta, A, Isvaran, K. 2009. Effect of rodents on seed fate of five hornbill-dispersed tree species in a tropical forest in north-east India. JOURNAL OF TROPICAL ECOLOGY 25:507-514.

Hornbills are important dispersers of a wide range of tree species. Many of these species bear fruits with large, lipid-rich seeds that could attract terrestrial rodents. Rodents have multiple effects on seed fates, many of which remain poorly understood in the Palaeotropics. The role of terrestrial rodents was investigated by tracking seed fate of five horn bill-dispersed tree species in a tropical forest in north-cast India. Seeds were marked inside and outside of exclosures below 6-12 parent fruiting trees (undispersed seed rain) and six hornbill nest trees (a post-dispersal site). Rodent visitors and seed removal were monitored using camera traps. Our findings suggest that several rodent species especially two species of porcupine were major on-site seed predators. Scatter-hoarding was rare (1.4%). Seeds at hornbill nest trees had lower survival compared with

parent fruiting trees, indicating that clumped dispersal by hornbills may not necessarily improve seed survival. Seed survival in the presence and absence of rodents varied with tree species. Some species (e.g. *Polyalthia simiarum*) showed no difference, others (e.g. *Dysoxylum binectariferum*) experienced up to a 64% decrease in survival in the presence of rodents. The differing magnitude of seed predation by rodents can have significant consequences at the seed establishment stage.

Vine, SJ, Crowther, MS, Lapidge, SJ, Dickman, CR, Mooney, N, Piggott, MP, English, AW. 2009. Comparison of methods to detect rare and cryptic species: a case study using the red fox (*Vulpes vulpes*). WILDLIFE RESEARCH 36(5):436-446.

Choosing the appropriate method to detect and monitor wildlife species is difficult if the species is rare or cryptic in appearance or behaviour. We evaluated the effectiveness of the following four methods for detecting red foxes (*Vulpes vulpes*) on the basis of equivalent person hours in a rural landscape in temperate Australia: camera traps, hair traps (using morphology and DNA from hair follicles), scats from bait stations (using DNA derived from the scats) and spotlighting. We also evaluated whether individual foxes could be identified using remote collection of their tissues. Genetic analysis of hair samples was the least efficient method of detection among the methods employed because of the paucity of samples obtained and the lack of follicles on sampled hairs. Scat detection was somewhat more efficient. Scats were deposited at 17% of bait stations and 80% of scats were amplified with a fox-specific marker, although only 31% of confirmed fox scats could be fully genotyped at all six microsatellite loci. Camera trapping and spotlighting were the most efficient methods of detecting fox presence in the landscape. Spotlighting success varied seasonally, with fox detections peaking in autumn (80% of spotlighting transects) and being lowest in winter (29% of transects). Cameras detected foxes at 51% of stations; however, there was limited seasonality in detection, and success rates varied with camera design. Log-linear models confirmed these trends. Our results showed that the appropriate technique

for detecting foxes varies depending on the time of the year. It is suggested that wildlife managers should consider both seasonal effects and species biology when attempting to detect rare or elusive species.

Wang, SW, Macdonald, DW. 2009. The use of camera traps for estimating tiger and leopard populations in the high altitude mountains of Bhutan. BIOLOGICAL CONSERVATION 142(3):606-613.

We used camera traps in combination with capture-recapture data analysis to provide the first reliable density estimates for tigers and leopards from the high altitude and rugged terrain in Bhutan's Jigme Singye Wangchuck National Park. Fifty days of camera trapping in each of five study zones collapsed into two trapping blocks, resulted in a sampling effort of 4050 trap days. Camera trapping yielded 17 tiger photos (14 left flanked and 3 right flanked) and 48 leopard photos (25 left flanked and 23 right flanked). Using photos of these left flank, the closed heterogeneous Jackknife Model M(h) was the best fit for the capture history data. A capture probability ((P) over cap) of 0.04 was obtained for both tigers and leopards, thus generating population size (N) of 8 tigers (SE = 2.12) and 16 leopards (SE = 2.91) with densities of 0.52 tiger 100 km^{-2} and 1.04 leopard 100 km^{-2}. Photographic evidence indicated that tigers and leopards did not overlap in their spatial use of space. Tigers preferred less disturbed areas located further away from settlements, while leopards appeared to be more resilient to disturbances in so far as they were found nearer to human settlements. Camera trapping using a capture-recapture framework was an effective tool for assessing population sizes for tiger and leopard in low density areas such as Bhutan.

Wibisono, HT, Figel, JJ, Arif, SM, Ario, A, Lubis, AH. 2009. Assessing the Sumatran tiger *Panthera tigris sumatrae* population in Batang Gadis National Park, a new protected area in Indonesia. ORYX 43(4):634-638.

The 1,080 KM^2 Batang Gadis National Park in the North Sumatra province of Indonesia was established in December 2004 by the regional government of Mandailing Natal district. The Park has the potential to make an important contribution to tiger conservation but lacks scientific data on the occurrence of the species. This study aimed to assess the tiger population of the Park, using camera trapping conducted between December 2005 and July 2006. We recorded a mean tiger density of 1.8 tigers per 100 KM^2 (95% CI 1.8-6.4) and, based on this, estimated the tiger population in and adjacent to the Park to be 29-103 adults. We found that tiger presence was negatively correlated with altitude and positively correlated with distance from forest edge to the interior, and < 18% of the total suitable habitat occupied by tigers was of high quality. This study indicates that Batang Gadis National Park potentially serves as a natural corridor betwen the Angkola and Barumun-Rokan ecosystems, areas totalling c. 6,500 KM^2, and that this landscape could serve as a stronghold for tiger populations in northern Sumatra.

Winarni, NL, O'Brien, TG, Carroll, JP, Kinnaird, MF. 2009. Movements, distribution, and abundance of Great argus pheasants (*Argusianus argus*) in a Sumatran rainforest. AUK 126(2):341-350.

We used radiotelemetry, habitat sampling, camera trapping, and line-transect surveys to explore movement patterns, distribution, and abundance of Great Argus Pheasants (*Argusianus argus*) ill Sumatra, Indonesia. We radiotracked six adult and one subadult males. Territories averaged 14.5 ± 8.5 ha, and home-range size did not vary by month or by relative abundance of selected plant foods. Daily travel distance (849 ± 211 m) varied significantly between months but did not reflect changes ill plant foods. Territories were used almost exclusively by resident males. Males preferentially used undisturbed forest (habitat I). Vegetation structure at male display sites and random points indicated that display sites were located in undisturbed forest, with few lianas and small leaf size on trees adjacent to the display site. Between 1998 and 2001, we conducted five line-transect surveys in conjunction with camera-trap Surveys. Density

estimates of calling males varied from 0.4 to 2.5 males km^{-2}, and the total density estimate ranged from 0.9 to 3.7 birds

km^{-2}. Density estimates increased substantially between 1998 and 2001, reflecting recovery from depressed densities after the 1997-1998 El Nino drought. Habitat occupancy estimates varied from 25% to 38% but were not significantly different over time. The proportion of occupied habitat was similar to the proportion of habitat I. We conclude that Great Argus Pheasants prefer undisturbed forest and rarely use other habitat even as population density increases. Restricted movements and habitat preference may limit the ability of Great Argus Pheasants to colonize forest fragments.

2008

Bagla, P. 2008. Species conservation - Tigers in decline, Indian survey finds. SCIENCE 319(5866):1027.

The use of new sampling techniques has cut by half the estimated number of wild tigers in India. Experts say the decline reflects more than just a change in methodology, poaching, human encroachment, and habitat loss take a heavy toll. Officials at the Wildlife Institute of India in Dehradun, which conducted the new study, adopted the new approach that used camera-trap surveys, line-transect sampling, and occupancy modeling. However, it omitted a vast marshy area known as the Sundarbans forest for which researchers had not developed a sampling method.

Borchert, M, Davis, FW, Kreitler, J. 2008. Carnivore use of an avocado orchard in southern California. CALIFORNIA FISH AND GAME 94(2):61-74.

In southern California avocados are an important commercial fruit that often are planted near or immediately adjacent to wildlands. Among cultivated fruits, avocados are unusually high in both lipids and proteins. Fruits remain green on the tree and ripen only after they fall to the ground or are harvested. As a result, they offer a relatively constant, year-round food source in the form of unharvested, fallen fruit. In 2005 for 5.5 months, we camera-trapped medium and large mammals in 13.5 ha of a 55.5 ha commercial avocado orchard in southern California. We also monitored fruit fall and subsequent removal to quantify the amount of energy available to mammals and estimated how much of the ground fruit they consumed. Cameras captured 7 carnivores: black bear, *Ursus americanus*, domestic dog, coyote, *Canis latrans*, bobcat, *Lynx rufus*, gray fox, *Urocyon cinereoargenteus*, raccoon, *Procyon lotor*, and striped skunk, *Mephitis*

mephitis; non-carnivores included western gray squirrel, *Sciurus griseus* and Virginia opossum, *Didelphia virginiana*. All but bobcats were photographed eating avocados. Black bears, gray foxes and striped skunks frequented the part of the orchard least affected by human activities. In contrast, coyotes and raccoons were more common where humans and domestic dogs were present. Mammals consumed all or nearly all marked avocados on the ground, usually within 50 days. We estimated that they consumed only a small portion (<2%) of the total fruit crop. Avocado orchards offer super-rich food patches that are readily accessible to an array of medium and large mammals.

Bowkett, AE, Rovero, F, Marshall, AR. 2008. The use of camera-trap data to model habitat use by antelope species in the Udzungwa Mountain forests, Tanzania. AFRICAN JOURNAL OF ECOLOGY 46(4):479-487.

The ecology of many species of duiker, and other African forest antelope, is poorly known and yet knowledge of the factors determining their distribution and abundance is critical to the conservation of this increasingly threatened group. Camera-trapping was used to investigate forest antelope ecology in the biologically diverse Udzungwa Mountains, Tanzania. The relationship between camera-trapping rates and vegetation (and other habitat variables) was investigated using generalized linear modelling. Over 630 photographs of antelope were obtained, with Harvey's duiker being the most recorded species. The camera-trap rate of Harvey's duiker was positively related to the species diversity of small plant stems and negatively related to an index of visibility, while that of suni antelope was negatively related to the percentage ground cover of leaf-litter. The camera-trap rate of Harvey's duiker was also negatively related to distance to the nearest village, as predicted for a species targeted for subsistence hunting. Camera-traps also recorded bushbuck and the threatened Tanzanian endemic Abbott's duiker, but there were insufficient captures to model habitat use for these species. Results of this study illustrate the potential of camera-trapping for modelling habitat requirements and providing

guidelines for the conservation management of threatened antelope populations in forest habitats.

Chapron, G, Miquelle, DG, Lambert, A, Goodrich, JM, Legendre, S, Clobert, 2008. The impact on tigers of poaching versus prey depletion. JOURNAL OF APPLIED ECOLOGY 45(6):1667-1674.

1. There exists a continuing dilemma in prioritizing conservation actions for large carnivores. Habitat loss, poaching, and prey depletion have often been cited as the three primary threats, but there is debate over the relative importance of each.

2. We assess the relative importance of poaching and prey depletion rates, and use existing information in the literature and multi-type branching process and deterministic felid population models to address four lines of evidence used to infer that tiger populations are inherently resilient to high mortality rates.

3. Our results suggest that tigers, more so than leopards or cougars, require large populations to persist, are quite susceptible to modest increases in mortality, and less likely to recover quickly after population declines. Demographic responses that would ensure population persistence with mortality rates that are sustainable for cougars or leopards are biologically unrealistic for tigers.

4. We propose alternative interpretations of evidence used to suggest that tigers are inherently resilient to high mortality rates. In contrast to other solitary felids, tigers breed later and their inter-birth interval is larger, making them less resilient to poaching. A model used to support the contention that prey depletion has greater impact on population persistence than poaching appears to be based on false premises. Camera-trapping data that suggest positive population growth despite low survival rate cannot differentiate mortality from emigration, and does not differentiate the impact of varying survival rate on different sex-age classes; for example,

low survival rate of dispersers is tolerable if survival rate of adult breeding females is high.

5. Synthesis and applications. While high prey numbers are essential to sustain tiger populations, our results suggest prey recovery efforts will not be sufficient if mortality rates reach 15%. Extrapolating demographic responses from other, even closely related species to develop conservation strategies can be misleading. Reduction of human-caused mortality, especially of resident breeding females, appears to be the most essential short-term conservation effort that must be made. Since mortality rates are usually unknown and generally stochastic in nature, any management policy that might reduce survival rates should be firmly avoided.

Clark, HO, Orland, MC. 2008. Comparison of two camera trap systems for detection of American marten on a winter landscape. CALIFORNIA FISH AND GAME 94(1):53-59.

Camera traps are commonly deployed to detect carnivores for a variety of research objectives and situations. However, having the correct camera model, type, and configuration is critical in order to detect the target species. We compared two camera models and configurations to detect the American marten in a montane coniferous forest during the winter. The Trailmaster (R) system did not detect marten and some landscape elements consistently compromised its effectiveness. Cuddeback (TM) systems, not vulnerable to these elements, successfully detected the target species.

Datta, A, Anand, MO, Naniwadekar, R. 2008. Empty forests: Large carnivore and prey abundance in Namdapha National Park, north-east India. BIOLOGICAL CONSERVATION 141(5):1429-1435.

Illegal hunting poses a dual threat to large carnivores through direct removal of individuals and by prey depletion. We conducted a camera-

trapping survey in the Namdapha National Park, north-east India, conducted as part of a programme to evaluate carnivore and prey species abundance. Clouded leopard (*Neofelis nebulosa*) was the only large carnivore detected by camera-trapping. Indirect evidences indicated the presence of the wild dog (*Cuon alpinus*) and leopard (*Panthera pardus*), however, there was no evidence of tigers (*Panthera tigris*), suggesting their possible extinction from the lower elevation forests. Of the major ungulate prey species, sambar (*Cervus unicolor*) and wild pig (*Sus scrofa*) were the only large prey detected, while the Indian muntjac (*Muntiacus muntjak*) was the only small prey species detected. Relative abundances of all species were appreciably lower than estimates from other tropical forests in south-east Asia. We suspect that illegal hunting may be the cause for the low carnivore and prey species abundance. An ongoing community-based conservation programme presents an opportunity to reduce local people's dependence on hunting by addressing their socio-economic needs and for using their skills and knowledge of the landscape for wildlife conservation. However, long-term wildlife monitoring is essential to assess the efficacy of the socio-economic interventions in bringing about wildlife recovery.

Di Bitetti, MS, Paviolo, A, De Angelo, CD, Di Blanco, YE. 2008. Local and continental correlates of the abundance of a neotropical cat, the ocelot (*Leopardus pardalis*). JOURNAL OF TROPICAL ECOLOGY 24:189-200.

As top predators, wild cats play a key ecological role in tropical forests, but little is known about the factors that regulate their abundance. This study looked for correlates of ocelot (*Leopardus pardalis*) abundance at two spatial scales. First, camera-trap surveys conducted in the Atlantic Forest of Misiones, Argentina, were used to test the hypothesis that selective logging and poaching affect the local abundance of this cat. Second, published density estimates (N = 21) were used to test the hypothesis that rainfall and latitude are correlated with the abundance of ocelots across their continental range. In Misiones, ocelot densities ranged from 4.96 ± 1.33 individuals per 100 KM^2 in the intensely logged and hunted areas to 17.6 ± 2.25 individuals per 100 KM^2 in areas with low human impact. The

frequency of records, number of individuals recorded per station, and density estimates were 2-3 times higher in areas with relatively low levels of logging and poaching. At a continental scale, ocelot densities decrease with latitude and increase with rainfall. Primary productivity seems to determine the abundance of wild cats across their range, but at a local scale their abundance may be affected by logging and poaching or by competition with other species.

Di Bitetti, MS, Paviolo, A, Ferrari, CA, De Angelo, C, Di Blanco, Y. 2008. Differential responses to hunting in two sympatric species of brocket deer (*Mazama americana* and *M. nana*). BIOTROPICA 40(5):636-645.

Hunting by humans may affect the abundance and activity patterns of game species. We examined the effect of hunting on the abundance and activity patterns of sympatric red brocket deer *Mazama americana* and dwarf brocket deer *M. nana*. We conducted four camera-trap surveys (158 sampling stations, 10,244 trap-days, total area sampled 1200 KM^2) in three areas within the Atlantic Forest of Misiones, Argentina, that differ in protection and hunting pressure. We used logistic regression and tests of independence to evaluate if protection, hunting pressure, and other independent variables affect the probability of recording each species and their recording rate. We used the Mardia-Watson-Wheeler test to examine if the daily activity pattern differs between species and changes with hunting pressure. Red brocket deer were more frequently recorded (397 records, 58% of stations) than dwarf brocket deer (100 records, 37% of stations). The probability of recording red brockets was higher in areas with better protection and increased with the distance to the main accesses used by poachers. The probability of recording dwarf brockets was higher in areas with low protection. Red brockets were more nocturnal than dwarf brockets, a difference that may reduce interspecific competition. However, red brockets were more diurnal in the best-protected areas, suggesting that they can adjust their activity to local hunting pressure. Hunting has opposite effects on the abundance of these deer and may facilitate their coexistence.

Hunting should be carefully controlled or managed to ensure the conservation of these little known species.

Dillon, A, Kelly, MJ. 2008. Ocelot home range, overlap and density: comparing radio telemetry with camera trapping. JOURNAL OF ZOOLOGY 275(4):391-398.

Because ocelots *Leopardus pardalis* and other solitary carnivores are elusive and hard to study, little is known about their density and population status. In the past few years, camera trapping and mark-recapture statistics have been used to estimate the density of a number of felids. Although camera trapping is now providing baseline data for managers and conservationists alike, recent doubts have been raised concerning the accuracy of the standard camera trapping procedure. We used radio telemetry to gain new information on ocelot home-range size and spatial organization in Central America, and compared the radius of our average ocelot home range with the standard camera trapping buffer. We compared the resulting density estimates to assess the current camera trapping methodology's ability to estimate animal density. Five adult ocelots (two male and three female) were tracked to determine an average ocelot home range of 26.09 KM^2 (95% fixed kernel) and 18.91 KM^2 (100% minimum convex polygon), with males demonstrating larger ranges than females. All ocelots had larger home ranges in the dry season. Male-male home-range overlap averaged 9% while female-female overlap averaged 21%. Males shared 56% of their range with a primary female and 16% with a second and third female, while females shared 58% of their home range with a primary male and 3% with a secondary male. Density estimates based on the average home-range radius (11.24-12.45 ocelots per 100 KM^2) were less than those determined from standard camera trapping methods (25.88 ocelots per 100 KM^2), but similar to those determined using twice the camera trapping buffer to estimate density (12.61 ocelots per 100 KM^2). Our results suggest that a standard camera trapping protocol may overestimate ocelot density. Accurate representation of animal densities and standardization of density estimation techniques are

paramount for comparative analyses across sites and are vital for felid conservation.

Dinata, Y, Nugroho, A, Haidir, IA, Linkie, M. 2008. Camera trapping rare and threatened avifauna in west-central Sumatra. BIRD CONSERVATION INTERNATIONAL 18(1):30-37.

Tropical forests are becoming increasingly degraded and fragmented by logging, which can affect the survival of forest bird species in different ways. In this study, we present avifauna data collected from a monitoring programme in west-central Sumatra that set camera traps in three study areas with different habitat types, levels of degradation and protection status. From 5,990 camera trap-nights, 248 independent bird photographs were recorded, comprising four orders and nine species, including three endemic species. The Great Argus Pheasant (*Argusianus argus*) was recorded in all study areas and most frequently (n = 202 photographs), followed by the threatened Salvadori's Pheasant (*Lophura inornata*). The greatest diversity of bird species (five) and abundance index (1.44 bird photographs/loo trap-nights) was recorded from a primary hillsubmontane forest site located inside Kerinci Seblat National Park (KSNP) bordering degraded forest in a former logging concession recently repatriated into KSNP. However, inside a primary-selectively logged hill-submontane forest site spread over KSNP and an ex-logging concession, a Sumatran Ground Cuckoo (*Carpococcyx viridis*) was photographed. This species is noteworthy because prior to this study it had only been documented once since 1916. It is therefore crucial to use the camera trap results to increase the protection status for the ground cuckoo area. This has already happened in the other two study areas, where camera trap data have been used to reclassify the areas as Core Zones, the highest level of protection inside KSNP. This study illustrates how routine monitoring can have wider benefits through recording, and conserving, threatened and endemic non-target species in unexpected habitats that might not otherwise have been surveyed.

Ferguson, AW, Weckerly, FW, Baccus, JT, Forstner, MRJ. 2008. Evaluation of predator attendance at pitfall traps in Texas. SOUTHWESTERN NATURALIST 53(4):450-457.

Researchers using drift-fence sampling with associated pitfall traps have analysed a number of problems associated with this technique. One unquantified problem is the effect foraging vertebrate predators might have on animals captured in pitfall traps. We use Deer Cam (R) cameras and track-monitoring stations to estimate amount and variety of vertebrate predators attending pitfall arrays in Bastrop and Guadalupe counties, Texas. We recorded 316 photographs of 19 species of vertebrates over 327 camera days among 16 drift-fence arrays. During 1,838 trap nights, we documented 679 individual track sets at track-monitoring stations established on 50 individual pitfall traps and 8 control plots. Ten potential vertebrate predators were documented visiting pitfall arrays with the raccoon (*Procyon lotor*) being the most frequently recorded species. Statistical analyses indicate that presence of predators at track-monitoring stations or pitfall traps did not influence detectability or capture success of small vertebrates. However, these results could be confounded by the low effect size and reduced power due to low number of animals captured in pitfall traps during the study. Consistent and frequent visits by predators to pitfall traps indicate that risks exist for confined animals and the potential consequences increase for rare or endangered taxa, which potentially could be exposed to higher levels of predation when confined to pitfall traps.

Hebeisen, C, Fattebert, J, Baubet, E, Fischer, C. 2008. Estimating wild boar (*Sus scrofa*) abundance and density using capture-resights in Canton of Geneva, Switzerland. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 54(3):391-401.

We estimated wild boar abundance and density using capture-resight methods in the western part of the Canton of Geneva (Switzerland) in the early summer from 2004 to 2006. Ear-tag numbers and transmitter frequencies enabled us to identify individuals during each of the counting sessions. We used resights generated by self-triggered camera traps as recaptures. Program Noremark provided Minta-Mangel and Bowden's estimators to assess the size of the marked population. The minimum numbers of wild boars belonging to the unmarked population (juveniles and/or piglets) were added to the respective estimates to assess total population size. Over the 3 years, both estimators showed a stable population with a slight diminishing tendency. We used mean home range size determined by telemetry to assess the sampled areas and densities. Mean wild boar population densities calculated were 10.6 individuals/KM^2+/- 0.8 standard deviation (SD) and 10.0 ind/KM^2 0.6 SD with both estimators, respectively, and are among the highest reported from Western Europe. Because of the low proportion of marked animals and, to a lesser extent, of technical failures, our estimates showed poor precision, although they displayed similar population trends compared to the culling bag statistics. Reported densities were consistent with the ecological conditions of the study area.

Horn, JW, Arnett, EB, Kunz, TH. 2008. Behavioral responses of bats to operating wind turbines. JOURNAL OF WILDLIFE MANAGEMENT 72(1):123-132.

Wind power is one of the fastest growing sectors of the energy industry. Recent studies have reported large numbers of migratory tree-roosting bats being killed at utility-scale wind power facilities, especially in the eastern United States. We used thermal infrared (TIR) cameras to assess the flight behavior of bats at wind turbines because this technology makes it possible to observe the nocturnal behavior of bats and birds independently of supplemental light sources. We conducted this study at the Mountaineer Wind Energy Center in Tucker County, West Virginia, USA, where hundreds of migratory tree bats have been found injured or dead beneath

wind turbines. We recorded nightly 9-hour sessions of TIR video of operating turbines from which we assessed altitude, direction, and types of flight maneuvers of bats, birds, and insects. We observed bats actively foraging near operating turbines, rather than simply passing through turbine sites. Our results indicate that bats 1) approached both rotating and nonrotating blades, 2) followed or were trapped in blade-tip vortices, 3) investigated the various parts of the turbine with repeated fly-bys, and 4) were struck directly by rotating blades. Blade rotational speed was a significant negative predictor of collisions with turbine blades, suggesting that bats may be at higher risk of fatality on nights with low wind speeds.

Iglesias, J, Sanchez-Cordero, V, Magana-Cota, G, Bolanos, R, Aranda, M, Hernandez, R, Botello, FJ. 2008. Noteworthy records of margay, *Leopardus wiedii* and ocelot, *Leopardus pardalis* in the state of Guanajuato, Mexico. MAMMALIA 72(4):347-349.

NO ABSTRACT

Iob, G, Vieira, EM. 2008. Seed predation of *Araucaria angustifolia* (Araucariaceae) in the Brazilian Araucaria Forest: influence of deposition site and comparative role of small and 'large' mammals. PLANT ECOLOGY 198(2):185-196.

Seed predation and seed dispersal are key factors that determine plant recruitment. In this study, we compared the role of small (< 200 g) and 'large' mammals as predators of *Araucaria angustifolia* (Araucariaceae) seeds in the Brazilian Araucaria Forest. We also investigated the effect of deposition site, namely open grassland, forest edge or forest interior (> 50 m from the edge) on seed-removal rates. We conducted field experiments on seed removal in July 2003 and 2004. We compared the habitat types using two exclusion treatments: semi-permeable exclosure (exclusive access

of small rodents) and an open control (access of all mammal groups). We considered proportion of seeds removed after 15 days to investigate the effect of year, habitat type, and exclusion treatment on seed removal by using three-factor permutational ANOVA. We also evaluated seed fate and seed consumers by using spool-and-line devices attached to seeds and camera trapping. The results showed that seed removal differed significantly between years and among habitat types, but not between exclusion treatments. Removal rates were higher in 2004 than in 2003 and also were significantly lower in the open field when compared with both forested types (edge or interior) in both years. There was also a significant interaction between 'year' and 'habitat' which was driven by an increase in 2004 removal rates in the open field compared to the previous year. Our combination of manipulative experiments, camera-trapping survey, and spool-and-line seed tracking demonstrated that small rodents are responsible for the majority of seed removal of *A. angustifolia* in the study area. The low removal rates in open habitats indicate that they could serve as safe sites for *A. angustifolia* seeds. The results also suggested a potential role of small rodents as seed dispersers (about 4% of removed seeds were not consumed). The knowledge of how fragmentation affects pattern of seed predation and establishment of A. angustifolia through changes in abundance of different-sized mammals is essential for the conservation of the Brazilian Araucaria Forest and its most characteristic species.

Kelly, MJ. 2008. Design, evaluate, refine: camera trap studies for elusive species. ANIMAL CONSERVATION 11(3):182-184.

NO ABSTRACT

Kelly, MJ, Holub, EL. 2008. Camera trapping of carnivores: Trap success among camera types and across species, and habitat selection by species, on Salt Pond Mountain, Giles County, Virginia. NORTHEASTERN NATURALIST 15(2):249.262.

To evaluate trap success among camera types and across species as well as assess habitat selection by target carnivore species, we established 16 infrared-triggered camera stations across a 26.9-KM2 study area located on primarily Jefferson National Forest land in Virginia. We monitored camera stations for 72 days (August to October 2005) for a total of 891 trap nigbts (TN) of effort. Overall trap success for all animals combined was 40.74 captures per 100 TN. *Procyon lotor* (raccoon) had the highest predator trap success (2.81/100 TN), followed by: *Ursus americanus* (black bear, 1.91/100 TN); *Lynx rufus* (bobcat, 1.46/100 TN); *Canis latrans* (coyote, 1.01/100 TN); and *Urocyon cinereoargenteus* (gray fox, 0.56/100 TN). *Odocoileus virginianus* (white-tailed deer) had the highest overall trap success (21.32/100 TN), followed by *Sciurus carolinensis* (gray squirrel, 6.17/100 TN). Passive camera units, especially DeerCam, had higher trap success than active camera units, and digital camera units (Reconyx) out-performed film cameras. We extracted percent cover of habitat features (% coniferous, % deciduous, % water, % agricultural) from a geographic information system (GIS) using circular buffers around each trap site and compared carnivore-pre sent sites to carnivore-absent sites. We compared carnivore trap success to the distance to the main access road and to trap success of prey species, primarily deer and gray squirrel. We also compared each carnivore's trap success to that of the other carnivore species to determine if carnivore presence or activity levels influenced other carnivores. Black bear, coyote, and raccoon tended to avoid areas with a high percentage of coniferous forest, and only bobcat showed significant avoidance of coniferous forest. Bobcat trap success increased with distance to the main road, and coyote trap success was positively (but weakly) related to gray squirrel trap success. Human foot traffic did not affect carnivore trap success. This study elucidates differences among camera trap systems, and highlights the potential to monitor carnivore species simultaneously and in combination with a GIS to predict occurrence across a landscape.

Kelly, MJ, Noss, AJ, Di Bitetti, MS, Maffei, L, Arispe, RL, Paviolo, A, De Angelo, CD, Di Blanco, YE. 2008. Estimating puma densities from camera trapping across three study sites: Bolivia, Argentina, and Belize. JOURNAL OF MAMMALOGY 89(2):408-418.

Estimates of abundance are extremely valuable for species conservation, yet determining abundance for elusive, wide-ranging, carnivores is difficult. We estimated density of pumas using remote cameras across study sites in Bolivia, Argentina, and Belize. We used obvious and subtle markings to identify individual pumas in photographs and conducted double-blind identifications to examine the degree of agreement among investigators. Average agreement on identification between pairs of investigators was nearly 80.0% and 3-way agreement was 72.9%. Identification of pumas as different individuals was uncommon (7.8% pairwise, 0.69% 3-way disagreement) with the remainder described as unidentifiable. Densities of pumas varied consistently from site to site regardless of investigator. Bolivian pumas moved the shortest distances between camera stations and Argentinean pumas the longest, but distances among cameras and area covered by surveys varied among sites. We applied a correction factor to the Bolivian data to account for the small area surveyed and found that, averaged across investigator, Bolivia had significantly more pumas per 100 KM^2 (mean ± SD; 6.80 ± 1.5) than Belize (3.42 ± 1.3) or Argentina (0.67 ± 0.2). Numbers of pumas in Argentina match those of low-density North American sites, and those for Belize are consistent with the Pantanal and high-density North American sites. Densities of pumas can be reliably estimated with remote cameras for these sites, and our work presents the 1st density estimates for Central America and for forested environments in South America.

Khorozyan, IG, Malkhasyan, AG, Abramov, AV. 2008. Presence-absence surveys of prey and their use in predicting leopard (Panthera pardus) densities: a case study from Armenia. INTEGRATIVE ZOOLOGY 3(4):322-332.

It is important to predict how many individuals of a predator species can survive in a given area on the basis of prey sufficiency and to compare predictive estimates with actual numbers to understand whether or not key threats are related to prey availability. Rugged terrain and low detection probabilities do not allow for the use of traditional prey count techniques in mountain areas. We used presence-absence occupancy modeling and camera-trapping to estimate the abundance and densities of prey species and regression analysis to predict leopard (*Panthera pardus*) densities from estimated prey biomass in the mountains of the Nuvadi area, Meghri Ridge, southern Armenia. The prey densities were 12.94 ± 2.18 individuals km^{-2} for the bezoar goat (*Capra aegagrus*), 6.88 ± 1.56 for the wild boar (*Sus scrofa*) and 0.44 ± 0.20 for the roe deer (*Capreolus capreolus*). The detection probability of the prey was a strong function of the activity patterns, and was highest in diurnal bezoar goats (0.59 ± 0.09). Based on robust regression, the estimated total ungulate prey biomass (720.37 ± 142.72 kg km^{-2}) can support a leopard density of 7. 18 ± 3.06 individuals 100 km^{-2}. The actual leopard density is only 0.34 individuals 100 km^{-2} (i.e. one subadult male recorded over the 296.9 KM^2), estimated from tracking and camera-trapping. The most plausible explanation for this discrepancy between predicted and actual leopard density is that poaching and disturbance caused by livestock breeding, plant gathering, deforestation and human-induced wild fires are affecting the leopard population in Armenia.

Kitamura, S, Yumoto, T, Poonswad, P, Suzuki, S, Wohandee, P. 2008. Rare seed-predating mammals determine seed fate of *Canarium euphyllum*, a large-seeded tree species in a moist evergreen forest, Thailand. ECOLOGICAL RESEARCH 23(1):169-177.

Natural seed deposition patterns and their effects on post-dispersal seed fate are critical to tropical tree recruitment. The major dispersal agents of the large-seeded tree *Canarium euphyllum* in Khao Yai National Park,

Thailand, are large frugivorous birds such as hornbills, which generated spatially heterogeneous seed deposition patterns because they regurgitated seeds at perching trees and conspecific and heterospecific feeding trees. We investigated the fate of seeds dispersed in this manner using seed removal experiments and automatic camera trapping. Seeds placed experimentally around conspecific feeding trees had higher removal rates than seeds placed elsewhere. These effects were likely mediated by two seed-eating rodents, the Indochinese ground squirrel (*Menetes berdmorei*) and the giant long-tailed rat (*Leopoldamys sabanus*). Consequently, the spatial patterns generated by hornbills had consequences for post-dispersal seed fates, particularly whether or not the seeds were removed by rodents. Primary dispersal by hornbills does alter seed fate by altering the probability of rodent-seed interaction, but the ultimate impact of dispersal by hornbills will depend on how important rodent scatterhoarding is to seed germination and seedlings. Given that major seed dispersers of *C. euphyllum* are now absent or rare in degraded forests in tropical Asia, it is becoming increasingly important to understand the roles of scatterhoarding rodents in these altered habitats in this region.

Linkie, M, Haidir, WA, Nugroho, A, Dinata, Y. 2008. Conserving tigers *Panthera tigris* in selectively logged Sumatran forests BIOLOGICAL CONSERVATION 141(9):2410-2415.

The response of most large carnivores to selective logging is poorly understood. On the one hand, selective logging may represent loss of important habitat, yet, on the other hand, selective logging may increase browse availability for a terrestrial ungulate prey base, thereby indirectly benefiting large carnivores. Using a camera trap-based sampling method, we estimate tiger density in two primary-selectively logged forest areas that straddle Kerinci Seblat National Park, Sumatra. We then investigate potential differences between the habitat use of tigers: within these study areas and forest types; and, within the finer-scale landscape features associated with these covariates. Across the mixed forest study areas, tiger density estimates (adult individuals/100 KM^2 ± S.E.) of 2.95 ± 0.56 and

1.55 ± 0.34 were produced. However, within these areas, tigers showed a preference for primary over degraded forest, and this was related to the greater accessibility of degraded forest sites to people, e.g., through their proximity to roads. Presently, the majority of Sumatran tigers occur within large tracts of primary forest, but these extend outside of the island's protected area borders, and these unprotected forests are especially at risk from the high levels of deforestation in Sumatra. As forest is cleared, previously remote, and therefore safer, tracts of primary forest become accessible and, eventually, degraded. Yet, from our study, degraded forest in combination with primary forest supported sufficiently high tiger densities and can, therefore, make an important contribution to tiger conservation. It is therefore essential to lessen the detrimental effects of accessibility through increasing law enforcement and destroying ex-logging roads.

Lucherini, M, Vidal, EL, Merino, MJ. 2008. How rare is the rare Andean cat? MAMMALIA 72(2):95-101.

Although rareness is the main criterion used to list the Andean cat *Leopardus jacobita* as endangered, information on its population abundance is lacking. During 14 expeditions to north-western Argentina, we recorded the culpeo *Lycalopex culpaeus* at all sites where we interviewed local people, the Pampas cat *Leopardus colocolo* at 85.2% of sites and *Leopardus jacobita* at 66.7% of sites. Encounter rates for indirect signs of small cats and foxes were similar. DNA genotyping showed that only 4.9% of faecal samples from small cats were from *L. jacobita*. Camera trapping recorded culpeos in 85.7%, Pampas cats in 71.4%, and Andean cats in 42.9% of the areas. The mean capture rate for culpeos was more than twice that for Pampas cats and five-fold that for Andean cats. Direct signs of *L. culpaeus* were the most abundant, whereas those for *L. colocolo* and *L. jacobita* were similar. Culpeos are more widespread and abundant than small cats in the High Andes. Populations of *L. jacobita* are less homogeneously distributed than those of *L. colocolo*, but clear differences in abundance of sympatric populations were not detected. Our results support

the need for conservation measures for *L. jacobita*, an endemic of the High Andes.

Lyra-Jorge, MC, Ciocheti, G, Pivello, VR. 2008. Carnivore mammals in a fragmented landscape in northeast of Sao Paulo State, Brazil. BIODIVERSITY AND CONSERVATION 17(7):1573-1580.

Sao Paulo is the most developed state in Brazil and little of its native vegetation remains. In Luiz Antonio and Santa Rita do Passa Quatro municipalities, only small fragments of cerrado (Brazilian savanna) physiognomies (cerrado, cerrado sensu stricto) and of semideciduous forest have been left, surrounded by eucalyptus silviculture and sugar-cane agriculture. However, that vegetation mosaic still shelters large mammals, including several carnivore species. To detect the carnivores present in such a mosaic area (50,000 ha), and to find out how they use the landscape, we recorded them through 21 camera traps and 21 track plots, during 18 months. Species richness, diversity and relative frequency were evaluated according to the habitat. Ten species were recorded, some of them locally threatened to extinction (*Puma concolor*, *Leopardus pardalis*, *Chrysocyon brachyurus*). Species diversity did not significantly differ among fragments, and although most species preferred one or another habitat, the carnivore community as a whole explored all the study area regardless of the vegetation cover; eucalyptus plantations were as used by the carnivores as the native fragments. Therefore, it seems possible to maintain such animals in agricultural landscapes, where some large native fragments are left and the matrix is permeable to native fauna.

Lyra-Jorge, MC, Ciocheti, G, Pivello, VR, Meirelles, ST. 2008. Comparing methods for sampling large- and medium-sized mammals: camera traps and track plots. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 54(4):739-744.

Activities involving fauna monitoring are usually limited by the lack of resources; therefore, the choice of a proper and efficient methodology is fundamental to maximize the cost-benefit ratio. Both direct and indirect methods can be used to survey mammals, but the latter are preferred due to the difficulty to come in sight of and/or to capture the individuals, besides being cheaper. We compared the performance of two methods to survey medium and large-sized mammal: track plot recording and camera trapping, and their costs were assessed. At Jatai Ecological Station (S21 degrees 31'15 ''- W47 degrees 34'42 ''-Brazil) we installed ten camera traps along a dirt road directly in front of ten track plots, and monitored them for 10 days. We cleaned the plots, adjusted the cameras, and noted down the recorded species daily. Records taken by both methods showed they sample the local richness in different ways (Wilcoxon, T=231; p<0.01). The track plot method performed better on registering individuals whereas camera trapping provided records which permitted more accurate species identification. The type of infra-red sensor camera used showed a strong bias towards individual body mass (R^2=0.70; p=0.017), and the variable expenses of this method in a 10-day survey were estimated about 2.04 times higher compared to track plot method; however, in a long run camera trapping becomes cheaper than track plot recording. Concluding, track plot recording is good enough for quick surveys under a limited budget, and camera trapping is best for precise species identification and the investigation of species details, performing better for large animals. When used together, these methods can be complementary.

Maffei, L, Noss, AJ. 2008. How small is too small? Camera trap survey areas and density estimates for ocelots in the Bolivian chaco. BIOTROPICA 40(1):71-75.

Studies on carnivores, which are generally difficult to observe directly because they are elusive and nocturnal, are carried out through indirect methods, e.g., camera trapping and radiotracking. The first method has been used to estimate population densities of species that can be differentiated as individuals using unique pelage patterns. However, the use

of capture-recapture methodology has raised doubts regarding the estimation of the sampling area around the camera traps, which is obtained using maximum distances traveled by individuals photographed at two or more different locations. In this paper, the results from camera traps are compared with a radiotracking study carried out simultaneously with ocelots (*Leopardus pardalis*) to confirm whether maximum distances observed in camera traps coincide with ranging patterns determined from radio telemetry, and in turn whether the sampling areas estimated from camera traps are appropriate for estimating density. Mean maximum distance moved was 2880 m according to camera trap records during a 60-d survey period while, with radiotracking, the maximum distance moved was 3176 m during the same period. The difference is not significant, and the sampling areas estimated with camera traps to assess ocelot density are reliable. However, if the area covered by cameras is reduced to less than three to four times average home range for the target species, then density estimates from camera trapping are exaggerated because of the reduced observed distances and the fact that multiple individuals can overlap in relatively small areas.

Marnewick, K, Funston, PJ, Karanth, KU. 2008. Evaluating camera trapping as a method for estimating cheetah abundance in ranching areas. SOUTH AFRICAN JOURNAL OF WILDLIFE RESEARCH 38(1):59-65.

In order to accurately assess the status of the cheetah *Acinonyx jubatus* it is necessary to obtain data on numbers and demographic trends. However, cheetahs are notoriously difficult to survey because they occur at very low population densities and are often shy and elusive. In South Africa the problem is further complicated in areas where land is privately owned, restricting access, with dense bush and cheetahs that are frequently persecuted. Cheetahs are individually identifiable by their unique spot patterns, making them ideal candidates for capture-recapture surveys. Photographs of cheetahs were obtained using four camera traps placed successively at a total of 12 trap locations in areas of known cheetah activity within a 300 KM^2 area in the Thabazimbi district of the Limpopo

Province. During 10 trapping periods, five different cheetahs were photographed. These results were used to generate capture histories for each cheetah and the data were analysed using the capture-recapture software package CAPTURE. Closure tests indicated that the population was closed (P = 0.056). The M(h) model was used to deal with possible heterogeneous capture probabilities among individual cheetahs. Closure tests did not reject the model assumption of population closure (P = 0.056). The M. model produced a capture probability of 0.17 with an estimate of 6-14 cheetahs (P = 0.95) and a mean population size of seven cheetahs (S.E. = 1.93). These results are promising and will be improved with employment of more camera traps and sampling a larger area.

Matthews, SM, Golightly, RT, Higley, JM. 2008. Mark-resight density estimation for American black bears in Hoopa, California. URSUS 19(1):13-21.

Accurate and precise population estimates are necessary to answer many management questions, but these estimates are generally unavailable for large carnivores because of their extensive movements, low densities, and secretive natures. These traits also often prevent the bounding of occupied areas necessary to estimate densities. We used a modified Petersen mark-recapture methodology to estimate black bear density in 1998 at 2 study sites on the Hoopa Valley Reservation, California, from mark-resight data. We used culvert traps to capture, radiocollar, and eartag bears, radio telemetry to establish closure, and remote cameras to collect resighting data. We calculated bear densities (90% confidence intervals) of 0.18 (0.09-0.32) and 1.33 (0.54-3.29) bears/KM^2 on the 2 sites. Knowledge of bear densities can now be incorporated into forest management actions and associated bear control measures on the Hoopa Valley Reservation.

McCain, EB, Childs, JL. 2008. Evidence of resident jaguars (*Panthera onca*) in the southwestern United States and the implications for conservation. JOURNAL OF MAMMALOGY 89(1):1-10.

Jaguars (*Panthera onca*) remain virtually unstudied in the desert environments at the northern extent of their range. Historic sightings from the United States indicate a declining population of resident jaguars from the late 1800s into the 1940s, after which only occasional jaguars were reported until the present. After 2 sightings of jaguars in 1996, we established a camera monitoring program in southeastern Arizona. From March 2001 to July 2007, we maintained 9-44 trail cameras and conducted opportunistic track surveys. We documented 2 adult males and a possible 3rd unidentified jaguar with 69 photographs and 28 sets of tracks. One jaguar, originally photographed in 1996, was resighted 64 times during 2004-2007. This >= 13-year-old male used habitats from the Sonoran lowland desert at 877 m above sea level to pine-oak woodlands at 1,577 m, and covered 1,359 KM^2 in 2 mountain complexes. Despite speculation that recent sightings of jaguars in the United States represented dispersing transients on sporadic forays from Mexico, we documented jaguars in Arizona frequently, continuously, and year-round, and videotaped several scent-marking behaviors, indicating the residency of adult jaguars within Arizona. We outline the importance of maintaining cross-border connectivity for long-term survival of the wide-ranging and thinly distributed binational population of jaguars. We recommend further research and we stress the fragmentation consequences of the proposed United States-Mexico border fence to the northernmost jaguar population, and particularly to jaguars in the United States.

McCarthy, KP, Fuller, TK, Ming, M, McCarthy, TM, Waits, L, Jumabaev, K. 2008. Assessing Estimators of Snow Leopard Abundance. JOURNAL OF WILDLIFE MANAGEMENT 72(8):1826-1833

The secretive nature of snow leopards (*Uncia uncia*) makes them difficult to monitor, yet conservation efforts require accurate and precise methods to estimate abundance. We assessed accuracy of Snow Leopard Information Management System (SLIMS) sign surveys by comparing them with 4 methods for estimating snow leopard abundance: predator: prey biomass ratios, capture - recapture density estimation, photo- capture rate, and individual identification through genetic analysis. We recorded snow leopard sign during standardized surveys in the SaryChat Zapovednik, the Jangart hunting reserve, and the Tomur Strictly Protected Area, in the Tien Shan Mountains of Kyrgyzstan and China. During June - December 2005, adjusted sign averaged 46.3 (SaryChat), 94.6 (Jangart), and 150.8 (Tomur) occurrences/km. We used counts of ibex (Capra ibex) and argali (Ovis ammon) to estimate available prey biomass and subsequent potential snow leopard densities of 8.7 (SaryChat), 1.0 (Jangart), and 1.1 (Tomur) snow leopards/100 KM2. Photo capture - recapture density estimates were 0.15 (n = 1 identified individual/1 photo), 0.87 (n = 4/13), and 0.74 (n = 5/6) individuals/100 KM2 in SaryChat, Jangart, and Tomur, respectively. Photo- capture rates (photos/100 trap- nights) were 0.09 (SaryChat), 0.93 (Jangart), and 2.37 (Tomur). Genetic analysis of snow leopard fecal samples provided minimum population sizes of 3 (SaryChat), 5 (Jangart), and 9 (Tomur) snow leopards. These results suggest SLIMS sign surveys may be affected by observer bias and environmental variance. However, when such bias and variation are accounted for, sign surveys indicate relative abundances similar to photo rates and genetic individual identification results. Density or abundance estimates based on capture - recapture or ungulate biomass did not agree with other indices of abundance. Confidence in estimated densities, or even detection of significant changes in abundance of snow leopard, will require more effort and better documentation.

Mortelliti, A, Boitani, L. 2008. Evaluation of scent-station surveys to monitor the distribution of three European carnivore species (*Martes foina, Meles meles, Vulpes vulpes*) in a fragmented landscape. MAMMALIAN BIOLOGY 73(4):287-292.

Scent-stations are frequently used in North and South America to monitor carnivore populations, and their efficacy has been widely tested on various species. On the other hand, scent-stations have rarely been used to monitor European species and their efficacy has never been tested. Therefore, an acritical use on Eurasiatic species may lead to biased results, but also a neglection of this technique may limit methodological improvements.

We evaluated scent-stations detection efficacy on three eurasiatic species: badger (*Meles meles*), fox (*Vulpes vulpes*) and beech marten (*Martes foina*) using data from a carnivore patch-use survey conducted in a fragmented landscape in the Province of Siena, central Italy. Scent-station survey data was compared with distribution data obtained from the utilisation of different techniques (track and camera trap surveys and interviews with local people) and an estimate of proportion of sites occupied inferred through the application of occupancy models.

We show how by using scent-stations, fox distribution was largely underestimated, badger distribution was biased (this species was missed in small fragments) while beech marten (Martes foina) distribution was relatively unbiased. We conclude that application of this technique should follow a pilot study and cost/benefits should be carefully considered.

O'Brien, TG. 2008. On the use of automated camera to estimate species richness for large- and medium-sized rainforest mammals. ANIMAL CONSERVATION 11:179-181.

NO ABSTRACT

O'Brien, TG, Kinnaird, MF. 2008. A picture is worth a thousand words: the application of camera trapping to the study of birds. BIRD CONSERVATION INTERNATIONAL 18(1):S144-S162.

This study reviews the use of remotely triggered still cameras, known as camera traps, in bird research and Suggests new methods useful for analyzing camera trap data. Camera trapping may be most appropriate for large, ground-dwelling birds, such as cracids and pheasants. Recent applications include documentation of occurrence of rare species and new species records, nest predation studies and behavioural studies including nest defence, frugivory, seed dispersal, and activity budgets. If bird postures are analyzed, it may be possible to develop behavioural time budgets. If birds are marked or individually identifiable, abundance may be estimated through capture-recapture methods typically used for mammals. We discourage use of relative abundance indices based on trapping effort because of the difficulty of standardizing surveys over time and space. Using the Great Argus Pheasant *Argus argusianus*, a cryptic, terrestrial, forest bird as an example, we illustrate applications of occupancy analysis to estimate proportion Of Occupied habitat and finite mixture models to estimate abundance when individual identification is not possible. These analyses are useful because they incorporate detection probabilities < 1 and covariates that affect the sample site or the observation process. Results are from camera trap surveys in the 3,568 KM^2 Bukit Barisan Selatan National Park, Indonesia. We confirmed that Great Argus Pheasants prefer primary forest below 500 m. We also find a decline in occupancy (6-8% yr^{-1}). Point estimates of abundance peak in 2000, followed by a sharp decline. We discuss the effects of rarity, detection probability and sampling effort on accuracy and precision of estimates.

Oliveira-Santos, LGR, Tortato, MA, Graipel, ME. 2008. Activity pattern of Atlantic Forest small arboreal mammals as revealed by camera traps. JOURNAL OF TROPICAL ECOLOGY 24:563-567.

NO ABSTRACT

Paviolo, A, de Angelo, CD, Di Blanco, YE, Di Bitetti, MS. 2008. Jaguar *Panthera onca* population decline in the Upper Parana Atlantic Forest of Argentina and Brazil. ORYX 42(4):554-561.

The Green Corridor of Argentina and Brazil is the largest forest remnant of the Upper Parana Atlantic Forest. The jaguar Population of this region is highly fragmented and reduced. To assess the status of the subpopulation of jaguars of the Green Corridor we conducted four camera-trap surveys in three sites with different levels of protection. At Urugua-i (34 stations, 1,495 trap-days) we recorded one individual (minimum density=0.12-0.33 per 100 KM^2). At Yaboti Biosphere Reserve (42 stations, 1,871 trap-days) we recorded two individuals (minimum density= 0.11-0.25 per 100 KM^2). At Iguazu National Park we conducted two surveys. In 2004 (39 stations, 1,839 trap-days) we recorded I-Our adult individuals, estimating a density of between 0.49 ± 0.16 and 1.07 ± 0.33 per 100 KM^2. In 2006, we increased the area sampled (47 stations, 2,059 trap-days) and recorded I I adult individuals, estimating a density of 0.93 ± 0.2 to 1.74 ± 0.34 per 100 KM^2. These density estimates are the lowest recorded for the species. Estimates for Ignazu are between 2-7.5 times lower than those reported in the early 1990s. This Population decline probably results from the interaction of several factors, including lack of prey as a result of poaching and persecution. We estimate that there is currently a Population of 25-53 adult jaguars in the Green Corridor. In spite of having sufficient potential habitat available this Population is threatened and urgent conservation action is required.

Rosellini, S, Osorio, E, Ruiz-Gonzalez, A, Isabel, AP, Barja, I. 2008. Monitoring the small-scale distribution of sympatric European pine martens (*Martes martes*) and stone martens (*Martes foina*): a multievidence approach using faecal DNA analysis and camera-traps WILDLIFE RESEARCH 35(5):434-440.

The European pine marten (*Martes martes*) and stone marten (*Martes foina*) are two closely related mustelids that live sympatrically over a large area of Europe. In the northern Iberian Peninsula, the distribution ranges of both species overlap extensively. The objectives of this study were (1) to verify whether, on a small scale, both species also live sympatrically and (2) to compare camera traps and scat DNA as methods for detecting marten species. The study was conducted in a protected area (province of Ourense, north-west Spain), which covers 6700 ha. To test the sympatry hypothesis, 90 fresh faecal samples, identified as faeces of genus Martes on the basis of their morphology, were collected from June 2004 to August 2006. The specific identification of faecal samples was conducted using polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) techniques. In addition, 20 camera-traps (916 camera-trap-nights) were in operation during the study period. Of the faecal samples collected, 88.8% were attributed to the European pine marten, while the remaining 11.2% were not amplified by PCR and thus could not be assigned. The European pine marten was identified in 57.9% of the photos of carnivores and the stone marten was not detected in any. The faecal DNA analysis and camera-trap results supported previous conclusions about habitat preferences and the distribution of the two species obtained using other methods. The two non-invasive methods that were used in this study were shown to be reliable techniques that can be employed simultaneously, because each method has advantages and disadvantages that are influenced by the size of the area inventoried, sampling effort, and cost and efficiency of the method. The data gathered using these methods provided important information on the understanding of trophic and competitive interactions between the species.

Rovero, F, Rathbun, GB, Perkin, A, Jones, T, Ribble, DO, Leonard, C, Mwakisoma, RR, Doggart, N. 2008. A new species of giant sengi or elephant-shrew (genus *Rhynchocyon*) highlights the exceptional biodiversity of the Udzungwa Mountains of Tanzania. JOURNAL OF ZOOLOGY 274(2):126-133.

A new species of sengi, or elephant-shrew, is described. It was discovered in the northern Udzungwa Mountains of Tanzania in 2005. Sengis (Order Macroscelidea, super-cohort Afrotheria) include four genera and 15 species of mammals that are endemic to Africa. This discovery is a significant contribution to the systematics of this small order. Based on 49 camera trap images, 40 sightings and five voucher specimens, the new sengi is diurnal and distinguished from the other three species of *Rhynchocyon* by a grizzled grey face, pale yellow to cream chest and chin, orange-rufous sides, maroon back and jet-black lower rump and thighs. The body weight of the new species is about 700 g, which is 25-50% greater than any other giant sengi. The new Rhynchocyon is only known from two populations that cover about 300 KM^2 of montane forest. It has an estimated density of 50-80 individuals km^{-2}. This discovery has important implications for the conservation of the high biodiversity that is found in the forests of the Eastern Arc Mountains.

Rowcliffe, JM, Carbone, C. 2008. Surveys using camera traps: are we looking to a brighter future? ANIMAL CONSERVATION 11(3):185-186.

NO ABSTRACT

Rowcliffe, JM, Field, J, Turvey, ST, Carbone, C. 2008. Estimating animal density using camera traps without the need for individual recognition. JOURNAL OF APPLIED ECOLOGY 45(4):1228-1236.

1. Density estimation is of fundamental importance in wildlife management. The use of camera traps to estimate animal density has so far been restricted to capture-recapture analysis of species with individually identifiable markings. This study developed a method that eliminates the requirement for individual recognition of animals by modelling the underlying process of contact between animals and cameras.

2. The model provides a factor that linearly scales trapping rate with density, depending on two key biological variables (average animal group size and day range) and two characteristics of the camera sensor (distance and angle within which it detects animals).

3. We tested the approach in an enclosed animal park with known abundances of four species, obtaining accurate estimates in three out of four cases. Inaccuracy in the fourth species was because of biased placement of cameras with respect to the distribution of this species.

4. Synthesis and applications. Subject to unbiased camera placement and accurate measurement of model parameters, this method opens the possibility of reduced labour costs for estimating wildlife density and may make estimation possible where it has not been previously. We provide guidelines on the trapping effort required to obtain reasonably precise estimates.

Scheibe, KM, Eichhorn, K, Wiesmayr, M, Schonert, B, Krone, O. 2008. Long-term automatic video recording as a tool for analysing the time patterns of utilisation of predefined locations by wild animals. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 54(1):53-59.

The design and application of automatic video recording systems for wild animals are described. Such systems enable continuous, long-time and repercussion-free surveillance of selected areas in the field. The performance characteristics of a conventional VHS video-tape system are compared to a digital video recording system. The recordings were used to develop daily and annual plots of occurrence for the different species and to display the preferences for darkness, twilight and light phase by the different species over the year. Absolute utilisation frequency as well as relative species composition can be obtained and compared between seasons or different places. The videos also were analysed for time budgets of basic behaviour patterns like feeding, walking, observing, social interaction, flight and comfort behaviour. Automatic video technique is a

highly convenient tool for systematic long-term field research on occurrence of wild animal species, daily and annual activity rhythms, behaviour and area utilisation. Such systems can be applied especially to record animals at clearings, feeding or bait places, water sources, salt licks or traps.

Stein, A, Fuller, T, Marker, L. 2008. Opportunistic use of camera traps to assess habitat-specific mammal and bird diversity in northcentral Namibia. BIODIVERSITY AND CONSERVATION 17(14):3579-3587.

In northcentral Namibia, Waterberg Plateau Park (WPP) is a protected area that acts as a refuge for rare and endangered species, while the farmlands surrounding the Park are managed for livestock production, but support populations of wildlife for game farming, trophy hunting, and conservation. During June-October 2006, camera-traps were set within and surrounding WPP to assess leopard (Panthera pardus) density (n = 19 camera stations and 946 camera-trap-nights). Fortuitously, photographic results (2,265 photos of identifiable mammal (n = 37) and bird (n = 25) species) allowed us to assess aspects of species diversity and differences among the Park, the farmland areas along the Waterberg Plateau escarpment, and the flatlands surrounding the escarpment. Species composition among the three areas was markedly different, and made sense with respect to differences in habitat and management features. Camera-trapping efforts, although intended for a narrow purpose, may also provide a rather robust record of differences in mammal and bird diversity in adjacent habitats and can be incorporated into long-term monitoring programs.

Tobler, MW, Carrillo-Percastegui, SE, Pitman, RL, Mares, R, Powell, G. 2008. An evaluation of camera traps for inventorying large- and medium-sized terrestrial rainforest mammals. ANIMAL CONSERVATION 11(3):169-178.

Mammal inventories in tropical forests are often difficult to carry out, and many elusive species are missed or only reported from interviews with local people. Camera traps offer a new tool for conducting inventories of large- and medium-sized terrestrial mammals. We evaluated the efficiency of camera traps based on data from two surveys carried out at a single site during 2 consecutive years. The survey efforts were 1440 and 2340 camera days, and 75 and 86% of the 28 large- and medium-sized terrestrial mammal species known to occur at the site were recorded. Capture frequencies for different species were highly correlated between the surveys, and the capture probability for animals that passed in front of the cameras decreased with decreasing size of the species. Camera spacing and total survey area had little influence on the number of species recorded, with survey effort being the main factor determining the number of recorded species. Using a model we demonstrated the exponential increase in survey effort required to record the most elusive species. We evaluated the performance of different species richness estimators on this dataset and found the Jackknife estimators generally to perform best. We give recommendations on how to increase efficiency of camera trap surveys exclusively targeted at species inventories.

Tobler, MW, Carrillo-Percastegui, SE, Pitman, RL, Mares, R, Powell, G. 2008. Further notes on the analysis of mammal inventory data collected with camera traps. ANIMAL CONSERVATION 11(3):187-189.

NO ABSTRACT

Trolle, M, Noss, AJ, Cordeiro, JLP, Oliveira, LFB. 2008. Brazilian tapir density in the Pantanal: A comparison of systematic camera-trapping and line-transect surveys. BIOTROPICA 40(2):211-217.

The density of Brazilian tapirs (*Tapirus terrestris*) was studied in the northeastern part of the Pantanal wetlands of Brazil using two simultaneous and independent methods: (1) systematic camera trapping combined with capture-recapture analysis, with camera traps spaced I km apart and distributed over 54 KM^2; and (2) line-transect sampling using an array of 12 linear transects, from 3.8 to 7.2 km long, covering the principal open and forest habitat types across the entire 1063 KM^2 SESC Pantanal Reserve. The two methods yielded conservative density estimates of 0.58 ± 0.11 tapirs/KM^2 (camera trapping) and 0.55 (95% CI 0.30-1.01) tapirs/KM^2 (line transects). The study suggests that certain Pantanal habitats and sites can sustain relatively high population densities of tapirs when these animals are protected from hunting. Further testing of the camera-trapping methodology as applied to tapirs is required, particularly focusing on extending the survey period. As it represents a relatively rapid method for estimating population density, in comparison to line-transect surveys, and as it generates information simultaneously on multiple species that are conservation priorities, we recommend that camera-trapping surveys be applied more widely across a variety of Pantanal habitats and land-use categories in order to confirm the value of the vast 140,000 KM^2 wilderness region for this vulnerable species.

Wakefield, S, Attum, O, Robinson, ER, Sandoka, MA. 2008. Seasonal use of a waterhole by Nubian ibex *Capra nubiana* (Artiodactyla: Bovidae). MAMMALIA

72(2):123-125.

NO ABSTRACT

Watari, Y, Takatsuki, S, Miyashita, T. 2008. Effects of exotic mongoose (*Herpestes javanicus*) on the native fauna of Amami-Oshima Island, southern Japan, estimated by distribution patterns along the historical gradient of mongoose invasion. BIOLOGICAL INVASIONS 10(1):7-17.

We examined the distribution patterns of native animals on Amami-Oshima Island, southern Japan, along a historical gradient of mongoose establishment and estimated the effects of mongoose on the native fauna. To assess the relative abundance of various ground-dwelling animals, we used the following four methods; sensor cameras for exotic mammals, nighttime driving census for nocturnal native vertebrates, line census for ground-dwelling lizards, and adhesive traps for arthropods. The results indicated that seven species with larger body size, including mammals, birds, reptiles, and amphibians, were rarely observed in mongoose-infested area. By contrast, medium-sized animals showed neutral relationships with mongoose establishment. Interestingly, the densities of smaller-sized animals were higher in mongoose-infested area. It could be interpreted that smaller species have increased in abundance through top-down cascades, i.e., decreases in native predators such as frogs and lizards caused by the mongoose have resulted in increases in the abundance of smaller animals. Predation pressures by mongoose and native predators may be canceled out for medium-sized animals, causing neutral responses to mongoose by these animals. This study appears to be the first example that shows the influence of mongoose on a wide variety of native animals. In addition, our findings indicate the importance of considering the food web structure of a recipient ecosystem and contribute to the prediction and assessment of ecological risks caused not only by mongoose, but also by other invasive top predators.

Xu, AH, Jiang, ZG, Li, CW, Guo, JX, Da, SL, Cui, QH, Yu, SY, Wu, GS. 2008. Status and conservation of the snow leopard *Panthera uncia* in the Gouli Region, Kunlun Mountains, China. ORYX 42(3):460-463.

The elusive snow leopard *Panthera uncia* is a rare and little studied species in China. Over 1 March-15 May 2006 we conducted a survey for the snow leopard in the Gouli Region, East Burhanbuda Mountain, Kunlun Mountains, Qinghai Province, China, in an area of c. 300 KM^2 at altitudes of 4,000-4,700 m. We surveyed 29 linear transects with a total length of C. 440 km, and located a total of 72 traces (pug marks, scrapes and urine marks) of snow leopard along four of the transects. We obtained eight photographs of snow leopard from four of six camera traps. We also recorded 1,369 blue sheep, 156 Tibetan gazelles, 47 argali, 37 red deer and one male white-lipped deer. We evaluated human attitudes towards snow leopard by interviewing the heads of 27 of the 30 Tibetan households livin in the study area. These local 9 people did not consider that snow leopard is the main predator of their livestock, and thus there is little retaliatory killing. Prospects for the conservation of snow leopard in this area therefore appear to be good. We analysed the potential threats to the species and propose the establishment of a protected area for managing snow leopard and the fragile alpine ecosystem of this region.

2007

Alvarez, AD, Galetti, M. 2007. Artificial nest predation in Atlantic Forest Island: testing the place and the different types of egg. REVISTA BRASILEIRA DE ZOOLOGIA 24(4):1011-1016.

Experiments on artificial nests are usually used to test ecological hypothesis and behavioural that affects the predation of natural bird nests. It is has been discussed about the size of the egg, texture and color affecting predation rate, but a few studies evaluate which egg type is more appropriate to simulate nest predation in tropical areas. The objective of this work was to compare the predation of different models of eggs (*Coturnix coturnix*, plasticine and Serinus canarius) on the ground and understory in an island with high abundance of nest predators. The study was carry out in October 2004 at Anchieta Island, Ubatuba, Sao Paulo, Brazil. The nests on the ground showed a statistical significance difference in the predation of quail eggs, plasticine and canary eggs. However, we did not find differences between plasticine and canaries eggs. The nests in the understory had a different pattern on the ground of quail eggs (25%) and plasticine (28%) and there was a difference when we compare canary eggs with plasticine and quail eggs. Our work pointed out that different eggs may have different predation rates. Therefore, studies that evaluate reproductive fitness of the bird community based on artificial nests must considered different egg types and strata.

Babweteera, F, Savill, P, Brown, N. 2007. *Balanites wilsoniana*: Regeneration with and without elephants. BIOLOGICAL CONSERVATION 134(1):40-47.

Tropical forest trees that produce large fruits and/or large seeds are believed to be dependent on a few and often rare large vertebrates for

dispersal. However, little is known about the population dynamics of such trees when they lose their specialised dispersers. This study examines the juvenile spatial distribution of *Balanites wilsoniana*, Dawe & Spraque, which is believed to be dependant solely on elephants for dispersal, in forests with and without elephants. Using camera traps, elephants were confirmed to be the only frugivores feeding and thus dispersing *Balanites wilsoniona* fruits. There was a high density of seedlings beneath adult trees in one forest without elephants, which was attributed to low seed and seedling predation in this forest. Nevertheless, it was only in the forest with elephants that juveniles were established away from adult trees. Analysis of the spatial distribution of these juveniles by size revealed that saplings and poles are more likely to be found away from adult trees thus providing evidence that dispersal enhances juvenile survival. This study underlines the importance of seed dispersal for trees that cannot maintain their populations through seedlings germinating and surviving beneath adult conspecifics. The study also demonstrates that loss of vertebrates has ramifications for tree species dynamics above and beyond loss of seed dispersers.

Barea-Azcon, JM, Virgos, E, Ballesteros-Duperon, E, Moleon, M, Chirosa, M. 2007. Surveying carnivores at large spatial scales: a comparison of four broad-applied methods. BIODIVERSITY AND CONSERVATION 16(4):1213-1230.

Reliable methods to estimate species richness are very important to managers and conservationists because they provide key data to make the right decisions in conservation programmes. In the case of carnivore mammals, traditional methods, such as direct count censuses, are not useful since these animals are usually scarce, elusive and nocturnal. Difficulties in carnivore sampling are compounded when monitoring programmes are developed at large spatial scales, where high economic costs and field efforts are necessary to achieve reliable richness or abundance estimates. These problems have highlighted the need to find more effective carnivore survey methods, especially in regions with high rates of landscape change, such as the Mediterranean basin. The present study, performed in a typical

Mediterranean area, was the first in Europe to test simultaneously the relative efficiencies of four broad-applied sampling methods to detect carnivore species at large spatial scales. Sign surveys based on scat detection, scent stations, camera-trapping and live-trapping were investigated. We compared efficiencies using biological parameters and by considering both the logistic and economic costs of each method. Overall, scent stations and sign surveys were the most efficient methods both in economic and logistic terms. In addition, the use of scent stations may be necessary to detect species rarely detected by scats. Detailed and extensive training programmes for conducting sign surveys and scent stations may overcome perceived problems thus enhancing the widespread use of both methods. Our results are applicable not only to other Mediterranean areas, but also to other habitats and regions of the world. More research into the suitability of these and other methods in relation to different landscapes, seasons and species is required.

Botello, F, Monroy, G, Illoldi-Rangel, P, Trujillo-Bolio, I, Sanchez-Cordero, V. 2007. Systematic images from camera-traps: a proposal of data card. REVISTA MEXICANA DE BIODIVERSIDAD 78(1):207-210.

The main objective of biological collections is to accumulate biological data. The use of camera-traps for inventories and ecological studies of mammals has shown a noteworthy recent increase. However, the basic information associated with the images is not organized in a formal or systematic way, like the specimens of a scientific collection. Here, we propose a format to produce digital photosampling cards where the image of the photographed species is associated with the same basic information that is recorded for a traditional sample; in this way, they can be easily incorporated in scientific collections, thus documenting the available information for the sites that are sampled by this method.

Capt, S. 2007. Monitoring and distribution of the lynx *Lynx lynx* in the Swiss Jura Mountains. WILDLIFE BIOLOGY 13(4):356-364.

Lynx were reintroduced to the Jura Mountains in the mid-1970s. A first retrospective update of the situation in France and Switzerland was undertaken 10 years later. Since then, real-time collection of occasional observations has been going on in both countries. The monitoring methods have been standardised since the beginning of the 1990s using, among other methods, a network of observers. During 1972-2001, 862 observations were collected in Switzerland and in this paper, these are used to describe the colonisation of the Swiss Jura Mountains and the present distribution of lynx. A comparison with the results of French researchers shows that during the first years of recolonisation, most of the observations were collected in the Swiss part of the Jura Mountains. Today, the French territory has become the core area of the population and includes about 2/3 of the population. The population has recovered after a period of reduced presence at the beginning of the 1990s. The range occupied perma nently by lynx in the Swiss Jura Mountains is estimated to be 2,100 km, representing a potential population of 17-23 resident individuals. The range occupied permanently by lynx in the Jura Mountains on both sides of the border is estimated to be 7,100 KM^2. Depending on the degree of saturation in the population, this represents a potential population of 56-78 resident individuals. Compared to existing habitat suitability models, most of the suitable habitat has already been occupied. In the future more importance will be given to the exchange of information across the international border and the participation of local people in the survey. I recommend that active monitoring using camera-traps be carried out periodically as a supplement to the ongoing passive surveillance system.

Carrillo, E. 2007. Tracking the elusive jaguar. NATURAL HISTORY 116(4):30-34.

Camera trapping, radio collars and radio transmission were used to tract jaguars in Cost Rica.

Clifford, DL, Woodroffe, R, Garcelon, DK, Timm, SF, Mazet, JAK. 2007. Using pregnancy rates and perinatal mortality to evaluate the success of recovery strategies for endangered island foxes. ANIMAL CONSERVATION 10(4):442-451.

Following a dramatic population decline in 1999, captive-breeding and translocation programs were initiated to recover the Santa Catalina Island fox *Urocyon littoralis*. Neonatal losses during the first year of captive breeding raised concerns, but little information was available on which to base reproductive expectations in captivity, and pregnancy rates and pup mortality had not been assessed in free-ranging foxes. In 2002 and 2003 we evaluated the relative contributions of captive breeding and translocation to population recovery by comparing pregnancy rates and perinatal mortality in free-ranging and captive Santa Catalina Island foxes, and by comparing pregnancy rates and perinatal mortality were also compared between resident free-ranging foxes and foxes that had been captive bred and released, or translocated as juveniles. Pregnancy rates and fetal number were determined using ultrasound. Free-ranging pregnant foxes were followed via radiotelemetry, and a combination of camera-traps, observation and targeted trapping was used to determine how many pups survived to weaning. Video cameras and observations were used to determine the weaning success for captive foxes. The adult pregnancy rate for free-ranging foxes (95.0%) was higher than for adult captive foxes (47.6%; P=0.003). Perinatal mortality for pups born to free-ranging mothers (43.2%) was higher than for pups born to captive mothers (15.0%, P=0.055). Adult pregnancy rates and perinatal mortality were 100 and 25.0% for translocated and captive-bred foxes combined, and 92.3 and 53.6% for resident wild foxes. The average weaned litter size (+/- standard deviation) for free-ranging foxes (1.8 ± 0.6) was similar to that for captive foxes (2.1 ± 0.4). Successful pup production by translocated and captive-bred foxes supports the utility of these strategies to recover island foxes.

Our approach, integrating veterinary and field biology techniques to assess the contributions of different management strategies to population recovery, can be utilized for other endangered species.

Dillon, A, Kelly, MJ. 2007. Ocelot *Leopardus pardalis* in Belize: the impact of trap spacing and distance moved on density estimates. ORYX 41(4):469-477.

We used remote cameras to obtain information on an elusive species and to examine the effects of different camera trapping methodologies on abundance estimates. We determined activity pattern, trail use, trap success, and density of ocelot *Leopardus pardalis* in seven camera-trap surveys across two habitat types in western Belize: tropical broad-leaf rainforest and tropical pine forest. Ocelots in the rainforest were active mostly at night, in particular immediately after sunset, and they travelled on low-use roads (especially in the wet season) and high-use roads (especially in the dry season) more than established and newly cut trails. Trap success was relatively high in the rainforest (2.11-6.20 captures per 100 trap nights) and low in the pine forest (0.13-0.15 captures per 100 trap nights). Camera trapping combined with mark-recapture statistics gave densities of 25.82-25.88 per 100 KM^2 in the broad-leaf versus 2.31-3.80 per 100 KM^2 in the pine forest. Density estimates increased when animals repeatedly captured at the same camera (zero-distance moved animals) were included in the buffer size analysis. Density estimates were significantly negatively correlated with distance between cameras. We provide information on ocelot population status from an unstudied portion of its range and advise that camera trap methodologies be standardized to permit comparisons across sites.

Fiehler, CM, Cypher, BL, Bremner-Harrison, S, Pounds, D. 2007. A theft-resistant adjustable security box for digital cameras JOURNAL OF WILDLIFE MANAGEMENT 71(6):2077-2080.

Remote camera traps are becoming an increasingly popular, affordable, and valuable tool for wildlife research. However, theft and vandalism of these camera systems can result in substantial financial loss and loss of valuable data. We developed an adjustable steel camera security box to protect our Cuddeback((R)) (Non Typical, Inc., Park Falls, WI) digital scouting cameras. Our cameras were deployed for 160 days and experienced no theft or vandalism during that time. Our armored camera box successfully protected our equipment and data, can be sized to accommodate any brand of camera, and can be used in a variety of field situations.

Giman, B, Stuebing, R, Megum, N, Mcshea, WJ, Stewart, CM. 2007. A camera trapping inventory for mammals in a mixed use planted forest in Sarawak.

RAFFLES BULLETIN OF ZOOLOGY 55(1):209-215.

A series of camera trapping surveys was done in and around an Acacia plantation in central Sarawak to monitor wildlife populations within the planted forest. The study area was divided into 1 KM*2* blocks with two cameras placed in each block for thirty days at each position, and placed in five study areas for a period of approximately six months. Camera sites were baited with a variety of commercially available scent lures. During 1,632 trap-nights, a total of 25 species of mammals were detected and photographed, comprising 15 families, and 23 genera, including local Bearded Pig (*Sus barbatus*), Sambar Deer (*Cervus unicolor*), Sun Bear (*Helarctos malayanus*), and an Otter Civet (*Cynogale bennettii*). Some lures failed to attract any mammals, while oily lures such as Fish Oil, seemed to better withstand rain, increasing the long-term chances for obtaining species photographs. Magna Glan, producing a very strong odor, attracted numerous terrestrial mammals and remained detectable even to humans for at least one month, even during the rainy season. The implications of the

results of this study for successfully monitoring tropical forest wildlife is discussed.

Goncalves, FA, Cechin, SZ, Bager, A. 2007. Nest predation of *Trachemys dorbigni* (Dumeril & Bibron) (Testudines, Emydidae) in Southern Brazil. REVISTA BRASILEIRA DE ZOOLOGIA 24(4):1063-1070.

Nests of the D'Orbigny's slider, *Trachemys dorbigni*, were monitored during the nesting season of 2005/2006 to evaluate predation rates; time variation on these rates; to identify predator species and their importance on nest destruction and the influence of nest dispersion on predation rates in Southern Brazil. Of the 58 monitored nests, 98% (n = 57) were destroyed by predators. Predation events occurred primarily during the first 48 hours after oviposition and there was no time variation on predation rates. Using camera traps and direct observations we could identify six species of nest predators. There was not prevalence of any predator. Nest density did not influence predation rates, but there was a negative correlation between time after egg laying and predation.

Hackett, HM, Lesmeister, DB, Desanty-Combes, J, Montague, WG, Millspaugh, JJ, Gompper, ME. 2007. Detection rates of eastern spotted skunks (*Spilogale putorius*) in Missouri and Arkansas using live-capture and non-invasive techniques. AMERICAN MIDLAND NATURALIST 158(1):123-131.

The eastern spotted skunk (*Spilogale putorius*) is a rare species of conservation concern throughout much of its range, but effective management is hampered by a lack of information on appropriate survey strategies. We validated three commonly used techniques to identify the presence of eastern spotted skunks at four sites in Missouri and Arkansas where the species was known to occur. Live-capture with box-traps revealed

a strong seasonal pattern in capture success in both states, with virtually all captures occurring between late Sept. and early May. This pattern of detection also occurred when surveys were conducted using non-invasive camera-traps and enclosed track-plates in Missouri. Track-plates were more efficient than camera-traps at detecting eastern spotted skunks, with a lower latency to initial detection (LTD) and higher probability of detection (POD). Our results indicate that the use of enclosed track-plates is a powerful non-invasive technique for detecting eastern spotted skunks when surveys are conducted between late Sept. and early May. Surveys conducted during late spring and summers are inappropriate given the high likelihood of not detecting the species despite its presence.

Kasper, CB, Mazim, FD, Soares, JBG, De Oliveira, TG, Fabian, ME. 2007. Composition and relative abundance of the medium-large sized mammals of Turvo State Park, Rio Grande do Sul, Brazil. REVISTA BRASILEIRA DE ZOOLOGIA 24(4):1087-1100.

Between January of 2005 and December of 2006, studies on the composition and relative abundance of medium and large sized mammals were carried out in Turvo State Park. Records came from camera-trapping, in addition to visualization and presence and absence data from track surveys along pre determined transects. At total, 29 species of medium-large sized mammals were listed. Of these, *Dasyprocta azarae* Lichtenstein, 1823 and *Sylvilagus brasiliensis* (Linnaeus, 1758) were the most frequently found. For carnivores, the majority of records were for *Nasua nasua* (Linnaeus,1766) and *Leopardus pardalis* (Linnaeus, 1758), whereas *Leopardus tigrinus* (Schreber, 1775), *Leopardus wiedii* (Schinz, 1782) and *Galictis cuja* (Molina 1782), had the least. Among the ungulates, only Pecari tajacu (Linnaeus, 1758) showed frequent records, ranking fourth overall. Some species, common to other environments, showed few records at Turvo State Park, such as *Dasypus novemcinctus* Linnaeus, 17S8 and *Didelphis albiventris* Lund, 1840. Data was suggestive of the probable local extinction of *Tayassu pecari* (Link, 1795) in the Park. The conservation of the medium and large sized mammals of this conservation area is strongly

associated with the conservation of the "Misiones Green Corridor", which probably represents a source area for many species.

Kauffman, MJ, Sanjayan, M, Lowenstein, J, Nelson, A, Jeo, RM, Crooks, KR. 2007. Remote camera-trap methods and analyses reveal impacts of rangeland management on Namibian carnivore communities. ORYX 41(1):70-78.

Assessing the abundance and distribution of mammalian carnivores is vital for understanding their ecology and providing for their long-term conservation. Because of the difficulty of trapping and handling carnivores many studies have relied on abundance indices that may not accurately reflect real abundance and distribution patterns. We developed statistical analyses that detect spatial correlation in visitation data from combined scent station and camera-trap surveys, and we illustrate how to use such data to make inferences about changes in carnivore assemblages. As a case study we compared the carnivore communities of adjacent communal and freehold rangelands in central Namibia. We used an index of overdispersion to test for repeat visits to individual camera-trap scent stations and a bootstrap simulation to test for correlations in visits to camera neighbourhoods. After distilling our presence-absence data to the most defensible spatial scale, we assessed overall carnivore visitation using logistic regression. Our analyses confirmed the expected pattern of a depauparate fauna on the communal rangelands compared to the freehold rangelands. Additionally, the species that were not detected on communal sites were the larger-bodied carnivores. By modelling these rare visits as a Poisson process we illustrate a method of inferring whether or not such patterns are because of local extinction of species or are simply a result of low sample effort. Our Namibian case study indicates that these field methods and analyses can detect meaningful differences in the carnivore communities brought about by anthropogenic influences.

Larrucea, ES, Serra, G, Jaeger, MN, Barrett, RH. 2007. Censusing bobcats using remote cameras. WESTERN NORTH AMERICAN NATURALIST 67(4):538-548.

We estimated bobcat (*Lynx rufus*) density for 3 different locations in northern California using active infrared-triggered cameras. Using differences in pelage pattern as well as other physical characteristics, we identified individual bobcats from photographs, and used mark-recapture techniques to estimate population density Camera density affected the precision Of Population estimates. The same population was estimated using camera densities of 0.5, 1, 2, 4, 6, and 8 cameras km^{-2}. Higher camera densities resulted in more captures and recaptures of bobcats and, consequently, in more precise density estimates. Similarly, the number of photo-captures and recaptures increased with increasing study duration. Increasing the area sampled resulted in the capture of more individuals but did not increase the percentage of recaptures. While some locations captured multiple bobcat photographs (e.g., 15 at 1 station), these photos tended to be recaptures of the same individual. There were no more than 2 individuals photo-captured at any one camera location. Bobcat density, varied among habitat types as predicted. We estimated density as 0.27 bobcats km^{-2} (s = 0.16) overall in an area in the northern Sacramento River Valley and as 0.35 bobcats km^{-2} (s = 0.56) in a steep and rocky canyon within the area. At a 3rd site in the Coast Range, the estimate was 0.39 bobcats km^{-2} (s = 1.44). Bobcats were more diurnal where human activity was less common. In addition, photo-capture was significantly higher along roads and trails without an attractant than it was off-trail with an attractant.

Linkie, M, Dinata, Y, Nugroho, A, Haidir, IA. 2007. Estimating occupancy of a data deficient mammalian species living in tropical rainforests: Sun bears in the Kerinci Seblat region, Sumatra. BIOLOGICAL CONSERVATION 137(1):20-27.

Tropical mammals represent some of the most threatened species, but also the least known because they tend to be difficult to study. To objectively evaluate the conservation status of these species, standardized methods are urgently required. The sun bear *Helarctos malayanus* is a case in point: it is cryptic, difficult to detect and consequently classified on the IUCN Red List as Data Deficient, and the highest priority for bear conservation research. In this study, we apply a detection/non-detection sampling technique using camera trap data with environmental covariates to estimate sun bear occupancy from three tropical forest study areas with different levels of degradation and protection status in Sumatra. Sun bear detections, and encounter rates, were highest in one of the primary forest study areas, but sun bear occupancy was highest in the degraded forest study area. Whilst, sun bears were recorded at a greater proportion of camera placements in degraded forest, these records were often on only one occasion at each placement, which greatly increased the final occupancy estimate. Primary forests with their large fruiting trees undoubtedly represent good sun bear habitat, but our results indicate that degraded forest can also represent important habitat. These forests should therefore not be considered as having limited conservation value and assigned to other uses, such as oil palm production, as has previously happened in Sumatra. Estimating occupancy between years will yield information on the population trends of sun bears and other tropical mammals, which can be used to provide more reliable conservation assessments.

Lopucki, R. 2007. Social relationships in a bank vole *Clethrionomys Glareolus* (Schreber, 1780) population: Video monitoring under field conditions. POLISH JOURNAL OF ECOLOGY 55(3):543-558.

Social behaviour of the bank vole was video recorded during direct encounters between individuals under natural conditions. The apparatus consisted of miniature video cameras, a system of image processing and recording, and infrared emitters. This device enabled continuous 24-h observations at several sites simultaneously. The study was conducted in an alder swamp Ribo nigri-Alnetum located in the Kampinos National Park,

central Poland (52 degrees 20'N, 20 degrees 25'E). Observations were made in the late summers of 2002 and 2003 at six independent baited sites for 10 days and nights per each site. Rodents visiting the sites were individually marked by fur clipping. In sum, 13 053 visits to the sites and 1868 encounters between two marked individuals of C. glareolus were video recorded during 1440 hours of observation. It has been found that under natural conditions, bank voles most often avoided each other (55% of the encounters). In the case of close contacts they were aggressive (30%), rarely tolerant (7%), and during the remaining encounters they showed a mixed behaviour. The voles met mainly in the night (94% of the encounters) despite of 25% of their daily activity ran during the day. The frequency and character of encounters depended on the sex, age, and the origin of individuals. Encounters between males were more aggressive than between females (P <0.01). In encounters between opposite sexes, males were dominants (P <0.00 1). Individuals with a larger body mass were dominant in access to food (P <0.000). Cases of the dominance of juveniles over adults were interpreted as a result of the site of their origin. Social relations between individuals were characterised by persistence and repeatability in time. The results are compared with the literature describing experiments with animals kept in the laboratory or in enclosures, and field observations based on trapping techniques and telemetry.

Lynam, AJ, Laidlaw, R, Noordin, WSW, Elagupillay, S, Bennett, EL. 2007. Assessing the conservation status of the tiger *Panthera tigris* at priority sites in Peninsular Malaysia. ORYX 41(4):454-462.

Wildlife managers require status and distribution information for informed decisions. Recognizing the tiger's globally threatened status and potential as an umbrella species for protection of forested landscapes, camera trap surveys for tigers and other large mammals have been conducted since 1997 in Peninsular Malaysia with the aim of assessing the population status of tigers in the Peninsula. Results from surveys at nine sites between December 1997 and December 1999 are reported here. Tigers were confirmed from six sites in the Main Range and Greater Taman Negara

landscape, with multiple locations inside putative priority tiger areas. Although the data were collected 8 years ago, they are supplemented with more recent information, including tiger-human conflict investigations during 2000-2005 that indicate tiger persistence at these sites. Tiger density estimates were 0.51-1.95 tigers per 100 KM^2. With results from other surveys, this suggests a national population of up to several hundred tigers. A thorough survey, with sufficient resources, should be carried out in the future to derive a more reliable tiger population estimate for Malaysia. Key threats are habitat loss and fragmentation, hunting of prey, commercial trade in tiger parts, and harassment and displacement. Recommendations for the recovery of tigers in Peninsular Malaysia are provided.

Martins, SD, Sanderson, JG, Silva-Junior, JDE, 2007. Monitoring mammals in the Caxiuanu National Forest, Brazil – First results from the Tropical Ecology, Assessment and Monitoring (TEAM) program. BIODIVERSITY AND CONSERVATION 16(4):857-870.

The need for long-term biodiversity monitoring using standardized protocols led to the creation of the Tropical Ecology, Assessment and Monitoring (TEAM) initiative. At some 50 field stations in tropical forests around the world, TEAM will monitor various taxa such as ants, birds, butterflies, medium and large terrestrial mammals, primates, litter fall, and trees, as well as landscape change in nine tropical biodiversity hotspots and three tropical wilderness areas. The TEAM terrestrial mammal program calls for using a grid of camera phototraps to monitor long-term trends in densities and occupancy rates of species that can or cannot be uniquely identified, respectively. We describe the TEAM camera phototrapping program and provide results for the first TEAM site-Caxiuana National Forest in northern Brazil. An intensive one year camera trapping effort was carried out to determine which months were most suitable for long-term monitoring. Fifteen species of medium and large terrestrial mammals and two large birds were recorded, including three xenarthrans, five carnivores, one perissodactyle, three artiodactyles, two rodents, and one marsupial. The medium and large terrestrial mammal diversity was well represented during two consecutive

wet and dry months, respectively. We also recorded activity patterns for all species photographed by our camera traps more than 10 times.

Matsubayashi, H, Lagan, P, Majalap, N, Tangah, J, Sukor, JRA, Kitayama, K. 2007. Importance of natural licks for the mammals in Bornean inland tropical rain forests ECOLOGICAL RESEARCH 22(5):742-748.

An intensive camera-trapping study and a nutrient analysis were carried out to understand how natural licks are important for mammals in inland tropical rain forests where soil cations are usually depleted. Using camera traps, we investigated the fauna, food habits, and the frequency of visitation by species at five natural licks in the Deramakot forest reserve, Sabah, Malaysia. All food-habit types of mammals (carnivore, herbivore-frugivore, insectivore, and omnivore), which included 29 (78.4%) of 37 species known in Deramakot, were recorded at the natural licks. The sambar deer, followed by the bearded pig, the lesser mouse-deer, the Malay badger, and the orangutan were the most commonly recorded species and represented 77.5% in terms of the frequency of appearance in all photographs taken throughout the year. These results indicated that, although the proportion of species recorded at the natural licks relative to the whole mammalian fauna of the forest was high, the frequency of visitation greatly varied among the species, and only a few species dominated. The frequency of visitation seemed to reflect both the density of species and the demand for the minerals, because some endangered, low-density species were more frequently recorded by cameras than expected-for example, the orangutan which was one of the top five species among natural-lick users. The natural licks with greater concentrations of minerals in seepage soil water were significantly preferred by the sambar deer and the bearded pig than those with lower concentrations of minerals. This result suggests that the chemical properties of soil water in natural licks determine the frequency of visitation of these herbivorous species that have strong demand for minerals.

McBride, RT, McBride, RT. 2007. Safe and selective capture technique for jaguars in the Paraguayan Chaco. SOUTHWESTERN NATURALIST 52(4):570-577.

Capture techniques are an important consideration for studies involving endangered or threatened species. Mortality or serious injury can cause an unfavorable reaction from the public and bias results. Safe and selective capture of jaguars (*Panthera onca*) depends on such factors as environmental conditions in the study area, accessibility, avoidance of nontarget animals, budget, time, mobility, and skills and training of the capture team. In consideration of these factors, trained cat hounds were chosen as a capture method for a study of jaguars in the Chaco of Paraguay. During winter months of June and July 2002 through 2006, representing 5 capture periods, 15 jaguars were captured and fitted with GPS-VHF collars during 92 days of hunting. Four of these 15 jaguars were recaptured and refitted with new collars. No jaguar was killed or injured during capture or recapture, and no nontarget animal, including jaguar kittens, was chased, captured, or harassed. Post-capture monitoring via telemetry indicated that 14 jaguars moved 1-5 km from capture site the following day, with Jaguar 2 moving 12 km the day after capture. Six collared jaguars were captured on camera 24 times. Camera-trap photos gave visual support that the collared jaguars remained in good physical condition.

Michalski, F, Peres, CA. 2007. Disturbance-mediated mammal persistence and abundance-area relationships in Amazonian forest fragments. CONSERVATION BIOLOGY 21(6):1626-1640.

Few researchers have investigated the synergistic effects of tropical forest fragmentation and disturbance on species persistence and abundance. We examined effects of both forest-patch metrics and forest disturbance in determining richness and abundance of midsized to large-bodied mammal

species in a highly fragmented Amazonian forest landscape. Twenty-one forest fragments, ranging from 2 to 14,480 ha, and two continuous forest sites were sampled based on sightings, tracks, line-transect censuses, armadillo burrow censuses, and camera trapping. Patch occupancy of 37 species recorded ranged from 4% to all forest sites surveyed. Forest fragment size was the strongest predictor of species persistence, explaining 90% of the variation in species richness. Information-theoretic analysis confirmed that fragment area was the most important explanatory variable for the overall species richness and abundance of mammal species, followed by surface fires, which affected the abundance of seven species. Large mammal species were typically absent from fragments < 100 ha, whereas some ubiquitous species were favored by fragmentation, exhibiting hyperabundance in small patches. Our findings highlight the importance of large (> 10,000 ha), relatively undisturbed forest patches to maximize persistence and maintain baseline abundances of Neotropical forest mammal species.

Mohd-Azlan, J, Sanderson, J. 2007. Geographic distribution and conservation status of the bay cat *Catopuma badia*, a Bornean endemic. ORYX 41(3):394-397.

Despite being one of the rarest felids in the world the Endangered Bomean bay cat *Catopuma badia* has received little conservation attention. Most information consists of historical records, morphological descriptions, and anecdotes from various sources. During 2003-2006 we undertook surveys using camera trapping, interviews and field observations, to determine the species' distribution and document any threats to its persistence. We also examined museum specimens and completed a thorough literature review, collecting 15 additional geographic records throughout Borneo. Our results show that opportunistic hunting and land use changes are the main threats to the bay cat, and we make recommendations for its conservation.

Ngoprasert, D, Lynam, AJ, Gale, GA. 2007. Human disturbance affects habitat use and behaviour of Asiatic leopard *Panthera pardus* in Kaeng Krachan National Park, Thailand. ORYX 41(3):343-351

Edge effects arising from road construction and other development in protected areas can negatively affect the behaviour of wildlife, particularly large carnivores. The Asiatic leopard *Panthera pardus* is a large carnivore that may be sensitive to edge effects. Camera trapping was used to assess the influence of human disturbance along forest edges on leopard behaviour and habitat use in a 104 KM² area of Kaeng Krachan National Park, Thailand. A minimum of four male and two female leopards was recorded in the study area. A Park access road bisecting the study area was not a barrier to leopard movement but movements and activity were affected by human traffic inside the Park. A regression model showed that leopard habitat use increased with distance from human settlements at the forest edge. As in other parts of its range, leopards at Kaeng Krachan National Park tended to show less diurnal activity in areas more heavily used by people compared to areas less used. As is the case with tigers, such responses may pose a threat to leopard population persistence but more research is needed to determine the demographic implications of edge effects for Asiatic leopards and other large tropical carnivores, and the appropriate mitigation strategies required.

Posa, MRC, Sodhi, NS, Koh, LP. 2007. Predation on artificial nests and caterpillar models across a disturbance gradient in Subic Bay, Philippines. JOURNAL OF TROPICAL ECOLOGY 23:27-33.

One possible mechanism underlying species losses in the tropics is an increase in predation due to habitat degradation. Relative levels of predation at three heights (ground. 1-1.5 m. > 5 in for nests and > 3 in for caterpillars) were compared across a gradient of disturbance in the Subic Bay Watershed Forest Reserve. Philippines over a 2-mo period. Four 750-m

transects were established in each habitat type (closed-canopy forest, open-canopy forest, rural areas) where artificial nests and caterpillar models were placed within 10m-radius plots and checked after it 5-d exposure period. Nests in open-canopy forest were least predated (16.7%,) with predation in rural areas (58.3%) being higher than in closed-canopy forest (32.8%). Predation nests at 1-1.5 in was significantly lower than ground nests. General linear mixed model analysis suggested that effects of habitat type on nest predation differed among heights. Attacks on caterpillars increased with disturbance (46.1-59.4%), but height was not found to have a significant effect on predation. Markings on plasticine models. Camera traps and live traps were used to establish possible predators. Shifts in predator dominance among the habitats were observed. Vegetation cover, tree density and small mammal abundance were not correlated with mean predation in the transects.

Rios-Uzeda, B, Gomez, H, Wallace, RB. 2007. A preliminary density estimate for Andean bear using camera-trapping methods. URSUS 18(1):124-128.

Andean (spectacled) bears (*Tremarctos ornatus*) are threatened across most of their range in the Andes. To date no field-based density estimations are available for this species. We present a preliminary estimate of the density of this species in the Greater Madidi Landscape using standard camera-trapping methods and capture-recapture analysis. We photographed 3 individually recognizable Andean bears in a 17.6 KM^2 study area spanning 4 adjacent high elevation humid Andean valleys during August-September 2004. Capture-recapture statistics estimated an abundance of 3 bears; plausible geographic buffers yielded density estimates of 4.4 or 6 bears/100 KM^2. We recommend that future camera-trapping studies on this species sample larger areas over longer periods and use 3 camera trap units at each station.

Rovero, F, De Luca, DW. 2007. Checklist of mammals of the Udzungwa Mountains of Tanzania. MAMMALIA 71(1-2):47-55.

NO ABSTRACT

Rumiz, DI, Pardo, E, Eulert, CF, Arispe, R, Wallace, RB, Gomez, H, Rios-Uzeda, B. 2007. New records and a status assessment of a rare dwarf brocket deer from the montane forests of Bolivia. JOURNAL OF ZOOLOGY 271(4):428-436.

Two skeletons, tracks, faecal pellets, photographs and local reports are described and compared with the few previous records of dwarf Andean deer from Bolivia and Peru. Tarsal bones and incisor teeth were diagnostic traits for *Mazama* and not for *Pudu*, while skull measurements, ear shape, body colour and facial patterns were consistent with descriptions of *Mazama chunyi*. Twenty-five new localities (including more than 60 sites in La Paz and Cochabamba) extended significantly the previously known range for *M. chunyi* in Bolivia. It occurs in Madidi, Apolobamba, Pilon Lajas, Cotapata, Carrasco and probably Isiboro Secure protected areas, in habitats ranging from grasslands and Polylepis elfin forests of the 'ceja de Yungas' at 3600 m to sub-Andean forests at 1000 m. A geographical information system modelled geographic distribution area based on altitude and ecological zone estimates a potential range of about 45 717 KM^2 in Bolivia. About 36% of this range (or 41% of the extent of occurrence) is degraded and fragmented, but the rest seems to be in relatively good conservation status. Habitat decline and a limited area of occupancy estimated for Bolivia (and suspected for Peru) suggest that *M. chunyi's* conservation status should be updated from Data Deficient to Vulnerable VU A4c; B2a+b(iii).

Salom-Perez, R, Carrillo, E, Saenz, JC, Mora, JM. 2007. Critical condition of the jaguar *Panthera onca* population in Corcovado National Park, Costa Rica. ORYX 41(1):51-56.

The jaguar *Panthera onca* is threatened throughout its range and categorized as Near Threatened on the IUCN Red List. To inform conservation of the jaguar population in Corcovado National Park, Costa Rica, population size was estimated using data from a 3-month camera trap study. Individuals were identified from their coat patterns. The resulting density estimate of 6.98 ± SD 2.36 individuals per 100 KM^2 was lower than expected. The sex ratio was 1.33 males per female, and the minimum home ranges of two males were 25.64 and 6.57 KM^2. Hunting pressure on jaguar and white-lipped peccaries Tayassu pecari, the jaguar's main prey in the Park, may be responsible for the low jaguar density as space does not seem to be a limiting factor. The numbers of females may have been underestimated because of sampling bias and therefore the sex ratio obtained in this and similar studies must be interpreted cautiously. Better protection of the corridor that connects the Park with other protected areas is essential to guarantee long-term survival of the jaguar in Costa Rica.

Simcharoen, S, Pattanavibool, A, Karanth, KU, Nichols, JD, Kumar, NS. 2007. How many tigers *Panthera tigris* are there in Huai Kha Khaeng Wildlife Sanctuary, Thailand? An estimate using photographic capture-recapture sampling. ORYX 41(4):447-453.

We used capture-recapture analyses to estimate the density of a tiger *Panthera tigris* population in the tropical forests of Huai Kha Khaeng Wildlife Sanctuary; Thailand, from photographic capture histories of 15 distinct individuals. The closure test results (z = 0.39, P = 0.65) provided some evidence in support of the demographic closure assumption. Fit of eight plausible closed models to the data indicated more support for model M(h), which incorporates individual heterogeneity in capture probabilities.

This model generated an average capture probability (p) over cap = 0.42 and an abundance estimate of (N) over cap((SE) over cap[(A) over cap (W)]) = 19 (9.65) tigers. The sampled area of (A) over cap (W)((SE) over cap[(A) over cap (W)]) = 477.2 (58.24) KM^2 yielded a density estimate of (D) over cap((SE) over cap[(D) over cap]) = 3.98 (0.51) tigers per 100 KM^2. Huai Kha Khaeng Wildlife Sanctuary could therefore hold 113 tigers and the entire Western Forest Complex c. 720 tigers. Although based on field protocols that constrained us to use sub-optimal analyses, this estimated tiger density is comparable to tiger densities in Indian reserves that support moderate prey abundances. However, tiger densities in well-protected Indian reserves with high prey abundances are three times higher. If given adequate protection we believe that the Western Forest Complex of Thailand could potentially harbour > 2,000 wild tigers, highlighting its importance for global tiger conservation. The monitoring approaches we recommend here would be useful for managing this tiger population.

Srbek-Araujo, AC, Chiarello, AG. 2007. Use of camera traps in mammal sampling: methodological considerations and comparison of equipments. REVISTA BRASILEIRA DE ZOOLOGIA 24(3):647-656.

Use of camera traps in mammal sampling: methodological considerations and comparison of equipments. The use of camera traps is quite recent in Brazil. The high cost of equipments and constant expenses with supplies can, in some circumstances, limit the number of units to be deployed and sampling effort. The present study discusses methodological issues aiming at optimizing the use of these traps in mammalian inventories and also provides a comparison of two brands of equipments. The study was carried out in Santa Lucia Biological Station (SLBS) in Center-north Espirito Santo state between January 2002 and November 2003, using three Wildlife Pro Camera (c) (WPC) units and four DeerCam (c) units. We realized the importance of sampling in different phitophysiognomies as they varied in mammal community. We detected a significant correlation between species richness and sampling effort in each trail, observing that 60% or more of

species richness recorded in SLBS was obtained when sampling effort was >= 250 camera-trap nights/trail. Nocturnal records predominated (67%) although the number of recorded species was similar between night and day. When camera traps were set in pairs, only 27% of records were simultaneous. The tested units showed significant differences in durability and efficiency, both within and between brands.

Trolle, M, Noss, AJ, Lima, EDS, Dalponte, JC. 2007. Camera-trap studies of maned wolf density in the Cerrado and the Pantanal of Brazil. BIODIVERSITY AND CONSERVATION 16(4):1197-1204.

The maned wolf (*Chrysocyon brachyurus*) is threatened by large-scale habitat loss, in particular due to conversion to agricultural land. This is the first published study on maned wolf density and the first test of individual identification from camera-trap photographs. We present results from two Brazilian regions: the Cerrado and the Pantanal. Using capture-recapture analysis of camera-trap data, we estimated densities per 100 square kilometers of 3.64 ± 0.77 individuals at the Cerrado site and 1.56 ± 0.77 individuals at the Pantanal site. Parallel radio-telemetry studies at the Pantanal site showed that maned wolves occupied home ranges of 39-58 KM^2 (mean = 50.3 ± 7.67 KM^2). Our study in the Cerrado took place in a private farm with a mixture of agricultural land and native habitats, representative of the majority of the present-day Cerrado. Whereas many other mammalian species have suffered in the region, our results show that the maned wolf may cope better with this highly fragmented landscape than one might have feared. Finally, the paper briefly compares maned wolf density with density of puma (*Puma concolor*) in the Pantanal site.

Trolle, M, Bissaro, MC, Prado, HM. 2007. Mammal survey at a ranch of the Brazilian Cerrado. BIODIVERSITY AND CONSERVATION 16(4):1205-1211.

The wildlife of the Brazilian Cerrado is threatened by large-scale habitat loss, in particular due to conversion to agricultural land. It is essential to study how the mammal fauna copes with the highly fragmented, human-influenced, non-protected landscape. The paper presents the results of a survey of the large to medium-sized mammals of a typical cattle ranch with a mixture of human-created and natural vegetation types. We recorded 18 species. Surprisingly, several species were found to still thrive in the area, however, many species are rare or have become extinct. We conclude the paper with comments relevant for the conservation of mammals in the Cerrado as a whole.

Vanak, AT, Gompper, ME. 2007. Effectiveness of non-invasive techniques for surveying activity and habitat use of the Indian fox *Vulpes bengalensis* in southern India. WILDLIFE BIOLOGY 13(2):219-224.

Non-invasive techniques for monitoring wildlife are increasingly used by researchers to identify the presence of carnivores in particular habitat types. For mid-sized carnivores the two primary methods used are camera trapping and track plates, both of which function by attracting an animal to a census apparatus which then records the visit by photograph or by track imprint. These techniques have rarely, however, been used to survey Asian mid-sized carnivores, and thus the value of the techniques in this region remains hypothetical. We used cameras and track plates to survey Indian foxes *Vulpes bengalensis* in and around Rollapadu Wildlife Sanctuary in the grasslands of central Andhra Pradesh and in Ranebennur Wildlife Sanctuary in western Karnataka. By surveying, we also address issues relating to fox activity and habitat use patterns. Cameras rapidly and efficiently detected the presence of foxes, and allowed us to show that foxes at both sites were strictly nocturnal during the periods of data collection. There was a significant relationship between grassland height and the latency to detection of foxes at Rollapadu. At both sites, foxes rarely visited the track plate stations that were run concurrently with cameras. We recommend that researchers attempting to survey foxes use cameras rather than enclosed track plates, and that efforts to survey other species non-

invasively include an experimental design that allows for validation of the survey technique.

2006

Azad, MAJBA. 2006. Mammal diversity and conservation in a secondary forest in Peninsular Malaysia. BIODIVERSITY AND CONSERVATION 15(3):1013-1025.

A comprehensive survey on large mammal diversity from a disturbed forest in Peninsular Malaysia has been carried out for over a period of 21 months. A total of 24 camera traps which accumulated to 5972 trap days. A total of 33 species 27 genera and 15 families of mammals were recorded via camera trapping and observations. The use of camera traps provides detailed information on diversity of some cryptic and secretive mammals. Secondary forest may support a wide diversity of mammals at a stable condition where intrusion, excision and fragmentation are reduced or avoided. The threats to mammals in the study are also discussed.

Azlan, JM, Lading, E. 2006. Camera trapping and conservation in Lambir Hills National Park, Sarawak. RAFFLES BULLETIN OF ZOOLOGY 54(2):469-475.

A rapid assessment using camera traps was carried out in Lambir Hills National Park from February 2004 to September 2004. In 1127 trap nights, six CamTrakker units and one DeerCam unit recorded a total of 225 wildlife photographs, which included seven orders, 11 families and 18 species of animals. *Macaca nemestrina* had the highest frequency of photo records with 63 exposures, while single exposures were recorded for *Arctictis binturong*, *Echinosorex gymnurus*, *Prionodon linsang*, *Rheithrosciurus macrotis*, *Sus barbatus*, and *Macaca fascicularis*. The rare *Neofelis nebulosa* was also recorded during this study. Activity patterns were calculated for five species. Low photo records of large mammals were

noted and is believed to be caused by illegal hunting. The conservation of these species is discussed.

Azlan, JM, Sharma, DSK. 2006. The diversity and activity patterns of wild felids in a secondary forest in Peninsular Malaysia. ORYX 40(1):36-41.

A study to describe the diversity of wild felids was carried out in Jerangau Forest Reserve, Ulu Terengganu, Malaysia, using camera traps, over a period of 21 months. A total of 24 camera traps were used, with a total of 5,972 trap days. Six species of wild cats in five genera were recorded: tiger *Panthera tigris*, leopard *Panthera pardus*, clouded leopard *Neofelis nebulosa*, leopard cat *Prionailurus bengalensis*, golden cat *Catopuma temminckii* and marbled cat *Pardofelis marmorata*. This represents all but two of the felid species known to occur in Peninsular Malaysia. The use of camera traps provided detailed information on the occurrence and activity patterns of these relatively secretive mammals. The most frequently photographed species was tiger (38.5% of records) followed by leopard (26.3%) and leopard cat (21.9%). The presence of charismatic flagship species such as tiger in this unprotected lowland dipterocarp secondary forest will be of help to local conservation organizations and the Wildlife Department in any proposals for the protection of these areas.

Bertrand, AS, Kenn, S, Gallant, D, Tremblay, E, Vasseur, L, Wissink, R. 2006. MtDNA analyses on hair samples confirm Cougar, *Puma concolor*, presence in southern New Brunswick, eastern Canada. CANADIAN FIELD-NATURALIST 120(4):438-442.

For the last 40 years, the presence of Cougars (*Puma concolor*) in eastern Canada has been highly controversial. The purpose of this study was to collect physical evidence of Cougars using a passive detection method. Baited hair-traps combined with camera-traps were installed in New

Brunswick and Nova Scotia, Canada. DNA analyses on two hair samples confirmed that the species was present in southern New Brunswick in 2003. A footprint photographed after an observation of a Cougar by reliable observers was examined by experts and was consistent with a Cougar footprint. Additional data are required to determine the status of Cougars in the northeastern part of its historical range.

Campbell, TA, Lapidge, SJ, Long, DB. 2006. Using baits to deliver pharmaceuticals to feral swine in southern Texas. WILDLIFE SOCIETY BULLETIN 34(4):1184-1189.

Few studies have evaluated oral delivery systems of pharmaceuticals (e.g., vaccines, fertility control agents, and toxicants) to feral swine (*Sus scrofa*) in the United States. Our objective was to assess, through a field trial, the percentage of feral swine and nontarget animals that remove and consume baits intended to transport pharmaceuticals to feral swine in southern Texas, USA. We hand-placed 1,178 iophenoxic acid (IA)-marked baits distributed over 1,721 ha (68 baits/KM^2) in April 2005 and monitored species-specific bait removal and consumption using track stations, automated camera systems, and serum IA values from captured animals. Ninety percent of baits were removed after 72 hours. For baits for which we determined the species that "definitely" or "likely" removed bait using track stations and cameras, 51% were taken by raccoons (*Procyon lotor*), 22% were taken by feral swine, and 20% were taken by collared peccaries (*Tayassu tajacu*). We found elevated serum IA values in 74% of trapped feral swine, 89% of raccoons, and 43% of opossums (*Didelphis virginiana*). Our oral delivery system was successful in marking a substantial proportion of feral swine. However, our observed removal rates suggest that the majority of the baits were taken by nontarget species and, therefore, unsuitable for most pharmaceutical applications in their current form.

Cowled, BD, Gifford, E, Smith, M, Staples, L, Lapidge, SJ. 2006. Efficacy of manufactured PIGOUT (R) baits for localised control of feral pigs in the semi-arid Queensland rangelands. WILDLIFE RESEARCH 33(5):427-437.

Conservative population declines of 73% were recorded in three independent feral pig populations in Welford National Park, Queensland, when PIGOUT (R) baits containing 72 mg of sodium fluoroacetate were used in a baiting program following prefeeding. Declines were measured using a prebaiting population census with remote cameras, followed by carcass recovery. The knockdown of susceptible feral pigs may have been higher than this, since any carcasses not recovered reduced the recorded efficacy. In addition, feral pigs know to have left the baiting area after trapping and telemetry-tagging, and subsequently not exposed to toxic baits, were included in the analysis. The use of remote cameras and carcass recovery appears to be a relatively accurate means of recording localised declines in feral pig populations. This method is applicable only when carcass recovery is possible, such as in open areas in the semi-arid rangelands. A decline of 86% of radio-tagged feral pigs attending bait stations was also recorded. Camera observations revealed no non-target consumption of baits. Measurement of sodium fluoroacetate-contaminated tissues from feral pigs showed that residues were too low to present a significant risk to recorded scavenging animals in the area. Some feral pigs vomited before death, with vomitus containing sodium fluoroacetate poison at high concentrations. No vomitus was consumed by non-target species. Almost all feral pigs were killed relatively rapidly after ingestion of sodium fluoroacetate and the signs observed in a small number of poisoned feral pigs did not indicate a significant welfare concern.

Cuellar, E, Maffei, L, Arispe, R, Noss, A. 2006. Geoffroy's cats at the northern limit of their range: activity patterns and density estimates from camera trapping in Bolivian dry forests. STUDIES ON NEOTROPICAL FAUNA AND ENVIRONMENT 41(3):169-177.

We used camera traps to survey Geoffroy's cats, *Oncifelis geoffroyi*, at six dry forest sites in Bolivia. Cumulative activity patterns across all sites are principally nocturnal though the species is active by day in both summer and winter. At two sites the number of captures and recaptures was sufficient to estimate abundance using the software Capture, and in turn a population density of 9-40 per 100 KM2 for the two sites. Geoffroy's cats are present in all dry forest types surveyed: Chaco savannas, Chaco dry forest, Chaco transitional forest, Chaco-Chiquitano transitional forest, Chaco-Cerrado transitional forest and Chiquitano dry forest. They are most abundant at the driest site, the only one with grassland formations and where ocelots are absent. Camera trapping records tend to be more numerous in the dry season, suggesting seasonal changes in behavior and habitat use.

de Leaniz, CG, Forman, DW, Davies, S, Thomson, A. 2006. Non-intrusive monitoring of otters (*Lutra lutra*) using infrared technology. JOURNAL OF ZOOLOGY 270(4):577-584.

Remote, non-intrusive monitoring of elusive mammals remains problematic, particularly in running waters. The utility of using submerged infrared counters for monitoring non-intrusively the activity of Eurasian otters *Lutra lutra* was assessed in three tributaries of the River Dee (Beltie, Cattie, Feardar; Scotland) during 2003-2004. Otters passing through the infrared counters were strongly nocturnal and displayed a bimodal diel activity pattern. Seasonal activity indices varied fourfold between tributaries and peaked during the salmonid breeding season. The median time elapsing between consecutive night visits was 2.02 ± 0.79 days and did not differ between tributaries. The median head-body length of adult otters was estimated at 75.0 ± 1.1 cm, whereas median upstream swimming speed was calculated at 0.97 ± 0.01 m s^{-1}. Minimum census estimates revealed the activity of at least two adults in the Beltie, two adults and three juveniles in the Cattie, and two adults with one juvenile in the Feardar. Our study indicates that, under suitable conditions, infrared technology can be used effectively to examine non-intrusively the activity of free-ranging otters in

running waters, offering some advantages over previous, more intrusive techniques that relied on the collection of spraints, the use of radioisotopes or the tracking of marked individuals.

De Luca, DW, Rovero, F. 2006. First records in Tanzania of the vulnerable Jackson's mongoose *Bdeogale jacksoni* (Herpestidae). ORYX 40(4):468-471.

New records in Tanzania of the Vulnerable Jackson's mongoose *Bdeogale jacksoni* expand its distribution by over 900 km to the south. During two independent camera-trap surveys over 3 years B. jacksoni, one of Africa's most cryptic small carnivores and previously thought to be endemic to Kenya, was recorded in forests of the Udzungwa Mountains. All records were highly localized within Matundu forest, at a maximum of 2.65 km apart. Most of the records (73%) were between 19.00 and 00.00, confirming that the species is primarily nocturnal. Conservation recommendations include further ecological research, genetic analyses, surveys in other Eastern Arc and ground-water dependent forests, and greater protection for Matundu.

Di Bitetti, MS, Paviolo, A, De Angelo, C. 2006. Density, habitat use and activity patterns of ocelots (*Leopardus pardalis*) in the Atlantic Forest of Misiones, Argentina. JOURNAL OF ZOOLOGY 270(1):153-163.

Camera-trap surveys were carried out at two different sites within the Atlantic Forest of Misiones province, Argentina, to study the density, habitat use and activity patterns of ocelots. At Urugua-i Provincial Park, 17 different individuals were captured (nine females, six males, two of unknown sex) during a 3-month-long survey (34 camera stations, 1409 trap days). At Iguazu National Park, 34 different individuals were trapped (20 adult females, nine adult males, two subadult females and three of unknown sex)

during the survey (39 sampling stations, 1631 trap days). Population density estimates (+/- SE) for Urugua-i, in an area of between 150 and 259 KM^2 (depending on the buffer used to estimate the area effectively sampled), range from 7.7 ± 1.4 to 13.4 ± 2.6 individuals x 100 km^{-2}, whereas at Iguazu, in an area of between 275 and 428 KM^2, a population density of between 12.8 ± 2.7 and 20.0 ± 4.2 individuals x 100 km^{-2} was estimated. Minimum observed range estimates for individuals with > 3 capture sites range from 3.19 to 37.09 KM^2 for four males and from 4.17 to 7.11 KM^2 for three females, but underestimate the true home range size. Ocelots were captured more frequently along old roads than on new trails opened with machetes. Ocelots were captured more frequently at night than during the day and reduce their use of roads and trails during the week previous to and during full moon nights, a behavior previously reported for Amazonian ocelots. Population density estimates for ocelots in the Upper Parana Atlantic Forest ecoregion are lower than those at other Neotropical sites. The whole Green Corridor contains a population of about 1280 individuals. This estimate should bring our attention to the larger cats (pumas and jaguars) that live at lower population densities because the future of their local populations is compromised if protected areas are not urgently created and properly managed.

Engeman, R, Whisson, D. 2006. Using a general indexing paradigm to monitor rodent populations. INTERNATIONAL BIODETERIORATION & BIODEGRADATION 58(1):2-8.

Population monitoring is a valuable component to managing invasive rodent populations. Indices can be efficient methods for monitoring rodent populations, as more labor-intensive density estimation procedures often are impractical or invalid to apply. Many monitoring objectives can be couched in an indexing framework. Indexing procedures obtain maximal utility if they exhibit key characteristics, including being practical to apply, being sensitive to population changes or differences in the target species, having an inherent variance formula to estimate precision of index values, and relying on as few assumptions as possible. Here, a general indexing

paradigm that promotes the characteristics that make indices most useful is specifically applied to rodent monitoring scenarios. Observations are made at stations located throughout the area of interest. Stations can take many forms, depending on the observations, and range from points for visual counts to tracking plots (or tiles), bait blocks, chew cards, camera stations, trap lines and many others. Thus, a wide variety of observation methods for many animal species can fit into this format. Observations are made at each station on multiple occasions for each indexing session. Collection of geographic location data for each station is encouraged. No assumptions of independence are made among stations or observation occasions, and measurements made at each station are required to be continuous or unboundedly discrete. The formula for a general index is presented along with a derived variance formula. Issues relevant to the application of this methodology to rodent populations, and indices in general, are discussed.

Garshelis, DL. 2006. On the allure of noninvasive genetic sampling - putting a face to the name. URSUS 17(2):109-123.

DNA from remotely-collected samples of hair or feces provides a means of assessing attributes of populations of wild animals, including genetic diversity, spatial distribution, patterns of habitat use, dispersal distances, population fragmentation, and population size. This technique has been called noninvasive genetic sampling, a term in common usage especially in the bear literature. It has taken on the connotation of being more humane than techniques such as radiotelemetry that require capture of animals. The term noninvasive, however, is misapplied: in the biological-genetic sense, it refers only to the invasion of the body (through the skin or an orifice), not to capture or general intrusiveness. If it is construed to mean nonintrusive in a more general sense, then other methods of collecting population data that do not require animal capture, such as camera trapping, sign surveys, sightings, and interviews, should be called noninvasive as well. Moreover, once an animal is radiocollared, the process of collecting telemetry data is also noninvasive. I recommend the use of a more neutral and also more informative and technically correct term, "remote," to describe genetic and

other forms of sampling that do not involve human handling of animals. Remote sampling aids investigators in reducing their effects on the study subjects and also may provide larger samples than can be obtained by trapping. However, many of the important biological questions that can be (and for > 30 years have been) studied by capturing animals and tracking them telemetrically cannot be addressed with genetic or other remote sampling techniques.

Gompper, ME, Kays, RW, Ray, JC, Lapoint, SD, Bogan, DA, Cryan, JR. 2006. A comparison of noninvasive techniques to survey carnivore communities in northeastern North America. WILDLIFE SOCIETY BULLETIN 34(4):1142-1151.

Carnivores are difficult to survey due, in large part; to their relative rarity across the landscape and wariness toward humans. Several noninvasive methods may aid in overcoming these difficulties, but there has been little discussion of the relative merits and biases of these techniques. We assess the value of 5 noninvasive techniques based on results from 2 multiyear studies of carnivores (including members of Camivora and Didelphidae) in New York forests. Two metrics were particularly valuable in assessing the species-specific value of any particular survey technique: latency to initial detection (LTD) and probability of detection (POD). We found differences in the value of techniques in detecting different species. For midsized species (raccoon [*Procyon lotor*], fisher [*Martes pennanti*], opossum [*Didelphis virginiana*], and domestic cat [*Felis catus*]), camera traps and track-plates were approximately equivalent in detection efficiency, but the potential for wariness toward the survey apparatus resulted in higher LTD for track-plates than for cameras. On the other hand, track-plates detected small carnivores (marten [*M. americana*] and weasels [*Mustela* spp.]) more often than cameras and had higher PODs for small and midsized species than did cameras. Cameras were efficient mechanisms for surveying bears (Ursus americanus; low LTD, high POD) but functioned poorly for discerning presence of coyotes (*Canis latrans*; high LTD, low POD). Scat surveys and snowtracking were the best methods for coyotes, which avoided camera

traps and artificial tracking surfaces. Our analysis of fecal DNA revealed that trail-based fecal surveys were inefficient at detecting species other than coyotes, with the possible exception of red foxes (*Vulpes vulpes*). Genetic analyses of feces and snowtracking revealed the presence of foxes at sites where other techniques failed to discern these species, suggesting that cameras and track-plates are inefficient for surveying small canids in this region. The LTD of coyotes by camera traps was not correlated with their abundance as indexed by scat counts, but for other species this metric may offer an opportunity to assess relative abundance across sites. Snowtracking surveys were particularly robust (high POD) for detecting species active in winter and may be more effective than both cameras and track-plates where conditions are suitable. We recommend that survey efforts targeting multiple members of the carnivore community use multiple independent techniques and incorporate mechanisms to truth their relative value.

Haines, AM, Janecka, JE, Tewes, ME, Grassman, LI, Morton, P. 2006. The importance of private lands for ocelot *Leopardus pardalis* conservation in the United States. ORYX 40(1):90-94.

The distribution of ocelots *Leopardus pardalis* in the USA is limited to southern Texas. Identification and monitoring of ocelot populations enables biologists to assess population health and status. Use of camera traps has been successfully used to monitor numerous populations of wild felids, including the ocelot. Our objectives were to identify ocelot presence within southern Texas and estimate ocelot population size and density. We used camera traps to survey for ocelots on four study sites in southern Texas. We recorded ocelot presence on one study site with an abundance estimate of three individuals and a density estimate of 0.30 ± SE 0.03 ocelots km(-2). The conservation implications of this study suggest concentrating conservation efforts in and around the study site (Yturria Ranch) found to have ocelots. In addition, this study emphasizes the importance of including private landowners in the ocelot recovery process.

Hayes, RA, Nahrung, HF, Wilson, JC. 2006. The response of native Australian rodents to predator odours varies seasonally: a by-product of life history variation? ANIMAL BEHAVIOUR 71:1307-1314.

Small mammals are subject to predation from mammalian, avian and reptilian predators. There is an obvious advantage for prey species to detect the presence of predators in their environment, enabling them to make decisions about movement and foraging behaviour based on perceived risk of predation. We examined the effect of faecal odours from marsupial and eutherian predators, and a native reptilian predator, on the behaviour of three endemic Australian rodent species (the fawn-footed melomys, *Melomys cervinipes*, the bush rat, *Rattus fuscipes*, and the giant white-tailed rat, *Uromys caudimaculatus*) in rainforest remnants on the Atherton Tableland, North Queensland, Australia. Infrared camera traps were used to assess visit rates of rodents to odour stations containing faecal and control odours. Rodents avoided odour stations containing predator faeces, but did not avoid herbivore or control odours. The responses of the three prey species differed: in the late wet season U. caudimaculatus avoided predator odours, whereas R. fuscipes and M. cervinipes did not. In contrast, in the late dry season all three species avoided odour stations containing predator odours. We speculate that these different responses may result from variation in life history traits between the species.

Heilbrun, RD, Silvy, NJ, Peterson, MJ, Tewes, ME. 2006. Estimating bobcat abundance using automatically triggered cameras. WILDLIFE SOCIETY BULLETIN 34(1):69-73.

Ineffective survey methods of carnivores limit the ability of managers and researchers to make sound research conclusions and management recommendations. Because bobcats (*Lynx rufus*) are individually identifiable due to their unique coat patterns, it may be possible to obtain density estimates using capture-recapture models. We photo-trapped bobcats on

the 3,156-ha Welder Wildlife Foundation Refuge in southern Texas from September 2000 through August 2001 to determine whether automatically triggered cameras could produce reliable estimates of bobcat density. Using the Schumacher-Eschmeyer estimator, we obtained an abundance estimate of 15 individuals (95% CI = 13.6-16.7) from 56 bobcat photographs. Our estimate was comparable to bobcat densities previously reported on our study area. This technique has the potential to provide wildlife managers and researchers with reliable data on bobcat abundance not previously available without the expense of physical capture and radiotelemetry. Our relatively high photographic success might be attributable to the dense chaparral-type vegetation and the large network of travel pathways available on our study area. These methods may not be as successful in open areas or where bobcat travel is not predictable. We encourage replication of this technique elsewhere in bobcat range where density, vegetation, and travel pathways differ.

Jackson, RM, Roe, JD, Wangchuk, R, Hunter, DO. 2006. Estimating snow leopard population abundance using photography and capture-recapture techniques. WILDLIFE SOCIETY BULLETIN 34(3):772-781

Conservation and management of snow leopards (*Uncia uncia*) has largely relied on anecdotal evidence and presence-absence data due to their cryptic nature and the difficult terrain they inhabit. These methods generally lack the scientific rigor necessary to accurately estimate population size and monitor trends. We evaluated the use of photography in capture-mark-recapture (CMR) techniques for estimating snow leopard population abundance and density within Hemis National Park, Ladakh, India. We placed infrared camera traps along actively used travel paths, scent-sprayed rocks, and scrape sites within 16- to 30-KM^2 sampling grids in successive winters during January and March 2003-2004. We used head-on, oblique, and side-view camera configurations to obtain snow leopard photographs at varying body orientations. We calculated snow leopard abundance estimates using the program CAPTURE. We obtained a total of 66 and 49 snow leopard captures resulting in 8.91 and 5.63 individuals

per 100 trap-nights during 2003 and 2004, respectively. We identified snow leopards based on the distinct pelage patterns located primarily on the forelimbs, flanks, and dorsal surface of the tail. Capture probabilities ranged from 0.33 to 0.67. Density estimates ranged from 8.49 (SE = 0.22) individuals per 100 KM^2 in 2003 to 4.45 (SE = 0.16) in 2004. We believe the density disparity between years is attributable to different trap density and placement rather than to an actual decline in population size. Our results suggest that photographic capture-mark-recapture sampling may be a useful tool for monitoring demographic patterns. However we believe a larger sample size would be necessary for generating a statistically robust estimate of population density and abundance based on CMR models.

Johnson, A, Vongkhamheng, C, Hedemark, M, Saithongdam, T. 2006. Effects of human-carnivore conflict on tiger (*Panthera tigris*) and prey populations in Lao PDR. ANIMAL CONSERVATION 9(4):421-430.

Unique to South-east Asia, Lao People's Democratic Republic contains extensive habitat for tigers and their prey within a multiple-use protected area system covering 13% of the country. Although human population density is the lowest in the region, the impact of human occurrence in protected areas on tiger *Panthera tigris* and prey populations was unknown. We examined the effects of human-carnivore conflict on tiger and prey abundance and distribution in the Nam Et-Phou Louey National Protected Area on the Lao-Vietnam border. We conducted intensive camera-trap sampling of large carnivores and prey at varying levels of human population and monitored carnivore depredation of livestock across the protected area. The relative abundance of large ungulates was low throughout whereas that of small prey was significantly higher where human density was lower. The estimated tiger density for the sample area ranged from 0.2 to 0.7 per 100 KM^2. Tiger abundance was significantly lower where human population and disturbance were greater. Three factors, commercial poaching associated with livestock grazing followed by prey depletion and competition between large carnivores, are likely responsible for tiger abundance and distribution. Maintaining tigers in the

country's protected areas will be dependent on the spatial separation of large carnivores and humans by modifying livestock husbandry practices and enforcing zoning.

Karanth, KU, Nichols, JD, Kumar, NS, Hines, JE. 2006. Assessing tiger population dynamics using photographic capture-recapture sampling. ECOLOGY 87(11):2925-2937.

Although wide-ranging, elusive, large carnivore species, such as the tiger, are of scientific and conservation interest, rigorous inferences about their population dynamics are scarce because of methodological problems of sampling populations at the required spatial and temporal scales. We report the application of a rigorous, noninvasive method for assessing tiger population dynamics to test model-based predictions about population viability. We obtained photographic capture histories for 74 individual tigers during a nine-year study involving 5725 trap-nights of effort. These data were modeled under a likelihood-based, "robust design'' capture-recapture analytic framework. We explicitly modeled and estimated ecological parameters such as time-specific abundance, density, survival, recruitment, temporary emigration, and transience, using models that incorporated effects of factors such as individual heterogeneity, trap-response, and time on probabilities of photo-capturing tigers. The model estimated a random temporary emigration parameter of gamma = 0.10 ± 0.069 (values are estimated mean ± SE). When scaled to an annual basis, tiger survival rates were estimated at S = 0.77 ± 0.051, and the estimated probability that a newly caught animal was a transient was tau = 0.18 ± 0.11. During the period when the sampled area was of constant size, the estimated population size N-t varied from 17 ± 1.7 to 31 ± 2.1 tigers, with a geometric mean rate of annual population change estimated as gamma = 1.03 ± 0.020, representing a 3% annual increase. The estimated recruitment of new animals, B-t, varied from 0 ± 3.0 to 14 ± 2.9 tigers. Population density estimates, D, ranged from 7.33 ± 0.8 tigers/100 KM^2 to 21.73 ± 1.7 tigers/100 KM^2 during the study. Thus, despite substantial annual losses and temporal variation in recruitment, the tiger density

remained at relatively high levels in Nagarahole. Our results are consistent with the hypothesis that protected wild tiger populations can remain healthy despite heavy mortalities because of their inherently high reproductive potential. The ability to model the entire photographic capture history data set and incorporate reduced-parameter models led to estimates of mean annual population change that were sufficiently precise to be useful. This efficient, noninvasive sampling approach can be used to rigorously investigate the population dynamics of tigers and other elusive, rare, wide-ranging animal species in which individuals can be identified from photographs or other means.

Kitamura, S, Suzuki, S, Yumoto, T, Poonswad, P, Chuailua, P, Plongmai, K, Maruhashi, T, Noma, N, Suckasam, C. 2006. Dispersal of *Canarium euphyllum* (Burseraceae), a large-seeded tree species, in a moist evergreen forest in Thailand. JOURNAL OF TROPICAL ECOLOGY 22:137-146

We investigated the dispersal of a large-seeded tree species. *Canarium euphyllum* (Burseraceae), in the moist evergreen forests of the Khao Yai National Park in Thailand. By combining direct observations of fruit consumption in tree canopies (543 h) and the camera-trapping observations of fallen fruit consumption on the forest floor (175 camera-days), we identified the frugivore assemblage that foraged on the fruits of *C. euphyllum* and assessed their role in seed dispersal and seed predation. In the canopy, our results showed that seeds were dispersed by a limited set of frugivores, one pigeon and four hornbill species, and predated by two species of squirrel. On the forest floor, seven mammal species consumed fallen fruits. A combination of high rates of fruit removal and short visiting times of mountain imperial pigeons (*Ducula badia*) and hornbills (*Buceros bicornis, Aceros undulatus, Anorrhinus austeni* and *Anthracoceros albirostris*) led us to conclude that these large frugivorous birds provide effective seed dispersal for this tree species, in terms of quantity. These frugivorous species often have low tolerance to negative human impacts and loss of these dispersers would have severe deleterious consequences for the successful regeneration of *C. euphyllum*.

Linkie, M, Chapron, G, Martyr, DJ, Holden, J, Leader-Williams, N. 2006. Assessing the viability of tiger subpopulations in a fragmented landscape. JOURNAL OF APPLIED ECOLOGY 43(3):576-586.

1. Conservation managers require accurate and timely information on the occurrence, size and viability of populations, but this is often difficult for cryptic species living at low densities over large areas. This study aimed to provide such information for tigers in the 36 400-KM^2 Kerinci Seblat (KS) region, Sumatra, by identifying and assessing subpopulation viability under different management strategies.

2. Tiger occurrence was mapped within a geographical information system (GIS) using repeat detection-non-detection surveys to incorporate a function of detection probability into a logistic regression model. The landscape variables that influenced tiger occupancy were then used to construct a spatially explicit habitat model to identify core areas.

3. The number of tigers within each core area was estimated by calculating the area of different forest types and their respective tiger densities as determined through camera trapping. The viability of each subpopulation was then assessed under different management scenarios using a population viability analysis (PVA).

4. Tiger occurrence was negatively correlated with distance to public roads. Four core tiger areas were identified, all predominantly located within KS National Park, estimated to support subpopulations of 21, 105, 16 and three adult tigers, respectively. PVA showed that the three larger subpopulations could be demographically viable if well protected. However, if poaching removed >= 3 tigers per year, then only the largest subpopulation would not reach extinction within 50 years. Connectivity to this large subpopulation would ensure survival of the smaller subpopulations, through providing a source of tigers to offset poaching losses.

5. Synthesis and applications. Our key management recommendations for tigers in the Kerinci Seblat region of Sumatra stress the importance of maintaining connectivity between the smaller areas and the larger area, and minimizing poaching within these smaller areas. More widely, our research has shown the feasibility of using detection-non-detection surveys combined with spatial modelling to provide timely information for conservation management.

Marnewick, KA, Bothma, JD, Verdoorn, GH. 2006. Using camera-trapping to investigate the use of a tree as a scent-marking post by cheetahs in the Thabazimbi district. SOUTH AFRICAN JOURNAL OF WILDLIFE RESEARCH 36(2):139-145.

The use of a specific tree as a scent-marking post by cheetahs (*Acinonyx jubatus*) was studied on a wildlife ranch in the Thabazimbi district of the Limpopo province. A remote-triggered camera was set up at a marula tree (*Sclerocarya birrea* subsp. *caffra*) which was known to be scent-marked frequently bycheetahs. In all, 87camera-days produced 43 photographs of various animals including African elephants (*Loxodonta africana*), African civets (*Civettictis civetta*), aardvarks (*Orycteropus afer*), white rhinoceroses (*Ceratotherim simum*), brown hyaenas (*Parahyaena brunnea*) and cheetahs. Twenty-three photographs of cheetahs were taken on 13 different occasions. The photographs were used to determine the gender of the cheetahs and to identify individuals by using their spot patterns. Seven different cheetahs were identified, all of which were adult males. Of the 13 cheetah visitations, 10 happened at night, two at dawn or dusk and one during daylight. Territorial marking included defecation on and under the tree, urine-spraying and clawing of the tree. The viability of obtaining a population estimate by using the capture-recapture method based on photographs taken at scent-marking trees is investigated.

Meijaard, E, Kitchener, AC, Smeenk, C. 2006. 'New Bornean carnivore' is most likely a little known flying squirrel MAMMAL REVIEW 36(4):318-324.

1. We analysed two camera-trap photos of an alleged new species of carnivore from Kalimantan, Borneo, Indonesia.

2. Comparisons of the features seen in the photos with morphological features of 17 similar-looking species from the region suggest that the animal is not a new species of carnivore, as had been widely speculated, but is most likely a rarely seen species of flying squirrel, probably *Aeromys thomasi*.

3. We advocate continuing adherence to the formalities of species description based on actual specimens and a formal review process. Even informal announcements about possible new species based on photographs or other indirect evidence should adopt a cautionary approach. All the possibilities should be eliminated using any available means, such as comparative morphometrics and assessments of body shape and posture, and coat colour.

O'Connell, AF, Talancy, NW, Bailey, LL, Sauer, JR, Cook, R, Gilbert, AT. 2006. Estimating site occupancy and detection probability parameters for meso-and large mammals in a coastal ecosystem. JOURNAL OF WILDLIFE MANAGEMENT 70(6):1625-1633.

Large-scale, multispecies monitoring programs are widely used to assess changes in wildlife populations but they often assume constant detectability when documenting species occurrence. This assumption is rarely met in practice because animal populations vary across time and space. As a result, detectability of a species can be influenced by a number of physical, biological, or anthropogenic factors (e.g., weather, seasonality, topography, biological rhythms, sampling methods). To evaluate some of these influences, we estimated site occupancy rates using species-specific

detection probabilities for meso- and large terrestrial mammal species on Cape Cod, Massachusetts, USA. We used model selection to assess the influence of different sampling methods and major environmental factors on our ability to detect individual species. Remote cameras detected the most species (9), followed by cubby boxes (7) and hair traps (4) over a 13-month period. Estimated site occupancy rates were similar among sampling methods for most species when detection probabilities exceeded 0.15, but we question estimates obtained from methods with detection probabilities between 0. 05 and 0. 15, and we consider methods with lower probabilities unacceptable for occupancy estimation and inference. Estimated detection probabilities can be used to accommodate variation in sampling methods, which allows for comparison of monitoring programs using different protocols. Vegetation and seasonality produced species-specific differences in detectability and occupancy, but differences were not consistent within or among species, which suggests that our results should be considered in the context of local habitat features and life history traits for the target species. We believe that site occupancy is a useful state variable and suggest that monitoring programs for mammals using occupancy data consider detectability prior to making inferences about species distributions or population change.

Pangau-Adam, MZ, Waltert, M, Muhlenberg, M. 2006. Nest predation risk on ground and shrub nests in forest margin areas of Sulawesi, Indonesia. BIODIVERSITY AND CONSERVATION 15(13):4143-4158.

Forest loss and fragmentation in Indonesia may seriously affect the survivorship of forest birds and lead to local extinction of bird populations. We used 786 artificial nests baited with quail eggs to examine the effect of habitat alteration on nest predation in Lore Lindu National Park, Sulawesi. Natural forest and four habitats of forest margin areas: forest edge, forest gardens, coffee plantations, and secondary forest, were studied. Two types of artificial nests, ground and shrub nests were placed in these habitats at two different locations for a period of 8 days. In addition, we used automatic cameras and cage-traps to identify the predators. Nests in shrubs

experienced significantly higher predation rates in forest margin areas than in natural forest. Predation on ground nests did not differ significantly between these habitat types, but was significantly higher than that on shrub nests in each habitat except forest edge. Rodents were the most common predators of both nests, but shrub nests were also susceptible to Dwarf cuscus (*Strigocuscus celebensis*), squirrels, and tree snakes. The nest predation rates we found were among the highest found in tropical rainforests, probably a consequence of the unique predator assemblages of Sulawesi. These results suggest that egg survival is negatively affected by human intervention and that human-induced habitats might have only limited importance for the conservation of Sulawesi's largely endemic understorey avifauna. These considerations might be important since forest margins comprise significant proportions of protected areas on Sulawesi and play an important role in future Park zoning concepts as well as in conservation-oriented land use management.

Premke, K, Klages, M, Arntz, WE. 2006. Aggregations of Arctic deep-sea scavengers at large food falls: temporal distribution, consumption rates and population structure. MARINE ECOLOGY PROGRESS SERIES 325:121-135.

Scavenging amphipods were studied at 6 locations in the Fram Strait (Arctic Ocean). At each location a tripod lander equipped with a time-lapse camera, acoustic doppler current profiler and baited traps was deployed at water depths between 1500 and 2600 m. All amphipods, both on photographs and captured, belonged to the superfamily Lysianassoidea or Stegocephaloidea. Differences between the stations occurred in time and number of amphipod maxima, consumption rates, taxonomic composition, size structure and current direction. Scavenger aggregation dynamics and behaviour on carcasses in the Arctic Ocean differ from those in other reported deep-sea areas in arrival time at bait, abundance and length distribution of individuals sampled. The giant amphipod *Eurythenes gryllus* dominated in our bait experiments; it exceeded numbers counted by other workers by > 13-fold, and the first individuals appeared up to 20 times

faster than in other reported experiments. Specimen attraction and abundance seem to be directly linked to the organic input of food falls in the area. Relations between scavenger aggregations and trophic conditions are discussed with respect to results obtained under different trophic regimes in the Arabian Sea and in the Pacific and Atlantic Oceans.

Schumann, M, Schumann, B, Dickman, A, Watson, LH, Marker, L. 2006. Assessing the use of swing gates in game fences as a potential non-lethal predator exclusion technique. SOUTH AFRICAN JOURNAL OF WILDLIFE RESEARCH 36(2):173-181.

Many Namibian farmers are diversifying from exclusive livestock farming to mixed farming, resulting in a sharp increase in the number of game-fenced areas. However, animals such as warthog (*Phacochoerus aethiopicus*), porcupine (*Hystrix africaeaustralis*) and aardvark (*Orycteropus afer*) dig holes under game fences, allowing access to predators such as cheetah (*Acinonyx jubatus*). Swing gates were installed along a 4800 m section of game fencing in the Otjiwarongo district of Namibia. The fence was monitored before and after gate installation and trip cameras were used to identify species that used the gates. Warthog, aardvark and porcupines commonly used the gates and the number of holes under the fencing was significantly reduced following gate installation. No predators were observed using the swing gates and the cost was substantially lower than fence electrification This initial research suggests that swing gates could be an important non-lethal predator exclusion technique, although further studies will be needed to confirm their long-term effectiveness. Using techniques such as swing gates, which effectively and economically reduce the frequency with which animals dig holes under fences may not only benefit farmers, but also reduce the unnecessary destruction of non-target wildlife species resulting from unselective trapping.

Soisalo, MK, Cavalcanti, SMC. 2006. Estimating the density of a jaguar population in the Brazilian Pantanal using camera-traps and capture-recapture sampling in combination with GPS radio-telemetry. BIOLOGICAL CONSERVATION 129(4):487-496.

The jaguar (*Panthera onca*) is the largest feline in the Americas and third largest worldwide, smaller in size only to the tiger (*P. tigris*) and lion (*P. leo*). Yet, in comparison, relatively few studies on jaguar population densities have been conducted and baseline data for management purposes are needed. Camera trapping and capture-recapture sampling methods were used to estimate the size of a jaguar population in the Pantanal's open wet grassland habitat, an important area for the long-term survival of the species. This study is the first jaguar population estimate conducted in co-operation with a GPS-telemetry study providing an important opportunity for comparing different methods of density estimation. An accessible area within a 460 KM^2 privately-owned ranch was sampled with equal effort during the dry seasons of 2003 and 2004. Thirty-one and twenty-five individual jaguars were identified in 2003 and 2004, respectively. Estimates of jaguar abundance were generated by program CAPTURE. Density estimates were produced according to different methods used to calculate the effectively sampled areas which ranged from 274 to 568 KM^2. For 2003, the currently-used mean maximum distance moved (MMDM) method produced a density of 10.3 jaguars/100 KM^2, while GPS-telemetry-based calculations produced a mean density of 6.6 jaguars/100 KM^2. For 2004, the MMDM method produced an estimate of 11.7 jaguars/100 KM^2 while GPS-telemetry calculations produced a density of 6.7 jaguars/100 KM^2. Our results suggest that the widely-used MMDM method used to calculate effectively sampled areas is significantly under-reflecting maximum distances moved by jaguars and their range-use and, thereby, considerably inflating cat density estimates. This overestimation could place a population in a difficult situation by lengthening the time taken to initiate protection measures because of underestimating the risk to that population.

Spalton, JA, al Hikmani, HM, Willis, D, Said, ASB. 2006. Critically Endangered Arabian leopards *Panthera pardus nimr* persist in the Jabal Samhan Nature Reserve, Oman. ORYX 40(3):287-294.

Between 1997 and 2000 a survey of the Arabian subspecies of leopard *Panthera pardus nimr* was conducted in the little known Jabal Samhan Nature Reserve in southern Oman. Using camera-traps 251 photographic records were obtained of 17 individual leopards; nine females, five males, two adults of unknown sex and one cub. Leopards were usually solitary and trail use and movements suggested large ranges characterized by spatial sharing but little temporal overlap. More active by day than night in undisturbed areas, overall the leopards exhibited two peaks in activity, morning and evening. The survey also provided records of leopard prey species and first records of nine Red List mammal species previously unrecorded in Jabal Samhan. Although people are mostly absent from the Reserve there is some conflict between leopards and shepherds who live outside the Reserve. The numbers and activities of frankincense harvesters in the Reserve need to be managed to safeguard the leopard and its habitat. The main challenge for the future is to find ways whereby local communities can benefit from the presence of the Reserve and from the leopards that the Reserve seeks to safeguard.

Varma, S, Pittet, A, Jamadagni, HS. 2006. Experimenting usage of camera-traps-for population dynamics study of the Asian elephant *Elephas maximus* in southern India. CURRENT SCIENCE 91(3):324-331.

To evaluate the application of camera-trap technology in population dynamics studies of the Asian elephant, indigenously designed, cost-effective, infrared-triggered camera-traps were used. Usability of pictures was defined based on quality, clarity and positioning of the subject. With 99 pictures of 330 elephants, 20 sequences were obtained and 44 distinct individuals were identified. It was found that 38.6% were adult females,

4.5% adult males, 13.6% sub-adult females, 6.8% sub-adult males, 20.4% juvenile females, while juvenile males were poorly represented (2%), and 13.6% were calves. These results were surprisingly identical with those of other systematic and long-term studies.

Weckel, M, Giuliano, W, Silver, S. 2006. Jaguar (*Panthera onca*) feeding ecology: distribution of predator and prey through time and space. JOURNAL OF ZOOLOGY 270(1):25-30.

Jaguars *Panthera onca* inhabiting tropical or subtropical evergreen moist forest have often been classified as opportunistic predators because they consume prey relative to its availability. However, these studies failed to address simultaneously the distribution of predator and prey through time and space, which may lead to an incomplete or erroneous understanding of jaguar foraging strategies. In this study, we reconstructed jaguar diet from scat, and used camera traps to investigate jaguar prey availability and the distribution of jaguar and its prey through space and time. We focused our examination of predator-prey temporal and spatial relations on forest infrastructure comprising man-made paths, small mammal trails, tapir *Tapirus bairdi* trail and trail-less, forested areas as they represent distinct habitats for prey selection. Overall, we observed high overlap between the prey used and available, suggestive of opportunistic foraging. However, jaguars exhibited selective tendencies in discriminating between larger prey. Jaguars used collared peccary *Tayassu tajacu* greater than its availability, while preying upon the equally abundant and similarly distributed white-lipped peccary *Tayassu pecari* and tapir less than predicted based upon availability. Armadillo *Dasypus novemcinctus* and paca *Agouti paca*, 56.6% of total consumption, were consumed relative to availability but exhibited low spatial overlap with jaguar. Armadillo and paca used trail-less, forested areas and small mammal trails not used by jaguar and were photographed more frequently at greater distances from man-made paths, major thoroughfares for jaguars. This study suggests that although forest jaguars use prey relative to its abundance, jaguars may rely on foraging strategies other than chance encounters for exploiting prey.

2005

Ball, SJ, Ramsey, D, Nugent, G, Warburton, B, Efford, M. 2005. A method for estimating wildlife detection probabilities in relation to home-range use: insights from a field study on the common brushtail possum (*Trichosurus vulpecula*). WILDLIFE RESEARCH2005 32(3):217-227.

Using field data from brushtail possums (*Trichosurus vulpecula*), we present a method for modelling wildlife detection probabilities. Whereas detection functions typically (e. g. for distance sampling) describe the probability of direct human observations of animal subjects, we adapted this approach for cryptic species where observation depends on animals being caught in traps. Specifically, we characterised the probability of individual brushtail possums being caught by leg-hold traps in an area of farmland and native forest in New Zealand. Detection probability was defined as the per-individual, per-trap, per-night probability of a possum being captured, and was modelled as a function of home-range utilisation. Radio-telemetry was used to define the home-range distributions of 18 possums, and a combination of scanning radio-receivers and movement-activated video-cameras recorded instances when radio-collared possums encountered and stepped on the trigger of leg-hold traps (inactivated by being wired open). We estimated a 5% chance of trapping individual possums with a single leg-hold trap located in the centre of their home range for one night (median value across possums). Furthermore, this probability decreased rapidly as a function of distance, so that at 120 m from the centre of the home range there was less than a 1% chance of trapping success per possum per night. The techniques developed in this study could be applied to a wide variety of species and sampling methods.

Bauer, JW, Logan, KA, Sweanor, LL, Boyce, WM. 2005. Scavenging behavior in puma. SOUTHWESTERN NATURALIST 50(4):466-471.

We examined scavenging on mule deer (*Odocoileus hemionus*) carcasses by puma (*Puma concolor*) in the Peninsular Ranges of San Diego County, California. Between January 2001 and October 2003, we placed 44 deer carcasses at 23 sites and used them to examine scavenging events. We also documented 2 additional deer carcasses, not placed as bait, that were scavenged by puma. Eighth to 12 puma (6 males, 2 to 5 females, and 1 of unknown sex) scavenged 20 of 46 deer carcasses (43.5%) at 12 of the 25 sites. Six puma (4 males, 2 females) were captured 7 times at scavenging sites. We identified 7 scavenging puma (5 males, 2 females) through captures and telemetry, and 1 unmarked, scavenging male from a camera trap. The 7 telemetered puma that scavenged ranged in age from 11 months to 9 years, and each individual scavenged on 1 to 6 deer (mean = 2.3). Deer carcasses were found and scavenged by puma from 1 to 14 days (mean = 5 days) after deposition, when carcass conditions ranged from frozen and fresh to rotting and maggot-infested. Puma treated scavenged carcasses as they would their own kills, dragging carcasses to preferred sites, caching, depositing scats, and making scrapes in the area. However, puma did not, always attempt to cache tethered carcasses. During fieldwork, we also discovered that 1 telemetered puma repeatedly visited a domestic livestock graveyard and scavenged on surface-discarded horse and cattle carcasses. Puma are known to be opportunistic predators, but our results indicate that they are opportunistic scavengers as well. Due to the propensity of puma to scavenge, it is likely that some perceived kills might be scavenging events. Frequent monitoring and timely field investigation of mortality signals detected from telemetered prey species will help investigators identify those events. Scavenging behavior should be considered when evaluating or predicting the effects of puma predation on prey species.

Gomez, H, Wallace, RB, Ayala, G, Tejada, R. 2005. Dry season activity periods of some Amazonian mammals. STUDIES ON NEOTROPICAL FAUNA AND ENVIRONMENT 40(2):91-95.

Camera trapping efforts at three adjacent sites in Madidi National Park and Natural Area of Integrated Management, Bolivia, revealed dry season activity periods for 15 species of Neotropical forest dwelling mammal. *Nasua* was strictly diurnal, *Atelocynus*, *Dasyprocta*, *Pecati* and *Tayassu* mostly diurnal, *Eira*, *Hydrochaeris*, *Mazama*, *Panthera* and *Puma* cathemeral, *Leopardus*, *Procyon* and *Tapirus* mostly nocturnal, and Cuniculus and Sylvilagus strictly nocturnal. In general, these results support previous natural history knowledge regarding these mammals in humid forests. The importance of considering activity periods when designing field survey and census methods is highlighted.

Grassman, LI, Haines, AM, Tewes, ME, Silvy, NJ. 2005. Stouffer wildlife timers as an index of vertebrate activity periods in a tropical forest. WILDLIFE SOCIETY BULLETIN 33(3):1174-1177.

Wildlife timers are an inexpensive alternative to radiotelemetry and camera trapping for assessing activity patterns of vertebrates. We tested the validity of using time-of-capture as an index of species activity periods by comparing wildlife-timer activity data with a concurrent radiotelemetry study of leopard cats (Prionailurus bengilensis) in Thailand. The wildlife timers yielded valid temporal data for a variety of captured vertebrates, although they were prone to mechanical failure in a moist, tropical environment. We recommend sheltering timers from direct rainfall and using silicone sealant to increase timer durability.

Grassman, LI, Tewes, FE, Silvy, AJ. 2005 From the field: Armoring the Camtrakker camera-trap in a tropical Asian forest. WILDLIFE SOCIETY BULLETIN 33(1):349-352.

Camera-trapping is an increasingly popular technique for surveying wildlife in the tropics. However, camera-trap damage caused by elephants (*Elephas*

spp.) poses significant financial and data losses. We describe the construction and use of an armored shell for the Camtrakker (R) camera-trap (CamTrak South, Watkinsville, Ga.). The addition of armoring doubled the weight of the unit but eliminated damage by elephants. We recommend armoring for camera-traps in regions containing elephants or other large carnivores, and where human theft may occur.

Hernandez, L, Laundre, JW, Gurung, M. 2005. From the field: Use of camera traps to measure predation risk in a puma-mule deer system. WILDLIFE SOCIETY BULLETIN 33(1):353-358.

Previous work indicated that automated camera traps may be useful in estimating predation risk among different microhabitats for mule deer (*Odocoileus hemionus*). We tested the prediction that the number of photographs taken by automated camera traps was inversely related to the amount of food left by deer in feeding boxes or giving up densities (GUDs). We positioned camera traps adjacent to standard mule deer feeding boxes placed in open and edge microhabitats of 3 forest types: Douglas-fir (*Pseudotsuga menziesii*), juniper (*Juniperus osteosperma*), and mountain mahongany (*Cercocarpus ledifolius*). We compared number of photographs taken with daily GUDs for the boxes for the 2 microhabitats. We found that GUD data of our study coincided with the previous work of lower GUDs in open versus edge microhabitats for Douglas-fir (288.6 ± 17.1 g vs. 389.6 ± 19.4 g; P < 0.001) and juniper (218.9 ± 26.3 g vs. 251.9 ± 29.6 g, P = 0.027) but not for mountain mahogany (272.4 ± 29.5 g vs. 287.0 ± 32.3 g, P=0.414). We also found significantly more total photos/camera taken in open microhabitat versus edge microhabitat in Douglas-fir (16.2 ± 2.2 vs. 7.4 ± 1.5; P=0.004). More photos/camera were taken in the open versus edge in the juniper forest type (15.6 ± 3.9 vs. 11.5 ± 3.9), but the difference was not significant. There was no difference in photos/camera between the 2 microhabitats in the mountain mahogany (18.4 ± 3.4 vs. 19.3 ± 1.9). Total number of photos/day/box also was significantly related to the GUDs for the 3 forest types (P=0.002-0.008). The amount of variability explained by regression equations

($r_{adjusted}^2$) ranged from 22% for Douglas-fir to 29% for juniper. We concluded that the total number of photographs taken does reflect the results of GUD analysis and that automated camera traps could be used to assess predation risk among different microhabitats.

Lim, BK, Engstrom, MD, Genoways, HH, Catzeflis, FM, Fitzgerald, KA, Peters, SL, Djosetro, M, Brandon, S, Mitro, S. 2005. Results of the Alcoa foundation-Suriname expeditions. XIV. Mammals of Brownsberg Nature Park, Suriname. ANNALS OF CARNEGIE MUSEUM 74(4):225-274.

An inventory of mammals in the vicinity of Brownsberg Nature Park, Suriname, incorporated a number of different sampling methods including examining museum voucher specimens, an animal-rescue operation, transect Surveys, camera photo-traps, and interviews with local inhabitants. We document a total of 125 mammal species present in the Park. These include tell opossums, five pilosans, four armadillos, 58 bats, eight monkeys, 13 carnivores, one tapir, four artiodactyls, and 22 rodents. Nine of these species are reported for the first time from Suriname: one mouse opossum (*Marmosops pinheiroi*); one naked-backed moustached bat (*Pieronotus gymnonotus*); four fruit-eating bats (*Artibeus bogolellsis*, *A. gnomus*, *A. obscurus*, and *A. planirostris*); two evening bats (*Eptesicus chiriquinus* and *Myotis riparius*) and one arboreal rice rat (*Oecomys auyantepui*). There are 191 indigenous non-marine mammals presently known from Suriname.

Maffei, L, Noss, AJ, Cuellar, E, Rumiz, DI. 2005. Ocelot (*Felis pardalis*) population densities, activity, and ranging behaviour in the dry forests of eastern Bolivia: data from camera trapping. JOURNAL OF TROPICAL ECOLOGY 21:349-353.

NO ABSTRACT

Rao, MH, Myint, T, Zaw, T, Htun, S. 2005. Hunting patterns in tropical forests adjoining the Hkakaborazi National Park, north Myanmar. ORYX 39(3):292-300.

Hunting for subsistence and trade constitute a major threat to wildlife populations within and outside protected areas in Myanmar. We examined hunting patterns in a forested landscape adjoining the Hkakaborazi National Park in north Myanmar with the aim of generating recommendations to manage hunting. The results described here focus on two issues: the significance of proximity to settlements and markets for prey abundance, and the influence of relative abundance and intrinsic preference on prey offtake. We used strip transect and camera trap surveys to generate relative abundance indices and overall encounter/capture rates for commonly hunted species at four sites that differed in their proximity to settlements and large trading towns. Questionnaires were used to obtain meal records and information on hunting. Encounter and capture rates for hunted species appear to be inversely related to proximity to villages as well as to large, commercial towns. Hunting is indiscriminate, with offtake determined largely by relative abundance rather than intrinsic preference or legislation. Specific management and policy recommendations include the need to monitor the impacts of hunting on vulnerable species, the demarcation of no-take areas, and modification of the legal framework for wildlife conservation.

Rivero, K, Rumiz, DI, Taber, AB. 2005. Differential habitat use by two sympatric brocket deer species (*Mazama americana* and *M. gouazoubira*) in a seasonal Chiquitano forest of Bolivia. MAMMALIA 69(2):169-183.

A study of habitat use of two sympatric brocket deer species was conducted by recording dung and tracks along 40 km traits cleared through four vegetation types in the chaco-cerrado border of Santa Cruz Department,

Bolivia. Deer signs of each species were characterized and discriminated by size and shape and counted for each habitat (transitional chaco forest, chiquitano riverine forest, chiquitano moist piedmont forest and cerrado open woodland) by walking 180-km in the wet season and 90-km in the dry season. The four habitats showed differences in vegetation structure and plant composition (canopy height and cover, horizontal visibility, and fruit resources) as well as frequency of signs for each brocket deer species. Although red brocket signs were less abundant than gray brocket signs, for both species and in every habitat we found consistently more tracks than dung in the wet season, and more dung than tracks in the dry season. Dung and track counts indicated that gray brockets were common and widespread in the four habitats, while reds occurred mostly in piedmont and riverine forest. Daily activity hours recorded by camera trapping showed that red brockets were active mostly from sunset until sunrise (6 pm to 6 am: 87% of 32 events) and gray brockets mostly in the morning (5 am to 10 am: 66% of 87 events). patterns of habitat use and daily activity suggest that these sympatric deer species segregate in space and time. A comparative study of their diet, plus more behavioral data from sympatric and allopatric situations are needed to better understand the way in which deer may partition resources.

Rovero, F, Jones, T, Sanderson, J. 2005. Notes on Abbott's duiker (*Cephalophus spadix* True 1890) and other forest antelopes of Mwanihana Forest, Udzungwa Mountains, Tanzania, as revealed by camera-trapping and direct observations. TROPICAL ZOOLOGY 18(1):13-23.

The Udzungwa Mountains of south-central Tanzania are part of an internationally outstanding area for biodiversity. This is reflected in the mammalian fauna and particularly in the forest antelopes: at least five species co-exist, including the Tanzanian endemic Abbott's duiker (*Cephalophus spadix* True 1890). Information on forest antelopes from Mwanihana Forest, one of the largest forest blocks within the Udzungwa Mountains, was collected by means of camera-traps and field observations. Eighty photographs of four antelope species were collected during 197

trap-days from four camera-trap sites. Seventy-one sightings were recorded during systematic counts and random survey walks for a total of 150 days of fieldwork. Results include the first photographs in the wild of Abbott's duiker, with one individual caught while holding what appears to be a frog in its mouth. The most photographed and sighted species was the Harvey's duiker (*Cephalophus natalensis harveyi* Thomas 1893), followed by the suni (*Neotragus moschatus* von Dueben 1846). Least photographed were Abbott's duiker and bushbuck (*Tragelaphus scriptus* Pallas 1766). The study shows the usefulness and potential of camera-traps to collect information on the presence, relative abundance and babits of antelopes in densely forested areas.

Ryser, A, Scholl, M, Zwahlen, M, Oetliker, M, Ryser-Degiorgis, MP, Breitenmoser, U. 2005. A remote-controlled teleinjection system for the low-stress capture of large mammals. WILDLIFE SOCIETY BULLETIN 33(2):721-730.

To recapture trap-shy Eurasian lynx (*Lynx lynx*) in Switzerland, we developed a selective and minimally invasive capture system (MICS). The device consists of a blowgun remotely controlled by means of 2 built-in cameras and a swiveling 2-way pan-tilt head. The blowgun is monitored and triggered from a distance of up to 400 m and is capable of shooting darts with high accuracy at distances of about 12 m. We darted lynx at kill sites, but the system generally can be used in any situation where a medium to large mammal stands still for a moment at a predictable distance. The MICS allows selection of specific individuals, thereby avoiding capture of nontarget animals. As there is no holding device, risk of injuries due to capture is minimized. Preliminary data on hematology and serum cortisol levels furthermore indicated that captures with the MICS induced less stress than captures with either box traps or foot-snares. We believe this new system opens new possibilities to capture cautious animals and provides considerable progress regarding animal welfare considerations.

Srbek-Araujo, AC, Chiarello, AG. 2005. Is camera-trapping an efficient method for surveying mammals in neotropical forests? A case study in south-eastern Brazil. JOURNAL OF TROPICAL ECOLOGY 21:121-125.

NO ABSTRACT

Trolle, M, Kery, M. 2005. Camera-trap study of ocelot and other secretive mammals in the northern Pantanal. MAMMALIA 69(3-4):409-416.

Reliable information on abundance of the ocelot (*Leopardus pardalis*) is scarce. We conducted the first camera-trap study in the northern part of the Pantanal wetlands of Brazil, one of the wildlife hotspots of South America. Using capture-recapture analysis, we estimated a density of 0.112 independent individuals per KM^2 (SE 0.069). We list other mammals recorded with camera traps and show that camera-trap placement on roads or on trails has striking effects on camera-trapping rates.

Wacher, T, Attum, O. 2005. Preliminary investigation into the presence and distribution of small carnivores in the Empty Quarter of Saudi Arabia through the use of a camera trap. MAMMALIA 69(1):81-84.

NO ABSTRACT

Wong, ST, Servheen, C, Ambu, L, Norhayati, A. 2005. Impacts of fruit production cycles on Malayan sun bears and bearded pigs in lowland tropical forest of Sabah, Malaysian Borneo. JOURNAL OF TROPICAL ECOLOGY 21:627-639.

We observed a period of famine in the lowland tropical rain forest of Sabah. Malaysia from August 1999 to September 2000. All six Malayan sun bears (*Helarctos malayanus*) that were captured and radio-collared were in poor physical condition and two were later found dead. The physical condition of bearded pigs (*Sus barbatus*) that were captured, observed or photographed by camera traps also revealed that the pigs were in various stages of emaciation and starvation. We surmise that the famine resulted from prolonged scarcity of fruit during an intermast interval in the study area. These phenomena of emaciated animals and fruit scarcity have also been reported from other areas of Borneo. Lowland tropical rain-forest trees of Borneo display supra-annual synchronized general fruiting. We believe that the starvation we observed and the generally low density of large animals in Borneo forests is a consequence of a history of prolonged food scarcity during non-general-fruiting years but may be accentuated by anthropogenic factors such as forest fragmentation, selective logging, and reduced density of fig trees in logged forests.

Zielinski, WJ, Truex, RL, Schlexer, FV, Campbell, LA, Carroll, C. 2005. Historical and contemporary distributions of carnivores in forests of the Sierra Nevada, California, USA. JOURNAL OF BIOGEOGRAPHY 32(8):1385-1407.

Aim Mammalian carnivores are considered particularly sensitive indicators of environmental change. Information on the distribution of carnivores from the early 1900s provides a unique opportunity to evaluate changes in their distributions over a 75-year period during which the influence of human uses of forest resources in California greatly increased. We present information on the distributions of forest carnivores in the context of two of the most significant changes in the Sierra Nevada during this period: the expansion of human settlement and the reduction in mature forests by timber harvest.

Methods We compare the historical and contemporary distributions of 10 taxa of mesocarnivores in the conifer forests of the Sierra Nevada and

southern Cascade Range by contrasting the distribution of museum and fur harvest records from the early 1900s with the distribution of detections from baited track-plate and camera surveys conducted from 1996 to 2002. A total of 344 sample units (6 track plates and 1 camera each) were distributed systematically across c. 3,000,000 ha area over a 7-year period.

Results Two species, the wolverine (*Gulo gulo*) and the red fox (*Vulpes vulpes*), present in the historical record for our survey area, were not detected during the contemporary surveys. The distributions of 3 species (fisher [*Martes pennanti*], American marten [*M. americana*], and Virginia opossum [*Didelphis virginiana*]) have substantially changed since the early 1900s. The distributions of fishers and martens, mature-forest specialists, appeared to have decreased in the northern Sierra Nevada and southern Cascade region. A reputed gap in the current distribution of fishers was confirmed. We report for the first time evidence that the distribution of martens has become fragmented in the southern Cascades and northern Sierra Nevada. The opossum, an introduced marsupial, expanded its distribution in the Sierra Nevada significantly since it was introduced to the south-central coast region of California in the 1930s. There did not appear to be any changes in the distributions of the species that were considered habitat generalists: gray fox (*Urocyon cinereoargenteus*), striped skunk (*Mephitis mephitis*), western spotted skunk (*Spilogale gracilis*), or black bear (*Ursus americanus*). Detections of raccoons (*Procyon lotor*) and badgers (*Taxidea taxus*) were too rare to evaluate. Contemporary surveys indicated that weasels (*M. frenata* and *M. erminea*) were distributed throughout the study area, but historical data were not available for comparison.

Main conclusions Two species, the wolverine and Sierra Nevada red fox, were not detected in contemporary surveys and may be extirpated or in extremely low densities in the regions sampled. The distributions of the mature forest specialists (marten and fisher) appear to have changed more than the distributions of the forest generalists. This is most likely due to a combination of loss of mature forest habitat, residential development and the latent effects of commercial trapping. Biological characteristics of individual species, in combination with the effect of human activities,

appear to have combined to affect the current distributions of carnivores in the Sierra Nevada. Periodic resampling of the distributions of carnivores in California, via remote detection methods, is an efficient means for monitoring the status of their populations.

2004

Gonzalez-Esteban, J, Villate, I, Irizar, I. 2004. Assessing camera traps for surveying the European mink, *Mustela lutreola* (Linnaeus, 1761), distribution. EUROPEAN JOURNAL OF WILDLIFE RESEARCH 50(1):33-36.

This study assesses the suitability of camera trapping as a method for detecting the European mink and determining its distribution in a region located in southwestern Europe. Using this technique, 98 river stretches were surveyed, resulting in the detection of 11 species of carnivores. A high photographic rate was obtained for the European mink, and we were able to get a picture of its distribution area in the year 2000. No seasonal differences were found in the efficiency of the method used. Camera trapping is an effective technique that provides quick updates of the distribution of the European mink and may be used in programs monitoring this species.

Hegglin, D, Bontadina, F, Gloor, S, Romer, J, Muller, U, Breitenmoser, U, Deplazes, P. 2004. Baiting red foxes in an urban area: A camera trap study. JOURNAL OF WILDLIFE MANAGEMENT 68(4):1010-1017.

Baiting red foxes (*Vulpes vulpes*) is an established method of vaccinating foxes against rabies in rural environments. Furthermore, anthelmintic baiting has been demonstrated to reduce the prevalence of the zoonotic tapeworm *Echinococcus multilocularis* in foxes. The recent invasion of foxes into urban areas on continental Europe represents a considerable health risk that calls for the evaluation of baiting strategies adapted to the urban environment. We investigated bait uptake by urban foxes using camera traps in Zurich, Switzerland. Baits with and without the anthelmintic praziquantel were placed in several arrangements (exposed, covered, buried), at different locations (fox dens, compost heaps, fox tracks) and in different seasons

(early summer, summer, winter). Ninety-one of 252 baits (36%) disappeared within 3 days. Most of the baits consumed near cameras were consumed by foxes (44 of 91). The remaining baits were consumed by hedgehogs (*Erinaceus europaeus*), snails (*Arion* sp.), dogs, rodents (*Apodemus* sp.), and unidentified animals. Bait uptake by foxes was significantly higher during summer than winter (P = 0.022), and foxes accepted baits most frequently at fox dens during early summer (52.8%). Burying baits reduced bait removal by species other than foxes (P < 0.01). For rabies control in urban areas, avoiding contact of nontarget species with the rabies vaccine is particularly important. Greater selection of the fox population can be achieved by distributing baits in winter, buying baits, and choosing sites that are less accessible to nontarget species. However, with anthelmintic treatment, uptake by nontarget species is of lesser importance; hence, the effort to bury the bait is unnecessary.

Innes, J, Nugent, G, Prime, K, Spurr, EB. 2004. Responses of kukupa (*Hemiphaga novaeseelandiae*) and other birds to mammal pest control at Motatau, Northland. NEW ZEALAND JOURNAL OF ECOLOGY 28(1):73-81.

The kukupa or New Zealand pigeon (*Hemiphaga novaeseelandiae*) is gradually declining on the New Zealand mainland, due mostly to predation by introduced pest mammals including ship rats (*Rattus rattus*) and brushtail possums (*Trichosurus vulpecula*). We report on a co-operative project between Maori landowners, the Department of Conservation, and Manaaki Whenua-Landcare Research researchers to restore a Northland kukupa population and to examine kukupa nesting success in relation to pest abundance. Ship rats and possums were targeted by trapping and poisoning throughout Motatau Forest (350 ha) from 1997 to 1999; only possums were targeted in 2000. All 13 kukupa nests located before pest control started in late 1997 failed at the egg stage, but all seven nests located in 1998-99 successfully fledged young when trapping and tracking indices of possums and ship rats were less than 4%. After pest control, counts of kukupa and some other bird species increased at Motatau

compared with counts in a nearby non-treatment block, suggesting numbers of adult kukupa can be increased in small forest areas by intensive pest control. This increase is due at least partly to increased nest success. Evidence from time-lapse video cameras, sign remaining at nests, and nest success rates under different pest control regimes suggest both ship rats and possums are important predators at kukupa nests.

Jacomo, ATDA, Silveira, L, Diniz, JAF. 2004. Niche separation between the maned wolf (*Chrysocyon brachyurus*), the crab-eating fox (*Dusicyon thous*) and the hoary fox (*Dusicyon vetulus*) in central Brazil. JOURNAL OF ZOOLOGY 262:99-106.

Four species of canids occur in the Cerrado of central Brazil. Three of them, the maned wolf *Chrysocyon brachyurus*, the crab-eating fox *Dusicyon thous* and the hoary fox *Dusicyon vetulus*, were studied in Emas National Park between 1996 and 1999 to investigate niche separation. The diet of the three species was studied to understand niche breadth and degree of overlap. Habitat and activity patterns were used as second and third ecological parameters to define niche dimensions, and were estimated using camera-trap data. The maned wolf is the largest species, weighing c. 21 kg, and is about three times larger than the crab-eating fox and six times larger than the hoary fox. The major ecological differences between the three species were found in their food niche and habitat use, where crab-eating fox presented higher differences from the hoary fox (Pianka's index of niche overlap (O)=0.405). Despite differences in niche breadth, habitat use between the hoary fox and the maned wolf were more similar, explaining their larger overlap, in comparison with habitat use by the crab-eating fox. Activity patterns among the species showed less divergence. The three species presented two activity peaks, one in the dusk-night period and another in the morning period. These data permit a better understanding of the ecological separation of the three Cerrado canids that enables their coexistence.

Karanth, KU, Chundawat, RS, Nichol, JD, Kumar, NS. 2004. Estimation of tiger densities in the tropical dry forests of Panna, Central India, using photographic capture-recapture sampling. ANIMAL CONSERVATION 7:285-290.

Tropical dry-deciduous forests comprise more than 45% of the tiger (*Panthera tigris*) habitat in India. However, in the absence of rigorously derived estimates of ecological densities of tigers in dry forests, critical baseline data for managing tiger populations are lacking. In this study tiger densities were estimated using photographic capture-recapture sampling in the dry forests of Panna Tiger Reserve in Central India. Over a 45-day survey period, 60 camera trap sites were sampled in a well-protected part of the 542-KM^2 reserve during 2002. A total sampling effort of 914 camera-trap-days yielded photo-captures of 11 individual tigers over 15 sampling occasions that effectively covered a 418-KM^2 area. The closed capture-recapture model M-h, which incorporates individual heterogeneity in capture probabilities, fitted these photographic capture history data well. The estimated capture probability/sample, (p) over cap = 0.04, resulted in an estimated tiger population size and standard error ((N) over cap,(S (E) over cap(N) over cap)) of 29 (9.65), and a density ((D) over cap (S (E) over cap(D) over cap)) of 6.94 (3.23) tigers/100 KM^2. The estimated tiger density matched predictions based on prey abundance. Our results suggest that, if managed appropriately, the available dry forest habitat in India has the potential to support a population size of about 9000 wild tigers.

Kawanishi, K, Sunquist, ME. 2004. Conservation status of tigers in a primary rainforest of Peninsular Malaysia. BIOLOGICAL CONSERVATION 120(3):329-344.

This study provided the first reliable density estimate of tigers based on photographic capture data in Taman Negara National Park, Peninsular Malaysia's most important conservation area. Estimated densities ((X) over

bar ± SE) of adult tigers ranged from 1.10 ± 0.52 to 1.98 ± 0.54 tigers/ 100 KM^2 (X-2 = 1.56, df = 2, P = 0.46) with the overall mean of 1.66 ± 0.21 tigers/100 KM^2. The tiger population in the 4343-KM^2 park was estimated to be 68 (95% CI: 52-84) adult tigers. Prey biomass estimates ranged from 266 to 426 kg/KM^2, and wild boar were the most important potential prey species in terms of abundance, biomass, and occupancy, followed by muntjac. Both tigers and leopards were more diurnal than nocturnal, which corresponded with the activity patterns of wild boar and muntjac. No evidence of poaching of large mammals was found in the 600-KM^2 study sites and overall human impacts on the tiger-prey community appear to be minimal, but in the long run its viability needs to be evaluated in a greater landscape context.

Kitamura, S, Suzuki, S, Yumoto, T, Poonswad, P, Chuailua, P, Plongmai, K, Noma, N, Maruhashi, T, Suckasam, C. 2004. Dispersal of *Aglaia spectabilis*, a large-seeded tree species in a moist evergreen forest in Thailand. JOURNAL OF TROPICAL ECOLOGY 20:421-427.

We investigated the seed dispersal of *Aglaia spectabilis*, a large-seeded tree species in a moist evergreen forest of Khao Yai National Park in Thailand. Although one-to-one relationships between frugivores and plants are very unlikely, large-seeded plants having to rely on few large frugivores and therefore on limited disperser assemblages, might be vulnerable to extinction. We assessed both the frugivore assemblages foraging on arillate seeds of *Aglaia spectabilis* and dispersing them and the seed predator assemblages, thereby covering dispersal as well as the post-dispersal aspects such as seed predation. Our results showed that frugivores dispersing seeds were a rather limited set of four hornbill and one pigeon species, whereas two squirrel species were not dispersers, but dropped the seeds on the ground. Three mammal species were identified as seed predators on the forest floor. Heavy seed predation by mammals together with high seed removal rates, short visiting times and regurgitation of intact seeds by mainly hornbills lead us to the conclusion that hornbills show high effectiveness in dispersal of this tree species.

Maffei, L, Cuellar, E, Noss, A. 2004. One thousand jaguars (*Panthera onca*) in Bolivia's Chaco? Camera trapping in the Kaa-Iya National Park. JOURNAL OF ZOOLOGY 262:295-304.

This paper reports on efforts to trap jaguars *Panthera onca* on camera in the dry forests of the Kaa-Iya del Gran Chaco National Park in Bolivia. Ad hoc camera trapping provided certain information on jaguar presence and habits, but was limited in application. Activity patterns showed that jaguars are active all day, particularly at one of three sites, with peaks in the morning and evening the more common pattern. Minimum observed home range was variable, with males (up to 65 KM^2) occupying more area than females (up to 29 KM^2). The authors adapted systematic methodologies first developed to survey tigers in India, based on individually distinctive pelage patterns in tigers and jaguars. Abundance is estimated using capture-recapture statistical analysis, and a sample area defined based on the maximum distance that individual jaguars move during the sample period. The methodology has proved successful for jaguars in dry Chaco forest, population densities of 1/30-45 KM^2 and 1/20 KM^2 are estimated in the two most extensive landscape systems of Kaa-Iya. The entire 34400 KM^2 protected area is estimated to sustain a population of over 1000 adult and juvenile jaguars, the largest single population of jaguar reported anywhere, and a viable population for long-term jaguar conservation.

Pina, GPL, Gamez, RAC, Gonzalez, CAL. 2004. Distribution, habitat association, and activity platterns of medium and large sized mammals of Sohora, Mexico. NATURAL AREAS JOURNAL 24(4):354-357.

Despite the proximity of Sonora, Mexico, to the United States, the mammalian fauna of Sonora has been poorly investigated, and many of the biological and ecological characteristics of these animals remain unknown. From July 1999 to August 2001, we carried out a mammalian inventory

using camera traps surveys in order to provide information on the occurrence, distribution, habitat association, and activity patterns of medium and large-sized terrestrial mammals in the three major habitat types of the Sierra Madre Occidental foothills in east-central Sonora: (1) Sinaloan thornscrub (ST), (2) Oak woodland (OW), and (3) thorn scrub-woodland ecotones (TW). Over 2348 trap-nights, we obtained 897 photographic records, documenting 18 species of wild mammals. White-tailed deer (*Odocoileus virginianus*), gray fox (*Urocyon cinereoargenteus*), mountain lion (*Puma concolor*), and coyote (*Canis latrans*) were the most frequently recorded and widely distributed species. In addition, we documented the presence of two endangered species, the jaguar (*Panthera onca*) and ocelot (*Leopardus pardalis*), as well as a threatened species, the badger (*Taxidea taxus*).

Rovero, F, Marshall, AR. 2004. Estimating the abundance of forest antelopes by line transect techniques: a case from the Udzungwa Mountains of Tanzania. TROPICAL ZOOLOGY 17(2):267-277.

We used line transect counts to collect data on population abundance of forest antelopes from three moist forest sites in the Udzungwa Mountains, Tanzania. The habitat quality of these forests differs in forest size, vegetation type, human impact and level of protection. The red duiker (*Cephalophus natalensis harveyi* Thomas 1893) was the only species regularly seen (mean of 0.16 animals seen per km walked) at one of the three sites, Mwanihana Forest, a large forest block within the Udzungwa Mountains National Park ranging in altitude from 300-2100 m. Counts of antelope tracks and dung piles were used to supplement information from areas where no direct observations were scored. This study provides the first account of the abundance of forest antelopes in the Udzungwa Mountains and confirms that methodological problems - such as poor antelope detectability due to understorey vegetation and difficulties in identifying antelope species - are inherent in estimations of forest antelope density by line transect counts. Combining counts of indirect signs with direct counts increases the information for some species and comparable

data show that camera-trapping can also greatly supplement the information, especially for more elusive and/or more nocturnal species.

Silver, SC, Ostro, LET, Marsh, LK, Maffei, L, Noss, AJ, Kelly, MJ, Wallace, RB, Gomez, H, Ayala, G. 2004. The use of camera traps for estimating jaguar *Panthera onca* abundance and density using capture/recapture analysis. ORYX 38(2):148-154.

Across their range jaguars *Panthera onca* are important conservation icons for several reasons: their important role in ecosystems as top carnivores, their cultural and economic value, and their potential conflicts with livestock. However, jaguars have historically been difficult to monitor. This paper outlines the first application of a systematic camera trapping methodology for abundance estimation of jaguars. The methodology was initially developed to estimate tiger abundance in India. We used a grid of camera traps deployed for 2 months, identified individual animals from their pelage patterns, and estimated population abundance using capture-recapture statistical models. We applied this methodology in a total of five study sites in the Mayan rainforest of Belize, the Chaco dry forest of Bolivia, and the Amazonian rainforest of Bolivia. Densities were 2.4-8.8 adult individuals per 100 KM^2, based on 7-11 observed animals, 16-37 combined 'captures' and 'recaptures', 486-2,280 trap nights, and sample areas of 107-458 KM^2. The sampling technique will be used to continue long-term monitoring of jaguar populations at the same sites, to compare with further sites, and to develop population models. This method is currently the only systematic population survey technique for jaguars, and has the potential to be applied to other species with individually recognizable markings.

Tilson, R, Defu, H, Muntifering, J, Nyhus, PJ. 2004. Dramatic decline of wild South China tigers *Panthera tigris amoyensis*: field survey of priority tiger reserves. ORYX 38(1):40-47.

This paper describes results of a Sino-American field survey seeking evidence of South China tigers *Panthera tigris amoyensis* in the wild. In 2001 and 2002 field surveys were conducted in eight reserves in five provinces identified by government authorities as habitat most likely to contain tigers. The surveys evaluated and documented evidence for the presence of tigers, tiger prey and habitat disturbance. Approximately 290 km of mountain trails were evaluated. Infrared remote cameras set up in two reserves captured 400 trap days of data. Thirty formal and numerous informal interviews were conducted with villagers to document wildlife knowledge, livestock management practices, and local land and resource use. We found no evidence of wild South China tigers, few prey species, and no livestock depredation by tigers reported in the last 10 years. Forest areas designated as tiger reserves, averaging about 100 KM^2 in size, are too small to support even a few tigers because commercial tree farms and other habitat conversion is common, and people and their livestock dominate these fragments. While our survey may not have been exhaustive, and there may be a single tiger or a few isolated tigers still remaining at sites we missed, our results strongly indicate that no remaining viable populations of South China tigers occur within its historical range. We conclude that continued field efforts are needed to ascertain whether any wild tigers may yet persist, concurrent with the need to consider options for the eventual recovery and restoration of wild tiger populations from existing captive populations.

Wegge, P, Pokheral, CP, Jnawali, SR. 2004. Effects of trapping effort and trap shyness on estimates of tiger abundance from camera trap studies. ANIMAL CONSERVATION 7:251-256.

Camera trapping has recently been introduced as an unbiased and practical method for monitoring tiger abundance. In a high density area in the Royal Bardia National Park in lowland Nepal, we tested this method by trapping very intensively within a 25 KM^2 area to determine the true number of animals in that area. We then tested the effect of study design by sub-sampling the data set using varying distances between trap stations and

by reducing the number of trapping nights at each station. We compared these numbers with the density estimates generated by the capture-recapture models of the program CAPTURE. Both distance between traps and trapping duration greatly influenced the results. For example, increasing the inter-trap distance from 1 to 2.1 km and reducing the trapping duration per station from 15 to 10 nights reduced the number of tigers captured by 25%. A significant decrease in trapping rates during successive 5-night periods suggested that our tigers became trap-shy, probably because of the photo flash and because they detected the camera traps from cues from impression pads 50 in from the traps. A significant behavioural response was also confirmed by the program CAPTURE. The best capture-recapture model selected by the computer program (M-bh) gave precise estimates from data collected by the initial 1 km spacing of traps. However, when we omitted data from half the number of traps, thus decreasing the sampling effort to a more realistic level for monitoring purposes, the program CAPTURE underestimated the true number of tigers. Most probably, this was due to a combination of trap shyness and the way the study was designed. Within larger protected areas, total count from intensive, stratified subsampling is suggested as a complementary technique to the capture-recapture method, since it circumvents the problem of trap shyness.

2003

Azian, JM, Sharma, DSK. 2003. Camera trapping the indochinese tiger, *Panthera tigris corbetti*, in a secondary forest in Peninsular Malaysia. RAFFLES BULLETIN OF ZOOLOGY 51(2):421-427.

Indochinese tigers (*Panthera tigris corbetti*) are the main mammalian predator in most Asian tropical rainforest ecosystems. However little is known about the distribution of this large carnivore in Peninsular Malaysia. In order to understand tiger-human conflict, we conducted a study to describe the relative abundance of tigers in Jerangau Forest Reserve, Ulu Terengganu, Malaysia, between February 2000 and October 2000. A total of ten individuals, including three cubs, were recorded. The use of camera traps provides detailed information on the abundance, ecology and habits of this cryptic and secretive mammal. The most frequently photographed tiger was an adult male (M1) followed by an adult female (F1) which comprised 66% and 12% of the total tiger individual photographs, respectively. The monthly individual accumulation curve did not show any signs of leveling out, suggesting that additional effort may reveal the presence of other individuals even if the camera sites were maintained. The same individuals were recorded both in isolated and continuous forest suggesting that tigers disperse through degraded forest habitat. As this study concentrated on assessing relative abundance of tigers, additional research will be necessary to understand the population dynamics for conservation of this felid species in secondary forest habitat.

Henke, SE, VanderZee, JH, Grubbs, SE, Gard, TA. 2003. Evaluation of Stouffer wildlife timers for conducting temporal wildlife studies. WILDLIFE SOCIETY BULLETIN 31(3):762-768.

Activity patterns of wildlife offer insight into animal behavior and interspecific interactions; however, temporal activity of nocturnal mammals is difficult to obtain. Devices to monitor capture time of mammals have been developed but are expensive, time-consuming, developed for a specific trap design, or require special skills to build. Commercially produced Stouffer (Stouffer Technologies, South Bend, Ind.) wildlife timers were developed for use with a variety of live-capture traps. We evaluated accuracy of timers in various weather conditions; evaluated the temporal composition, movements, and density of rodents on areas with and without the use of wildlife timers; and evaluated the temporal activity of mesopreclators with the aid of Stouffer timers. We placed 50 wildlife timers at room temperature (22degreesC) for 30 days, in an oven at 44degreesC for 5 days, in a freezer at -15degreesC for 5 days, outside during a 4-cm rain event, and outside during a 30-day trial when temperatures fluctuated from 3-27degreesC and relative humidity ranged from 47-98%. Wildlife timers kept accurate time regardless of weather conditions. We used 8 8 x 8 trapping grids in a self-paired design to assess rodent demographics. Order of trapping on grids with and without timers was random. Rodent temporal composition was similar between trapping grids with and without wildlife timers; however, hourly human disturbance on trapping grids not equipped with timers resulted in reduced rodent abundance and reduced estimated rodent diversity, and caused greater movements in rodents, which resulted in a decreased estimated rodent density. About 4% of wildlife timers (12 of 312 rodent captures) malfunctioned on rodent-sized capture traps; the most common malfunction involved the timer sliding forward on the trap after the spring-mounted door shut, deactivating the clock. Rodent traps equipped with timers required 10-fold more time to set than traps without timers; however, hourly trap checks were not required thereafter on grids equipped with timers. Overall, time required to check traps every hour to measure temporal activity of rodents was slightly greater than the time required to place timers on traps. Trapping grids equipped with Stouffer wildlife timers resulted in more precise rodent demographics than hourly trap checks by researchers. In addition, temporal activity of selected mesopreclators was obtained without malfunction of timers on Tomahawk traps, and setup time on the larger traps was negligible. Although moderately priced (U.S.$35/unit, 2000), Stouffer wildlife timers were effective in gaining

temporal information on a variety of species without affecting the behavior of those species or increasing the workload of researchers.

Jones, EG, Tselepides, A, Bagley, PM, Collins, MA, Priede, IG. 2003. Bathymetric distribution of some benthic and benthopelagic species attracted to baited cameras and traps in the deep eastern Mediterranean. MARINE ECOLOGY PROGRESS SERIES 251:75-86.

A series of baited camera and trap experiments in the eastern Mediterranean Sea between 1500 and 4264 m depth attracted a variety of opportunistic scavengers, with species composition changing with increasing depth, At the shallower stations (1500 to 1800 m), decapod crustaceans and fishes, dominated by elasmobranchs such as *Hexanchus griseus*, were attracted to and actively consumed the bait. Some of these species were observed at depths exceeding their previously reported ranges. This was believed to be a result of the absence of deep-water scavengers from the adjacent Atlantic due to dispersal barriers and elevated temperatures at depth. The diversity of bait-attending fauna declined with increasing depth. Elasmobranchs were not observed below 2500 m, and below 4000 m only the caridean shrimp *Acanthephyra eximia* and the macrourid *Chalinura mediterranea* were present; at this latter depth, bait consumption was negligible. This shift in species composition was reflected in changes in first arrival times. Increasing first arrival times of *H. griseus* suggested a decline in relative abundance from 1500 to 2500 m, whilst those of C. mediterranea indicated an increase in relative abundance from 1800 to 4264 m.

Kinnaird, MF, Sanderson, EW, O'Brien, TG, Wibisono, HT, Woolmer, G. 2003. Deforestation trends in a tropical landscape and implications for endangered large mammals. CONSERVATION BIOLOGY 17(1):245-257.

The remarkable large-mammal fauna of the Indonesian island of Sumatra is one of the most endangered on Earth and is threatened by rampant deforestation. We used remote sensing and biological surveys to study the effects of deforestation on populations of endangered large mammals in a Sumatran landscape. We measured forest loss and created a predictive model of deforestation for Bukit Barisan Selatan National Park and an unprotected buffer area based on satellite images between 1985 and 1999. We used automatic cameras to determine the distribution and relative abundance of tigers (*Panthera tigris sumatrae*), elephants (*Elephas maximus*), rhinoceros (*Dicerorhinus sumatrensis*), and tapirs (*Tapir indicus*). Between 1985 and 1999, forest loss within the park averaged 2% per year. A total of 661 km^2 of forest disappeared inside the park, and 318 km^2 were lost in a 10-km buffer, eliminating forest outside the park. Lowland forest disappeared faster than hill/montane forest (by a factor of 6) and forests on gentle slopes disappeared faster than forests on steep slopes (by a factor of 16). Most forest conversion resulted from agricultural development, leading to predictions that by 2010 70% of the park will be in agriculture and that by 2036 lowland forest habitat will be eliminated. Camera-trap data indicated avoidance of forest boundaries by tigers, rhinoceroses (up to 2 km), and elephants (up to 3 km). Classification of forest into core and peripheral forest based on mammal distribution suggests that, by 2010, core forest area for tigers and rhinoceros will be fragmented and reduced to 20% of remaining forest. Core forest area for elephants will be reduced to 0.5% of remaining forest. Halting forest loss has proven one of the most difficult and complex problems faced by Indonesia's conservation agencies today and will require a mix of enforcement, wise land-use strategies, increased education, capacity to manage, and new financing mechanisms.

Lee, RJ, Riley, J, Hunowu, L, Maneasa, E. 2003. The Sulawesi palm civet: expanded distribution of a little known endemic viverrid. ORYX 37(3):378-381.

To date, the Sulawesi palm civet *Macrogalidia musschenbroekii*, a viverrid endemic to the eastern Indonesian island of Sulawesi, was thought to be confined to North and Central Sulawesi. During a 14-month survey throughout south-east Sulawesi, new observations were made of the civet through camera-trapping in south-east Sulawesi forests: at Rawa Aopa National Park, Tanjung Peropa Wildlife Reserve, and Mangolo Recreation Forest, thereby extending the species' range significantly. This paper describes these sightings, and summarizes information on its status and distribution.

O'Brien, TG, Kinnaird, MF, Wibisono, HT. 2003. Crouching tigers, hidden prey: Sumatran tiger and prey populations in a tropical forest landscape. ANIMAL CONSERVATION 6:131-139.

We examine the abundance and distribution of Sumatran tigers (*Panthera tigris sumatrae*) and nine prey species in Bukit Barisan Selatan National Park on Sumatra, Indonesia. Our study is the first to demonstrate that the relative abundance of tigers and their prey, as measured by camera traps, is directly related to independently derived estimates of densities for these species. The tiger population in the park is estimated at 40-43 individuals. Results indicate that illegal hunting of prey and tigers, measured as a function of human density within 10 kin of the park, is primarily responsible for observed patterns of abundance, and that habitat loss is an increasingly serious problem. Abundance of tigers, two mouse deer (*Tragulus* spp.), pigs (*Sus scrofa*) and Sambar deer (*Cervus unicolor*) was more than four times higher in areas with low human population density, while densities of red muntjac (*Muntiacus muntjac*) and pigtail macaques (*Macaca nemestrina*) were twice as high. Malay tapir (*Tapirus indicus*) and argus pheasant (*Argusianus argus*), species infrequently hunted, had higher indices of relative abundance in areas with high human density. Edge effects associated with park boundaries were not a significant factor in abundance of tigers or prey once human density was considered. Tigers in Bukit Barisan Selatan National Park, and probably other protected areas

throughout Sumatra, are in imminent danger of extinction unless trends in hunting and deforestation are reversed.

Sequin, ES, Jaeger, MM, Brussard, PF, Barrett, RH. 2003. Wariness of coyotes to camera traps relative to social status and territory boundaries. CANADIAN JOURNAL OF ZOOLOGY 81(3):2015-2025.

The primary objective of this study was to develop a better understanding of coyote (*Canis latrans*) wariness particularly as it related to social status. We determined that territory status (controlling alpha, resident beta, or nonterritorial transient) affected vulnerability to photo-capture by infrared-triggered camera systems. All coyotes were wary of cameras, leading to relatively low numbers of photo-captures, most of which occurred at night. Alphas were significantly underrepresented in photographs and were never photo-captured inside their own territories. Betas were photographed inside and outside their territories, whereas transients were most often photographed on edges of territories. Both alphas and betas were photographed more often on territorial edges when outside their territories. We next addressed the question of how alphas were better able to avoid photo-capture. Alphas tracked human activity within their territories and presumably learned the locations of cameras as they were being set up. They did this either by approaching our location directly or by moving to a vantage point from where they could observe us. Betas and transients either withdrew or did not respond to human activity. Trials in which a dog was present were more likely to elicit an approach response from alphas. Avoidance of camera stations and the tracking of human activity implied wariness toward objects or locations resulting from their learned association with human presence rather than neophobia toward the objects themselves.

Silveira, L, Jacomo, ATA, Diniz, JAF. 2003. Camera trap, line transect census and track surveys: a comparative evaluation. BIOLOGICAL CONSERVATION 114(3):351-355.

Rapid faunal assessments can use different methods depending on environmental conditions and costs. To compare the efficiency of three methods in detecting species richness and abundance, we tested them in the grasslands of Emas National Park, central Brazil. Track census was the most effective method for detecting richness, followed by camera-trapping and direct faunal counts. Track census reached an asymptote for number of species after only 12 days, but all methods converged on similar estimates of species richness after around 30 days. There was no significant spatial correlation for species richness or total abundance, between camera trap and tracks, across the 29 samples distributed in the park. However, for some species, abundance showed significant spatial correlation between methods. Also, these rates were significantly correlated across species and the spatial correlation between methods was significantly associated with log-transformed body mass across species. We conclude that, despite the high initial costs for camera-trapping, this method is the most appropriate for mammal inventory in all environmental conditions, allowing a rapid assessment of wildlife conservation status.

Trolle, M. 2003. Mammal survey in the southeastern Pantanal, Brazil. BIODIVERSITY AND CONSERVATION 12(4):823-836.

The Pantanal floodplain of southwestern Brazil, with its mosaic of marshes, seasonally flooded savannas, woodlands and forests, is known as one of the wildlife hotspots of South America. The region harbors a rich mammal fauna and is a stronghold for a number of mammal species; however, still very few thorough mammal surveys have been conducted in the Pantanal. This is the first mammal survey from the southeastern part of the region. An intensive, three-month study of the medium to large, non-volant species was conducted at a location in the upper Rio Negro Basin, Aquidauana region, Mato Grosso do Sul. Thirty species of mammals were recorded, including 5 xenarthrans, 1 primate, 10 carnivores, 7 ungulates and 5 caviomorph rodents. It was possible to analyze the field biology of many of the species

to a level not previously published for the Pantanal. Recommendations are given for camera trapping in the Pantanal and the Amazon. Finally, the effects of intensive cattle ranching on conservation in the Pantanal are discussed.

Trolle, M. 2003. Mammal survey in the Rio Jauaperi region, Rio Negro Basin, the Amazon, Brazil. MAMMALIA 67(1):75-83.

The Brazilian part of the Rio Negro Basin, a major region of the Amazon, is one the least studied regions of the Amazon rainforest. Ail intensive, four months inventory, of the medium to large, non-volant mammal species was conducted in the area encompassing the lower Rio Xixuau!, a minor tributary to the Rio Jauaperi river, to the north of Rio Negro. The main habitats of the study area were seasonally flooded igapo forest, riparian vegetation, higher-lying terra-firme forest, secondary forest, minor water Courses and lakes. Using walked transects, camera trapping, observations form canoe, nightspotting, interviews, and identification of skulls, it was possible to list 42 species for the study site, including 8 xenarthrans, 7 primates, I I carnivores and 5 ungulates. The habitat use of the primate species is analyzed.

Trolle, M, Kery, M. 2003. Estimation of ocelot density in the pantanal using capture-recapture analysis of camera-trapping data. JOURNAL OF MAMMALOGY 84(2):607-614.

Neotropical felids such as the ocelot (*Leopardus pardalis*) are secretive, and it is difficult to estimate their populations using conventional methods such as radiotelemetry or sign surveys. We show that recognition of individual ocelots from camera-trapping photographs is possible, and we use camera-trapping results combined with closed population capture-recapture models to estimate density of ocelots in the Brazilian Pantanal. We estimated the

area from which animals were camera trapped at 17.71 KM^2. A model with constant capture probability yielded an estimate of 10 independent ocelots in our study area, which translates to a density of 2.82 independent individuals for every 5 KM^2 (SE 1.00).

2002

Beck, H, Terborgh, J. 2002. Groves versus isolates: how spatial aggregation of *Astrocaryum murumuru* palms affects seed removal. JOURNAL OF TROPICAL ECOLOGY 18:275-288.

Palm seeds of the genus *Astrocaryum* are known to attract a wide range of seed predators, including insects, rodents and peccaries. We investigated the removal of seeds of *Astrocaryum murumuru* var. *macrocalyx* in dense groves and under solitary palms, both within and outside of peccary exclosures. We set out arrays of 40 seeds at each of 40 sites representing four treatments: in the open and in peccary exclosures, in groves and under solitary palms. Seed removal from each site was monitored daily for 55 d. Infra-red-triggered cameras were installed to identify the species that removed seeds. >From the known and hypothesized behaviour of vertebrate seed predators under various circumstances, we predicted that (1) overall seed loss should be higher under solitary trees, (2) peccaries should forage preferentially in groves, (3) the variance in the rate of seed removal should be higher in groves, (4) a greater fraction of the seeds removed from solitary palms should be scatterhoarded, and consequently, (5) greater numbers of seedlings should recruit near solitary palms than in groves. The first four of these predictions were confirmed and the last was rejected by the results. Peccaries preferred to forage in groves, and small rodents preferred to forage under solitary palms. Whether in groves or under solitary palms, peccaries preferentially removed seeds from large arrays (21-40 seeds), and mostly ignored small arrays (less than or equal to 20 seeds). Camera trapping demonstrated that the most frequent visitors to seed arrays were *Myoprocta pratti* and *Proechimys* spp. There was no significant difference in the numbers of seedlings around trees in groves versus solitary trees.

Bergmann, M, Wieczorek, SK, Moore, PG, Atkinson, RJA. 2002. Utilisation of invertebrates discarded from the *Nephrops* fishery by variously selective benthic scavengers in the west of Scotland. MARINE ECOLOGY PROGRESS SERIES 233:185-198.

Demersal trawl fisheries generate large quantities of discards which temporarily increase the amount of carrion available to benthic communities and lead to a faster energetic turnover. This study examines the availability of discarded material to the benthos, assesses consumption times of different items and identifies scavengers attracted to those invertebrates most frequently discarded from Clyde Sea *Nephrops* trawlers, In field and laboratory trials, heavy-shelled dead whelks (*Buccinum undatum, Neptunea antiqua*) sank faster than softer-bodied species like cephalopods (*Allotheuthis subulata, Rossia macrosoma*) or echinoderms (*Ophiura ophiura, Asterias rubens*), making most discards available to the benthos (at ca, -60 m CD [chart datum]) within minutes after discarding. SCUBA and time-lapse camera observations in the Clyde Sea and Loch Sween indicated bait utilisation times between 24 and 48 h. Fast-moving animals like brachyuran crabs were the first to arrive at discard bait piles whose composition mimicked typical discards from the Clyde Sea Nephrops fishery. Bimonthly deployments of traps baited with invertebrate discards in the north of the Clyde Sea showed that *A. rubens*, followed by *Pagurus bernhardus, Liocarcinus depurator* and whelks, were the most abundant megafaunal scavengers. Fine-meshed funnel traps deployed inside those creels yielded up to 2819 amphipods per trap, with *Scopelocheirus hopei* and *Orchomene nanus* accounting for most of the catch, Together with whelks, *A. rubens* and *Carcinus maenas*, *O. nanus* showed a clear preference for crustacean bait. By contrast, *Pagurus bernhardus* was more attracted to *A. rubens* and, in I trial, to *O. ophiura* bait, Traps deployed in the south of the Clyde Sea yielded generally lower numbers and species diversity in the catch, with *Nephrops* being the most abundant megafaunal scavenger. It showed a preference for *L. depurator* and conspecific bait. While the results show that a range of epibenthic species readily utilise invertebrates discarded from Clyde Sea *Nephrops* trawlers, it is unknown to

what extent discards subsidise benthic communities as information on the ecological energetics of the species involved locally is currently lacking.

Carbone, C, Christie, S, Conforti, K, Coulson, T, Franklin, N, Ginsberg, JR, Griffiths, M, Holden, J, Kawanishi, K, Kinnaird, M, Laidlaw, R, Lynam, A, Macdonald, DW, Martyr, D, McDougal, C, Nath, L, O'Brien, T, Seidensticker, J, Smith, DJL, Sunquist, M, Tilson, R, Shahruddin, WNW. 2002. The use of photographic rates to estimate densities of cryptic mammals: response to Jennelle et al. ANIMAL CONSERVATION 5:121-123.

NO ABSTRACT

Davison, A, Birks, JDS, Brookes, RC, Braithwaite, TC, Messenger, JE. 2002. On the origin of faeces: morphological versus molecular methods for surveying rare carnivores from their scats. JOURNAL OF ZOOLOGY 257:141-143.

Charismatic mammals remain a linchpin in attracting publicity and funds for the conservation of native habitats and organisms. Unfortunately, the same animals are frequently scarce and difficult to survey. For many, confirming their presence through faecal surveys is the only cost-effective approach. Here we show that, contrary to received opinion, expert naturalists fail reliably to distinguish pine marten *Martes martes* faeces ('scats') from those of foxes *Vulpes vulpes*. Moreover, their judgement fails completely when the animals and their scats are at their most scarce. This unexpected result from such a well-studied species has important implications for the monitoring of endangered mammals. We recommend that in the future, a multi-evidence approach should be adopted to monitor elusive mammals, involving DNA methods, cast hair identification, camera traps, and non-leading 'sighting'

questionaires. For national surveys, it may soon become cost-effective to screen large numbers of samples using microarray technology.

Harrison, RL, Barr, DJ, Dragoo, JW. 2002. A comparison of population survey techniques for swift foxes (*Vulpes velox*) in New Mexico. AMERICAN MIDLAND NATURALIST 148(2):320-337.

We compared survey techniques for estimating relative and absolute abundances of swift foxes (*Vulpes velox*) in New Mexico. For relative abundance surveys, the most efficient technique is collection of scats followed by verification of species depositing scats with DNA analysis. By collecting scats, the proportions of individual locations where swift foxes were detected were 61.9% and 67.7% during surveys in 2000 and 2001, which were greater than the proportions using scent stations (31.4%, 47.1%) or trapping (11.5%, 8.4%). By collecting scats, we detected swift foxes in 100% of the fox home ranges within the study area. If scent-station surveys are used instead, scent-station transects consisting of stations spaced at 1.6 km (1.0 mile) intervals and operated for three nights are the most practical. Searching for tracks, spotlighting and calling are much less efficient techniques. For absolute abundance surveys, trapping and resighting with cameras at bait stations was more accurate than Counting unique microsatellite DNA genotypes from collected scats. Using trapping/resighting, we estimated the 95% confidence intervals for the swift fox Population within the study area to be 17.8-30.0, 11.9-25.3 and 15.2-17.3 in the periods November 1999-january 2000, February 2000 and january-March 2001, respectively. We counted 63 and 27 unique genotypes in early 2000 and 2001, respectively. The numbers of unique genotypes, which were much greater than population estimates obtained from trapping and resighting, were overestimated because of the presence of transient swift foxes and poor quality DNA front scats leading to allelic drop-out and/or false alleles.

Jeganathan, P, Green, RE, Bowden, CGR, Norris, K, Pain, D, Rahmani, A. 2002. Use of tracking strips and automatic cameras for detecting Critically Endangered Jerdon's coursers *Rhinoptilus bitorquatus* in scrub jungle in Andhra Pradesh, India. ORYX 36(2):182-188.

Jerdon's courser *Rhinoptilus bitorquatus* is a nocturnal cursorial bird that is now only known from a small area of scrub jungle in Andhra Pradesh, India, Its population size, distribution and habitat requirements are poorly known because of its elusive habits. We conducted a trial of a survey method that involved deploying an array of 5 in long tracking strips consisting of smoothed fine soil, and checking them for footprints at regular intervals. We developed diagnostic methods for distinguishing the footprints of Jerdon's courser from those of other species. Tracks of Jerdon's courser were obtained on about one strip-night in 30 from areas where the species was known to be present. We suggest a procedure for using tracking strips to survey areas where Jerdon's courser has not yet been detected. The use of tracking strips carries a small risk of misidentification of footprints of other species, especially yellow-wattled lapwing *Vanellus malarbaricus*, as those of Jerdon's courser, but has the advantage that large areas can be surveyed without the use of expensive equipment or night-time fieldwork. We recommend the use of automatic camera traps to obtain confirmation of records of probable Jerdon's courser footprints.

Jennelle, CS, Runge, MC, MacKenzie, DI. 2002. The use of photographic rates to estimate densities of tigers and other cryptic mammals: a comment on misleading conclusions. ANIMAL CONSERVATION 5:119–120.

NO ABSTRACT

Main, MB, Richardson, LW. 2002. Response of wildlife to prescribed fire in southwest Florida pine flatwoods. WILDLIFE SOCIETY BULLETIN 30(1):213-221.

We conducted an experiment using infrared-triggered camera traps to document relative abundance of wildlife in pine flatwoods habitat at different stages of post-fire recovery at the Florida Panther National Wildlife Refuge in southwest Florida. Total wildlife, which for the purposes of this study was defined as records of wild turkey (*Meleagris gallopavo*) and all mammals captured on film, used pine flatwoods habitat in a fire management unit (FMU) with a post-fire recovery history of 24 months significantly more than adjacent pine flatwoods in an FMU with a post-fire recovery history of 48 months (P = 0.04). Data suggested that the relative abundance of white-tailed deer (*Odocoileus virginianus*) was also higher in the 24-month post-fire FMU (P = 0.12) compared to the 48-month FMU. To evaluate response of wildlife to prescribed fire, we burned the 48-month FMU and, after approximately 8 weeks, repeated the camera-trap surveys in the newly burned (<6-month) FMU and the adjacent FMU, now at approximately 30-months post-fire recovery. We documented a significant increase in use of the recently burned (<6-month) FMU compared to previous levels of use (48-month FMU) by total wildlife (P = 0.04) and white-tailed deer (P = 0.02). Use of the <6-month FMU by wild turkey also appeared to increase P = 0.13). No difference was detected between the <6-month and the adjacent 30-month FMU in use by total wildlife P = 0.52), white-tailed deer (P = 0.43), Florida panther (P=0.23), or wild turkey P = 0.14), although data suggested that wild turkey may have preferred the newly burned area. More importantly, our data suggested that wildlife did not avoid pine flatwoods habitat at up to 30-month post-fire recovery. Wildlife use of pine flatwoods habitat, therefore, was observed to increase in areas recently burned (<6 months post-fire), was similar between FMUs with post-fire recovery of <6 and up to 30 months, and was lowest in habitat that had not been burned for 48 months. Maintaining a prescribed-fire rotation of less than or equal to 48 months, therefore, appears to improve habitat quality of pine flatwoods for white-tailed deer, wild turkey, and other wildlife in southwest Florida.

Shivik, JA, Gruver, KS. 2002. Animal attendance at coyote trap sites in Texas. WILDLIFE SOCIETY BULLETIN 30(2):502-507.

There is a need to develop alternative selective capture systems for coyotes (*Canis latrans*) and to generate information on the quantity and identity of species that visit locations where coyote traps are set. We used 24-hour video surveillance equipment to monitor coyote trap locations. We observed 564 visits by 20 vertebrate species during 2,822 hours of observation in 144 trap nights at 31 locations. Species other than coyotes were >16 times as likely to enter the area of observation (the trap area), but did not enter the area immediately proximal to the trap (the trap site) as frequently as coyotes. Current trap and lure systems may be more selective than published reports indicate because of the relatively higher abundance and activity of other species in areas where coyote traps are set. Coyotes and noncoyote species visited at different times of day; in the future, diurnally inactivated capture systems could mechanically exclude most noncoyote species and further increase capture-device selectivity.

Yasuda, M, Kawakami, K. 2002. New method of monitoring remote wildlife via the Internet. ECOLOGICAL RESEARCH 17(1):119-124.

A new system of monitoring remote wildlife via the Internet was developed. The system consists of a QuickTime streaming server with a digital PC camera and a recipient computer with monitoring software. Results of field experiments were fine. Wildlife (raccoon dogs and feral cats) inhabiting a forest remote from the observer were monitored and photographed automatically when detected. Data and frame rates were 35-300 kilobits per second and 3-14 frames per second, respectively, depending on the network traffic. This system is applicable wherever a broadband network is available and thus has great potential for ecological research.

2001

Bayrakci, R, Carey, AB, Wilson, TM. 2001. Current status of the western gray squirrel population in the Puget Trough, Washington. NORTHWEST SCIENCE 75(4):333-341.

The Puget Trough population of Washington's state-threatened western gray squirrel is centered in Oregon white oak ecotones adjacent to conifer forests and prairies on the Fort Lewis Military Reservation. Our goal was to determine the current status of western gray squirrels in this region. In 1998, we found five western gray squirrels in 538 hours of foot surveys in 133 oak sites. In 1999, we expanded our survey effort and included surveys on foot, surveys with simulated squirrel calls, Eve trapping, and bait stations with motion-sensitive cameras. No western gray squirrels were detected in any oak sites in 1999. One western gray squirrel was photographed in a ponderosa pine stand adjacent to oaks. The western gray squirrel population on Fort Lewis appears to have declined severely since low population numbers were reported in 1992-1993. Our ability to formulate mutually exclusive hypotheses underlying the decline of the western gray squirrel on Fort Lewis is limited by our lack of understanding of how these squirrels persist in highly-fragmented oak ecotones. Without intervention, however, the continued existence of this species in the Puget Trough may be doubtful.

Carbone, C, Christie, S, Conforti, K, Coulson, T, Franklin, N, Ginsberg, JR, Griffiths, M, Holden, J, Kawanishi, K, Kinnaird, M, Laidlaw, R, Lynam, A, Macdonald, DW, Martyr, D, McDougal, C, Nath, L, O'Brien, T, Seidensticker, J, Smith, DJL, Sunquist, M, Tilson, R, Shahruddin, WNW. 2001. The use of photographic rates to estimate densities of tigers and other cryptic mammals. ANIMAL CONSERVATION 4:75-79.

The monitoring and management of species depends on reliable population estimates, and this can be both difficult and very costly for cryptic large vertebrates that live in forested habitats. Recently developed camera trapping techniques have already been shown to be an effective means of making mark-recapture estimates of individually identifiable animals (e.g. tigers). Camera traps also provide a new method for surveying animal abundance. Through computer simulations, and an analysis of the rates of camera trap capture from 19 studies of tigers across the species' range, we show that the number of camera days/tiger photograph correlates with independent estimates of tiger density. This statistic does not rely on individual identity and is particularly useful for estimating the population density of species that are not individually identifiable. Finally, we used the comparison between observed trapping rates and the computer simulations to estimate the minimum effort required to determine that tigers or other species, do not exist in an area, a measure that is critical for conservation planning.

Lomolino, MV, Perault, DR. 2001. Island biogeography and landscape ecology of mammals inhabiting fragmented, temperate rain forests. GLOBAL ECOLOGY AND BIOGEOGRAPHY 10(2):113-132.

1 We expanded the island biogeography paradigm to test whether mammalian communities of the heavily fragmented temperate rain forests of the Olympic Peninsula were influenced by local environmental conditions, biogeographic factors (fragment area and isolation) and characteristics of the surrounding landscape.

2 We used live-trapping, sign surveys and infrared triggered cameras to compare distributions of non-volant mammals among fragments and between fragments and other principal landscape components (continuous old-growth, riparian corridors, second-growth forest and clearcuts).

3 Of the 24 species of non-volant mammals detected during our studies, 18 occurred in at least one fragment.

4 Species richness of old-growth was not significantly correlated with fragment area or isolation, per se, but was significantly and positively correlated with the amount of old-growth fragments and old second-growth (41-159 years) in the surrounding landscape ($r^{(2)}$ = 0.95, P < 0.005).

5 Distributions of three old-growth dependent species [shrew-mole (*Neurotrichus gibbsii*), Douglas squirrel (*Tamiasciurus douglasii*) and Trowbridge shew (*Sorex trowbridgii*)] were significantly associated with local environmental conditions within the fragment, with geographical isolation from continuous old-growth and riparian corridors, and with the amount of old-growth and old second growth in the adjacent matrix.

Zielinski, WJ, Slauson, KM, Carroll, CR, Kent, CJ, Kudrna, DG. 2001. Status of American martens in coastal forests of the Pacific states. JOURNAL OF MAMMALOGY 82(2):478-490.

American martens (*Martes americana*) are associated strongly with mature conifer forests and once occurred throughout the mountains of the coastal Pacific states. We sought to document the distribution of martens in this region using historical records and to understand recent change in their distribution. We described the distribution of martens from 1900 to 1949 using museum and trapping records and compared it to recent (1989-1998) detections at camera and track-plate stations. Martens were detected at only 12 of the 237 (5.1%) survey sample units in coastal California, Oregon, and Washington. Martens are absent from most of the historical range of the Humboldt marten (*M. a. humboldtensis*) in California and also may have declined on the Olympic Peninsula of Washington. Few data exist from northwestern Oregon and southwestern Washington, but the limited amount of protected public land and absence of reported road kills are reasons for concern fur populations in this region. Martens still occur in the central and southern coastal mountains of Oregon. Our results suggest that conservation of martens in coastal forests will require new initiatives to protect existing populations and new efforts to document all populations of martens in this region. Conservation measures should include a reevaluation

of timber harvest plans that affect habitat in coastal forests, interagency cooperation on a coastal marten conservation assessment, and the collection of new survey information, especially on private lands in southwestern Washington and northwestern Oregon.

2000

Cooper, SM, Ginnett, TF. 2000. Potential effects of supplemental feeding of deer on nest predation. WILDLIFE SOCIETY BULLETIN 28(3):660-666.

Supplemental feeding of white-tailed deer (*Odocoileus virginianus*) has become an increasingly popular management activity, particularly on private lands. Raccoons (*Procyon lotor*) and other small carnivores are very attracted to deer feeders and are potential predators of ground-nesting birds such as wild turkeys. We tested the hypothesis that predation on artificial ground nests was greater near deer feeders due to the increased presence of nest predators. We selected 2 ponds and 2 artificial water sources (windmills with troughs) on the basis of habitat similarity. We provided supplemental food in the form of shelled corn at one of each of the pond and windmill sites during 1997, 1998, and 1999. At each site we placed 50 artificial nests (3 chicken eggs) along a 800- x 40-m transect centered on the water source. We monitored the fate of these nests over 28 days. We identified nest predators through patterns of eggshell breakage, hair traps, and automatic cameras. We analyzed nest survival using a logit model and by Kaplan-Meier survival analysis. Raccoons and striped skunks (*Mephitis mephitis*) were the most common predators of the artificial nests. In years with adequate ground cover to conceal the nests, presence of supplemental deer feeders at the site significantly decreased survivorship of the artificial nests. In dry years with sparse ground cover, nest survivorship was extremely poor at all sites. The lack of cover for the nests outweighed any deleterious effects of the deer feeders. Previous studies have suggested that supplementing predators may be a way to reduce nest predation; our results suggest the contrary. We suggest that managers concerned with production of wild turkeys (*Meleagris gallopavo*) and other ground-nesting birds should avoid placing deer feeders in nesting habitat or avoid supplemental feeding during the nesting season.

Dilks, P, Lawrence, B. 2000. The use of poison eggs for the control of stoats. NEW ZEALAND JOURNAL OF ZOOLOGY 27(3):173-182.

Stoats (*Mustela erminea*) are an important predator of many forest bird species in New Zealand, and more effective methods for their control are being sought. Stoat control using Fenn traps has been shown to prevent predation on mohua (*Mohoua ochrocephala*), but this technique is labour-intensive and costly to use for protection of large areas of habitat. We evaluated 1080 delivered in eggs as a poison for control of stoats. The lethal dose has been determined by captive and field trials, but attempts to implement a large-scale control operation have given inconclusive results. To clarify the effectiveness of 1080 eggs as a control technique, we carried out further field trials with radio-tagged stoats in the Makarora Valley. Twenty animals were monitored by radio tracking, and data loggers and video cameras recorded their visits to bait stations. The precise time an individual stoat ate a poison egg could be determined from data logger and video information, and its fate was followed. Sixteen of twenty stoats were killed by 1080 eggs, three died of other causes and one remained alive at the end of the trials.

Shivik, JA, Bourassa, J, Donnigan, SN. 2000. Elicitation of brown treesnake predatory behavior using polymodal stimuli. JOURNAL OF WILDLIFE MANAGEMENT 64(4):969-975.

The brown treesnake (*Boiga irregularis*) is a species of special management concern, requiring improvement of capture methods through the development of effective artificial lures. Toward this end, we used night-vision cameras and mechanical models to study the interplay of sensory modalities for stimulating predatory behavior in brown treesnakes. Snakes oriented toward live mouse (*Mus musculus*) lures in complete darkness as much as they did to live mice lures under visible-light illumination; however, brown treesnakes in an unlighted environment responded qualitatively

differently by probing and biting at the lure holder rather than striking at the mouse within las did snakes in lighted trials). We altered the odors and vibratory cues of mechanical models to partition attractive stimuli and to measure snake response to vibratory cues. Fur-covered odorized (by rubbing with freshly defrosted dead neonatal mouse) models were more attractive than fur-covered non-odorized models, odor alone, and empty lure holders. Brown treesnake response to live mice did not differ from their response to smooth, odorized models, and moving versions of the smooth, odorized models stimulated more predatory behavior than unmoving models. Response from brown treesnakes appears to increase as odor and mechanical vibration stimuli are increased quantitatively and-or qualitatively Conceptually, we hypothesize that polymodal stimuli synergize to promote predatory behavior in foraging snakes and that for trapping purposes, a multi-sensory attractant, optimized at each modality will be required to achieve capture success similar to or better than that obtained using live mice lures.

1999

Howald, GR, Mineau, P, Elliott, JE, Cheng, KM. 1999. Brodifacoum poisoning of avian scavengers during rat control on a seabird colony. ECOTOXICOLOGY 8(6):431-447.

Langara Island, at the north-western tip of British Columbia's Queen Charlotte archipelago, was once nesting grounds for an estimated 500,000 seabirds. However, infestations of Norway rats (*Rattus norvegicus*) and their predation of eggs and breeding adults have caused extirpation or serious declines of all seabird species. By 1993, the breeding population of ancient murrelets (*Synthliboramphus antiquus*) had declined to 10% of its historical size. Successful eradication of rats on smaller New Zealand islands using the anticoagulant brodifacoum prompted its application on Langara Island. The island is also home to breeding bald eagles (*Haliaeetus leucocephalus*), peregrine falcons (*Falco peregrinus*), and other wildlife. No comprehensive studies of non-target impacts and potential for secondary poisoning were done during similar operations elsewhere; thus, in 1994 and 1995 we initiated a two-year study into the risk of secondary poisoning to non-target species. During 1994, rat carcasses were laid out with motion sensor cameras to identify potential scavengers. Ravens, northwestern crows and bald eagles were photographed at carcasses, and therefore at risk of feeding on rats that die above ground. During the baiting program, 19 rats were radio-tagged to determine the proportion dying above ground, and thus available to predators/scavengers. Ravens were found poisoned both from feeding directly on the bait, and predating/scavenging poisoned rats. Bald eagles were trapped and blood sampled for brodifacoum residue analysis and prothrombin time evaluation; 15% of the sampled population showed detectable residues but no adversely-affected birds were found. We conclude that the use of brodifacoum for rat removal on seabird islands poses a clear risk of secondary poisoning to avian scavengers. This risk must be weighed against the benefit of rat removal programs.

1998

Hicks, NG, Menzel, MA, Laerm, J. 1998. Bias in the determination of temporal activity patterns of syntopic *Peromyscus* in the southern Appalachians. JOURNAL OF MAMMALOGY 79(3):1016-1020.

We compared inferred activity patterns of two syntopic rodents, *Peromyscus leucopus* and *P. maniculatus*, in western North Carolina. Activity patterns were derived from capture-frequency data obtained from Sherman Live-traps equipped with digital timers following different trapping protocols. We tested the hypothesis that no differences would be observed in frequency distribution of captures from trapping grids monitored only in the morning (control) compared with grids where captured animals were released during the night and in the morning (treatment). Distributions of frequencies of captures on control and treatment grids were significantly different. On control grids, capture frequencies (based on 3-h intervals) of both species were higher in the first 3 h after sunset and decreased thereafter throughout the night, but frequencies of captures of both species were uniform throughout the night on treatment grids. Photographic records from automated cameras suggested increasing levels of activity throughout the night. Activity patterns derived from camera data were different from those derived from the control and treatment grids. Inferences regarding activity patterns are sensitive to method and trapping-protocol bias.

Jones, EG, Collins, MA, Bagley, PM, Addison, S, Priede, IG. 1998. The fate of cetacean carcasses in the deep sea: observations on consumption rates and succession of scavenging species in the abyssal north-east Atlantic Ocean. PROCEEDINGS OF THE ROYAL SOCIETY B-BIOLOGICAL SCIENCES 265(1401):1119-1127.

The fate of cetacean carcasses in the deep sea was investigated using autonomous deep-sea lander vehicles incorporating time-lapse camera systems, fish and amphipod traps. Three lander deployments placed cetacean carcasses at depths of 4000-4800 m in the north-east Atlantic for periods of 36 h, 152 h and 276 h before being recovered. The photographic sequences revealed that carcasses were rapidly consumed by fish and invertebrate scavengers with removal rates ranging from 0.05-0.4 kg h^{-1}. In the longest experiment the carcass was skeletonized within five days. In each deployment, approximately an hour after emplacement, the grenadier *Coryphaenoides* (*Nematonurus*) *armatus* and large numbers of lysianassid amphipods had arrived at the food-fall. The initially high numbers of grenadiers declined once the majority of the bait had been consumed and a variety of other fish and invertebrates were then observed, some taking up residence at the site. None of the fish species appeared to consume the carcass directly, but preyed upon amphipods instead. Funnel traps recovered with the carcass indicated a succession in the species composition of amphipods, with the specialist necrophages such as Paralicella spp. being replaced by more generalist feeders of the Orchomene species complex.

Karanth, KU, Nichols, JD. 1998. Estimation of tiger densities in India using photographic captures and recaptures. ECOLOGY 79(8):2852-2862.

The tiger (*Panthera tigris*) is an endangered, large felid whose demographic status is poorly known across its distributional range in Asia. Previously applied methods for estimating tiger abundance, using total counts based on tracks, have proved unreliable. Lack of reliable data on tiger densities not only has constrained our ability to understand the ecological factors shaping communities of large, solitary felids, but also has undermined the effective conservation of these animals. In this paper, we describe the use of a field method proposed by Karanth (1995), which combines camera-trap photography, to identify individual tigers, with theoretically well-founded capture-recapture models. We developed a sampling design for camera-trapping and used the approach to estimate tiger population size and

density in four representative tiger habitats indifferent parts of India. The field method worked well and provided data suitable for analysis using closed capture-recapture models. The results suggest the potential for applying this methodology to rigorously estimate abundances, survival rates, and other population parameters for tigers and other low-density, secretive animal species in which individuals can be identified based on natural markings. Estimated probabilities of photo-capturing tigers present in the study sites ranged from 0.75 to 1.00. Estimated densities of tigers > 1 yr old ranged from 4.1 ± 1.31 to 16.8 ± 2.96 tigers/100 KM^2 (mean ± 1 se). Simultaneously, we used line-transect sampling to determine that mean densities of principal tiger prey at these sites ranged from 56.1 to 63.8 ungulates/KM^2. Tiger densities appear to be positively associated with prey densities, except at one site influenced by tiger poaching. Our results generally support the prediction that relative abundances of large felid species may be governed primarily by the abundance and structure of their prey communities.

1997

Bayne, EM, Hobson, KA. 1997. Comparing the effects of landscape fragmentation by forestry and agriculture on predation of artificial nests. CONSERVATION BIOLOGY 11(6):1418-1429.

Fragmentation of forested landscapes can reduce the reproductive success of birds occupying residual forest patches. Previous studies, however, have focused primarily on how nest predation can change when landscapes become fragmented by agriculture rather than by logging. To determine if predation on artificial nests in forest patches was influenced by the surrounding landscape, we placed ground and shrub ness along the edge and interior of forest patches located in agricultural, logged, and contiguous forest landscapes within a single region of the southern boreal mixedwood forest of central Canada. Nest predators were identified using remotely triggered cameras and by marks left in plasticine eggs, whereas the relative abundance of nest predators such as corvids and small mammals was estimated by surveys and live-trapping. The percentage of ground nests destroyed at the edge and interior of patches in the logged and contiguous forest landscapes was significantly lower than the edge or interior of patches in the agricultural landscape. No differences in predation rate were observed for shrub nests among landscapes. We attributed higher rates of predation in the agricultural landscape to higher densities of red squirrels (*Tamiasciurus hudsonicus*) in the interior and a greater diversity of predators along edges. The similarity in predation rate between logged and contiguous forest landscape suggest that fragmentation caused by logging may result in little change in predator communities and in this respect, might be similar to fragmentation caused by natural disturbance regimes such as fire. In contrast, fragmentation by agriculture seems to have more serious consequences for nesting birds. Policy changes that limit the growth of agriculture in the southern boreal mixedwood forest are required to conserve the diverse avifauna of this region.

Ramsay, K, Kaiser, MJ, Moore, PG, Hughes, RN. 1997. Consumption of fisheries discards by benthic scavengers: utilization of energy subsidies in different marine habitats. JOURNAL OF ANIMAL ECOLOGY 66(6):884-896.

1. Man has increased the input of carrion to marine communities worldwide through the practice of discarding fisheries-derived material. A large proportion of discarded material sinks to the sea bed and becomes available to benthic scavengers. Carrion from fisheries discards will subsidize marine food webs, which can sometimes result in the enhancement of consumer populations.

2. This study examines the benthic scavengers that feed on fisheries discards in three habitats in the Irish Sea. We investigated the relationship between the abundance of scavengers feeding on carrion in terms of numbers of each species and the density of those scavenger species in the surrounding area.

3. Observations with bailed time-lapse cameras at a site offshore From Anglesey showed that the hermit crab Pagurus bernhardus was attracted to carrion in greatest abundance and aggregated at densities of up to 330 m^{-2}. At Red Wharf Bag, a wider range of species was observed: starfish *Asterias rubens*, hermit crabs *P. bernhardus*, whelks *Buccinum undatum* and swimming crabs *Liocarcinus spp*. There was relatively little scavenging activity at the Walney Island site where the edible crab Cancer pagurus appeared to consume the greatest proportion of the carrion.

4. Numbers of each scavenger species at the bait were only partially related to the background population density of each species at each site. The rate of consumption of carrion varied between sites and could be related to the abundance of different scavenger species at the bait.

5. Baited traps were used to investigate those benthic scavengers that were too small to be observed by time-lapse photography. The traps caught a variety of amphipod and isopod species. Some species were habitat-

specific, whereas others were ubiquitous, but specialized in eating a particular type of carrion; for example, *Orchomene nanus*, which was only caught in traps baited with crab.

6. The results demonstrated that the responses of scavengers to fisheries discards varied between different habitats. The responses of hermit crabs, *P. bernhardus*, were particularly variable, with large aggregations of individuals occurring at one site but not at others, despite similar background population densities.

1996

Kaiser, MJ, Bullimore, B, Newman, P, Lock, K, Gilbert, S. 1996. Catches in 'ghost fishing'' set nets. MARINE ECOLOGY PROGRESS SERIES 145(1-3):11-16.

Both trammel and gill nets are used to catch marine fishes and crustaceans around the British Isles. Their use is controversial in areas where there is a risk of incidental catches of seabirds or marine mammals. An additional concern is the fate and fishing capabilities of nets when they are lost either as a result of bad weather or when they are damaged by mobile fishing gear. Few, if any, studies have ascertained for how long or effectively these lost nets continue to fish, more commonly termed 'ghost fishing'. Two types of fixed gear, a gill and trammel net, were set by a commercial fisherman ca 1000 m offshore from a rocky coastal area in southwest Wales, UK. One end of each net was cut free to simulate net loss. The nets were then allowed to fish continually for 9 mo, during which time they were surveyed by divers recording catches by direct observation, still photography and video camera survey. Several hours after both nets had been set, a large number of dogfishes were caught, causing the nets to collapse. Within 1 d, 2 commercial crustacean species, spider crabs *Maja squinado* and brown crabs *Cancer pagurus*, were attracted to the dead and decomposing fishes. Many of these animals also became trapped in the netting and were fed upon by their conspecifics and other scavengers. Some of these crustaceans also became entangled and died, producing a sequence of captures throughout the observation period. Catch rate began to decline within a few days of the initial deployment, probably related to a decline in the effective fishing area. The results indicate that lost nets could continue to catch commercial crustacean species for at least 9 mo after initial loss.

van Schaik, CP, Griffiths, M. 1996. Activity periods of Indonesian rain forest mammals. BIOTROPICA 28(1):105-112

Activity periods of rain forest animals, especially those with flexible activity periods, are poorly known. We used camera trapping to describe the activity periods of at least partly terrestrial wildlife in 2 Sumatran and 1 Javan rain forest sites. We used these data and a comparison with the literature to classify all mammalian taxa occurring in the study areas as either diurnal, nocturnal, or cathemeral (potentially active during both day and night). Exploratory analyses revealed that body size and substrate are the major correlates of activity period, with diet and travel mode playing minor roles. We explain the substrate effect by noting thar vision-related constraints force diurnal mammals in an arboreal environment to stay diurnal regardless of conditions, and that nocturnal mammals are kept from becoming diurnal by predation risk by visually hunting diurnal predators. To explain why the largest animals are cathemeral we suggest that they require more time to forage than is provided by the roughly 12-hour diurnal or nocturnal period.

1995

Cucco, M, Malacarne, G. 1995. Increase of parental effort in experimentally enlarged broods of pallid-swifts. CANADIAN JOURNAL OF ZOOLOGY 73(8):1387-1395

Variation in parental effort of Pallid Swifts (*Apus pallidus*) was investigated for 3 years in a colony in northwestern Italy. The masses of adults and of bolus loads brought to chicks were monitored by electronic balances inserted under nests, and feeding rates were monitored by video cameras. Fluctuations in daily food availability were measured with an insect-suction trap. Manipulation experiments on broods originally consisting of three chicks were performed to increase (four chicks) or reduce (two chicks) adult effort, with the aim of determining if parents tend to allocate food primarily to themselves or to their offspring, and if mass loss in adults results from reproductive stress or from adaptive programmed anorexia. With the enlargement of brood size, mean bolus mass remained constant, but the visitation rate increased significantly. Daily food abundance did not influence the amount of food allocated to chicks (neither time spent foraging nor the bolus mass changed), but positively influenced the mass of adults, which showed large daily variations. These results indicate that parents tend to invest constantly in offspring, at their own expense when food is scarce. Our data lend support to the cost of reproduction hypothesis instead of adaptive anorexia, since adults lose mass mainly in the brooding period, when demand is highest, and always regain mass when prey availability is greater.

Karanth, KU. 1995. Estimating tiger *Panthera tigris* populations from camera-trap data using capture-recapture models. BIOLOGICAL CONSERVATION 71(3):333-338

The applicability of capture-recapture models for estimating tiger *Panthera tigris* numbers from camera-trap data was investigated in a part of Nagarahole National Park, India during 12 months (387 trap-nights) in 1991-92. Camera-traps were placed along regular travel routes of tigers to obtain 31 photographic 'captures' of individual tigers in a 15 km2 study area, during nine sampling occasions. Tigers could be identified unambiguously from photographs, and capture histories of 10 different animals were obtained. The data were analysed in the conceptual framework of capture-recapture theory, using probabilistic models. The results suggest that the closed capture-recapture model M(h) which allows for heterogeneity of capture probabilities among individual animals was appropriate for estimating tiger population size. The mean tiger numbers and their 95% confidence intervals were estimated at 11 (10-22) and 10 (10-15), respectively, with the M(h) (Jackknife) and M(h) (Chao) estimators. Considering the prey biomass available in the study area, the mean tiger densities of 13.3-14.7 adult/subadult tigers per 100 km^2 estimated from the above data appear to be reasonable. Capture-recapture models using comera-trap data offer scope for estimating objectively parameters such as size, density, survival, and recruitment for populations of tigers and other secretive animal species.

1991

Breininger, DR, Schmalzer, PA, Hinkle, CR. 1991. Estimating occupancy of gopher tortoise (*Gopherus polyphemus*) burrows in coastal scrub and slash pine flatlandsd. JOURNAL OF HERPETOLOGY 25(3):317-321.

One hundred twelve plots were established in coastal scrub and slash pine flatwoods habitats on the John F. Kennedy Space Center (KSC) to evaluate relationships between the number of burrows and gopher tortoise (*Gopherus polyphemus*) density. All burrows were located within these plots and were classified according to tortoise activity. Depending on season, bucket trapping, a stick method, a gopher tortoise pulling device, and a camera system were used to estimate tortoise occupancy. Correction factors (% of burrows occupied) were calculated by season and habitat type. Our data suggest that < 20% of the active and inactive burrows combined were occupied during seasons when gopher tortoises were active. Correction factors were higher in poorly-drained areas and lower in well-drained areas during the winter, when gopher tortoise activity was low. Correction factors differed from studies elsewhere, indicating that population estimates require correction factors specific to the site and season to accurately estimate population size.