A NATIONAL TIGER ACTION PLAN FOR THE UNION OF MYANMAR

Myanmar Forest Department,
Ministry of Forestry, Myanmar

Wildlife Conservation Society,
International Program

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A National Tiger Action Plan

For

The Union of Myanmar

Prepared by

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Cover illustration: Tiger (*Panthera tigris*) recorded by camera-trap from Thayet Chaung Township, Dawei District, Taninthayi Division.

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PREFACE

The Tiger represents many things to Myanmar people and to the Union of Myanmar and it's natural wilderness. It is a national symbol for the country, a flagship for conservation, an indicator of intact and healthy forest ecosystems, and a keystone species upon which other biodiversity and the forest itself are dependent. Despite their importance, the status of Myanmar's tiger population was uncertain for many years due to poaching for the trade in Traditional Chinese Medicine (TCM), hunting of their prey species, and forest clearance to meet human needs at the expense of wildlife. In the absence of detailed knowledge about where tigers live and how they are threatened in those places, plans to conserve the species were thwarted.

In 1999, the Myanmar Forest Department commissioned a study to determine the current status and distribution of tigers, and formulate an updated national strategy for their future management and conservation. This document "*A National Tiger Action Plan for the Union of Myanmar*" is the end product of a three-year program conducted jointly by the Myanmar Forest Department and the Wildlife Conservation Society with funding from the US National Fish and Wildlife Foundation and ExxonMobile's "Save The Tiger Fund". I am pleased to say that the program has gone well beyond my expectations. The Plan details what is needed to save Myanmar's tigers from extinction and so provides a valuable prospectus for future conservation. It will become a part of the Myanmar forest policy for recovery of the species.

U Shwe Kyaw
Director-General
Forest Department
Ministry of Forestry

FOREWORD

It is with great pleasure that I introduce the National Tiger Action Plan to the government and the people of Myanmar. Upon first arriving in Myanmar in 1993, I remember how surprised I was by the intense feeling of "rightness" that overcame me. Having worked more than a decade in other parts of Asia I was feeling despair over the future of conservation in the region. I had grown tired of grappling with issues that never got resolved, despite my best efforts, and I was losing faith in the ability of people to realize how important wildlife and wild lands were to the quality and integrity of their lives. It seemed impossible to me at the time that any place I chose to work again would be different. But I was wrong. Myanmar was different.

I had first become interested in Myanmar because of its potential as one of the world's last strongholds for large mammal species such as tigers, clouded leopards, and Asian elephants. And I hungered to go into the hinterlands of a country that contained the world's last great stands of teak trees, rugged, unexplored mountain ranges, and a diversity of wildlife almost unparalleled in the Asia-Pacific region. But what I had never anticipated was the intelligence, kindness, integrity, and diversity of the Myanmar people, and how seriously the Myanmar Forest Department and the Wildlife Division took their mandate to protect and conserve the country's remaining forests and wildlife.

I am pleased to have had the opportunity for the last ten years to work with staff of the Myanmar Forest Department. I feel honoured to have played a role in helping survey and designate some of the country's and the region's finest protected areas, such as Hkakabo Razi National Park and Hukaung Wildlife Sanctuary. But our work is only beginning. I was saddened to learn the results of the tiger surveys that were carried out by WCS and the Myanmar Forest Department. Yet I was heartened by the fact that there were still places of intact habitat where tigers and other wildlife had a chance for the future if proper actions were taken.

This National Tiger Action Plan compiled by Dr. Antony Lynam and the Myanmar Forest Department is a landmark document. Nothing of this magnitude has been compiled for any country where tigers still roam. But this document should not simply be viewed as a finished product to be placed on a shelf. It is a realistic plan of action that, if followed, could bring the tiger, a national treasure, back to Myanmar in numbers that will guarantee their future in the region for many generations to come. I am optimistic that the government and the people of Myanmar will do what needs to be done to save the tiger and the other spectacular wildlife species that wander their forests. And I hope that I and other WCS scientists will continue to have the opportunity to assist in any way possible towards this end.

I was correct about the feeling of "rightness" when I came to Myanmar in 1993. I hope I am also correct that in the years to come, Myanmar will point to its forests and wildlife with pride, and they will be held up as an example to other countries of what is possible when one cares about its natural heritage.

Alan Rabinowitz Ph.D
Director, Science and Exploration Program
Wildlife Conservation Society

A GUIDE TO USING THIS DOCUMENT

This document is divided into three sections. An executive summary of findings and general recommendations and a National Action Plan with specific recommendations, a schedule for the implementation of these actions, and responsible agencies is provided in pages VII-X. This is **minimum reading** for decision makers. For readers with some time to appreciate the background and rationale for these actions, PARTS 1-5 of this document (pages 1-12) is **essential reading**. PART 6 (pages 23-35) provides details of the field program that was mounted to acquire the information that provides the foundation for the Action Plan, and is **optional reading**.

EXECUTIVE SUMMARY OF FINDINGS AND RECOMMENDATIONS

Background

1. A hundred years ago the tiger (*Panthera tigris*) occurred across Asia from eastern Turkey to the Russian Far East and south to the Indonesian archipelago. Myanmar is one of fourteen countries in Mainland Asia where tigers persist today.

2. Reports and anecdotal information from surveyors, hunters, foresters, consultants and researchers attest to the former widespread occurrence of tigers in Myanmar, except in higher elevation areas in the north. That tigers existed over wide areas in the past was partly due to the existence of large expanses of intact habitat where human population density was low and disturbance to tigers and their prey was minimal.

3. Recent attempts to quantify Myanmar's tiger population were hampered because while rapid assessments for wildlife had been made in many areas, standardized survey methodologies for tigers were not yet available.

4. While tiger status remained uncertain, the trends for tigers and their habit ts are well understood. Widespread loss of habitat with changing landuse patterns, and the uncontrolled hunting of tiger prey, along with sport hunting, and commercial hunting for tigers spurned by a recent demand for traditional medicines in Asia led to the demise of tigers in the past. By the early part of the 20th Century thousands of tigers had been reported killed in Myanmar.

5. Myanmar lost 25% of its for est cover, potential habitat for tigers and other wildlife between the 1940's and 2000 (FAO, 2000). By 2002, 4.73% (31,792 km^2) of the country was either formally protected or proposed for protection. Tigers require large areas of contiguous habitat, usually 3,000 – 15,000 km^2 in size for long-term survival. While forest areas of this size exist in the country only three areas are currently protected. Nearly 80% of the protected areas are less than 1,000 km^2, with 10 areas less than 100 km^2.

Summary of activity and main findings

1. As a first step towards long-term future planning for tigers in Myanmar, and to guide efforts to identify new areas for protection, a project to develop an updated National Tiger Action Plan was initiated in 1998. The primary objective of the program was to determine tiger occurrence via direct field survey across potential tiger habitats, and use this information to select areas for special protection for tigers.

2. Tigers may serve as conservation "umbrellas". This is the concept that protecting places with tigers effects the conservation of other wildlife and biodiversity elements with smaller ranges.

3. The Myanmar Forest Department and the Wildlife Conservation Society initiated the program with financial support from the "Save The Tiger Fund," a joint project of the US National Fish and Wildlife Foundation and ExxonMobile Corporation.

4. A tiger conservation and survey techniques training workshop was conducted for Forest Department and NGO junior staff at Alaungdaw Kathapa National Park, historically known for its tigers. From the training, a team of seven participants was recruited to carry out field surveys, and conduct awareness work in communities adjacent to survey areas.

5. Using the results of a previous planning analysis for tigers, and updated maps of forest cover, a set of 17 potential tigers areas were identified from large blocks of forest.

6. Interviews of local people were done to determine likely places where tigers existed in these forest complexes and guide the selection of survey locations.

7. Using a field technique first developed in India, and modified for use in Southeast Asia, a team of trained staff conducted presence-absence surveys for tigers at each site. A field survey effort during 1999-2002 involving >15,000 nights with camera-traps, and >1,300 hours of sign searching across 5,500 km^2 of potential tiger habitat revealed the following results:

- Tiger occurred in less than a quarter of the potential areas;
- Based on the results of field surveys, tigers have disappeared from five areas surveyed; Alaungdaw Kathapa, Thaungdut, Mahamyaing, Nankamu, Panlaung-Pyadalin:
- Based on the results of field surveys, tigers have disappeared or occur at very low density in eight of the areas surveyed; Paletwa and Kaladan river catchment area, Sumprabum, Khaunglanphu, Paunglaung, Momeik-Mabain, Central Bago Yoma, Rakhine Elephant Range, Saramati Taung and adjacent areas;
- Based on reports from forestry officials, tigers may occur at low density in two other areas that were not surveyed; Shan Yoma (Kayah-Kayin) and S. Kachin:
- Based on the results of field surveys, tiger occur in Htamanthi Wildlife Sanctuary, Sagaing Division and surrounding areas. The population is small (<10 individuals) and is threatened with extinction:
- Based on the results of field surveys, tigers occur in a large intact forest landscape comprising Hukaung Valley and surrounding areas, in Kachin State. Moderate numbers (<50) of tigers are thought to exist there:
- Based on the results of field surveys, tigers occur in a large intact forest landscape in northern and southern Taninthayi Division. A relatively large (>50) population is thought to exist there. Together these areas represent the largest, intact habitats for tigers in Mainland Southeast Asia:
- In all areas where they persist in Myanmar tigers are threatened by poaching for commercial international trade, and poaching of prey for local consumption and local trade:

8. Based on information collected during the field survey program, probably no more than 150 tigers now exist in the wild in Myanmar and the population is rapidly declining. The Tiger might soon be on the verge of extinction in Myanmar if action is not taken immediately.

Recommendations for addressing conservation needs of tigers

1. Although the situation is critical, tiger populations may potentially be recovered if the Government makes an immediate and long-term plan of action.

2. The priority actions necessary in the short-term (2-5 years) for saving tigers are;

- Establish protected areas, protected corridors and priority management areas in and around the Hukaung Valley, and in Taninthayi Division to protect wild tigers and their habitat;
- Establish monitoring programs for tiger and prey population in these places to assess the effectiveness of conservation efforts;
- Reduce killing of tiger prey species and trade that has developed around those species. Train government staff in anti-poaching and anti-trafficking techniques and develop systems for patrolling these areas to ensure the preservation of these resources;
- Suppress all killing of tigers and the illegal trade in tiger products. Amend existing wildlife legislation to fall in line with international laws. Conduct wildlife conservation and awareness training for government personnel and recruit them to help identify and suppress wildlife trade;
- Define roles and responsibilities of field staff responsible for tiger conservation;

3. The priority actions necessary for saving tigers in the long-term (6-20 years) are;

- Improve public awareness and develop education curricula concerning the importance of tiger conservation to increase support from local people;
- Stop further loss of tiger habitat and restore degraded habitat by practising sustainable forest management;
- To conduct zoning of forest areas so as to avoid development and human intrusions inside tiger critical habitats;
- Strengthen international cooperation to maintain connectivity of tiger habitat across international boundaries possibly through the establishment of cooperative management of contiguous protected areas along borders.

TABLE 1: NATIONAL TIGER ACTION PLAN FOR MYANMAR

Action	Organisation delivering		Timeframe / to be completed by				
	Lead	Other possible relevant partners	2003	2004	2005	2006	2007
1. Suppressing all killing of tigers and the illegal trade in tiger products							
a) Amend the Protected Wildlife and Protected Areas Law to enable the enforcement of international laws within Myanmar. This would include articles prohibiting the sale or purchase of products suggesting or implying content of tiger bone, hair, organs, blood, teeth, claws or hide.	Myanmar Govt.		✓				
b) Impose heavy fines for offenders and use partial proceeds towards implementing international legislation.	Myanmar Govt.		✓				
c) Conduct wildlife conservation and awareness training for 100 government personnel, including military, customs, police, immigration and local administrative staff in Yangon, Mandalay, Myitkyina and other internal transit points for wildlife. This would include basic training in identifying wildlife protected by domestic and international legislation, and knowing their protection status.	Myanmar Govt. (relevant Ministries)	WCS and other NGOs	✓				
d) Conduct wildlife conservation and awareness training for all staff in tiger sites and landscapes.	Myanmar Govt. & WCS		✓				
e) Recruit local government staff to help identify tigers in trade and encourage them to report their observations to relevant authorities.	Myanmar Govt. & Mandalay, Sagaing and Taninthayi Division, Kachin and Shan States.	WCS and other NGOs	✓				
f) Create a Wildlife Investigations Unit to investigate and suppress crime against wildlife, including trade, trafficking, illegal killing and capture, habitat destruction, and other persecution. The unit will enforce domestic and international legislation. The unit would include staff of the Ministries of Home Affairs, Forestry and Tourism and would report directly to the Minister of Forestry.	Myanmar Govt.	WCS and other NGOs		✓			
g) Train and recruit government staff to join the Wildlife Investigations Unit. Form mobile units to suppress wildlife crime across the country.	Myanmar Govt.	WCS and other NGOs		✓			
2. Reducing killing of tiger prey species and associated trade.							
a) Amend the Protected Wildlife and Protected Areas Law to enable the enforcement of international laws within Myanmar. Modify Chapter V, Article 15 to recognize the international classifications of wildlife species, and their associated protection status.	Myanmar Govt.	WCS	✓				
b) With the view to protecting tiger prey species, allow the commercial farming of only selected wildlife species only in facilities designated by the Forest Department.	Myanmar Govt.		✓				
c) Take action to stop all killing of prey species at places where tigers are currently or potentially found.		WCS and other NGOs					✓
d) Train government staff at Hukaung Valley and Htamanthi, in anti-poaching and anti-trafficking techniques. Where possible involve local military personnel as instructors.	Myanmar Govt.		✓				
e) Recruit teams of EcoRangers whose sole responsibility is protection. Numbers of EcoRangers should at least 3 guards/100 km2 for effective management. Provide EcoRangers with necessary equipment, and salary incentives to motivate them to combat poaching.	Myanmar Govt.	WCS		✓			
f) Develop systematic patrolling inside all protected areas using EcoRangers. Make patrolling a mandatory management activity with a monthly schedule and budget.	Myanmar Govt.			✓			

Action	Organisation delivering		Timeframe / to be completed by				
	Lead	Other possible relevant partners	2003	2004	2005	2006	2007
g) Update the Wildlife Law to include protection for wildlife outside protected areas, and empower government staff to enforce the legislation.	Myanmar Govt.	WCS		✓			
h) Outside protected areas, study patterns of hunting and consumption of wildlife to determine its sustainability, especially for prey species.	WCS				✓		
i) In the List of Protected Animals (Ministry of Forestry, 1994), promote the following tiger prey species from Protected status to Completely Protected status; Wild buffalo (Bubalus bubalis).	Myanmar Govt.		✓				
j) In the List of Protected Animals (Ministry of Forestry, 1994), promote the following tiger prey species from Seasonally Protected status to Protected status; Hog deer (Axis porcinus) and Barking deer (Muntiacus muntjak).	Myanmar Govt.		✓				
k) Wildlife conservation and awareness training for all wildlife offenders.	Myanmar Govt.	WCS		✓			
l) Impose fines for wildlife offenders in tiger areas with proceeds towards supporting tiger conservation activities.	Myanmar Govt.			✓			
3. Improving forestry management to stop further loss of tiger habitat and to restore degraded habitat							
a) The National Code of Forest Harvest Practice involves 30 year cutting cycles, and use of elephants for removal of logs reduce environmental damage over other practices. Apply this traditional method of forest harvest effectively in all concessions in the country.	Myanmar Govt.	WCS, FAO, UNDP			✓		
b) Ban the hunting of wildlife in forest harvest areas.	Myanmar Govt.	WCS			✓		
c) Provide wildlife conservation awareness and education training to timber harvest staff.	WCS	Myanmar Govt.		✓			
d) Define Strict Conservation Zones for Hukaung Valley and Htamanthi where no human use of natural resources is allowed. Create buffer areas to allow restricted use by local people including extraction of non-timber forest products, fuel wood collection, and livestock grazing. Ban shifting cultivation and hunting of all kinds in the buffer area. Use EcoRanger patrol teams to enforce the restrictions.	Myanmar Govt.	WCS	✓				
4. Improving forestry management to reduce intrusions of local people into tiger habitat, and improve planning to avoid development in tiger critical areas							
a) Reclaim plantations and revoke all mining licences in Hukaung Valley and Htamanthi Wildlife Sanctuaries.	Myanmar Govt.						✓
b) Consider the location of government camps and permanent settlements outside of these reserves.	Myanmar Govt.						✓
c) Ban the construction of roads in protected areas and forest reserves.	Myanmar Govt.			✓			
d) Close or limit access along logging roads in Taninthayi Division to reduce the risk of collisions with tigers.	Myanmar Govt.				✓		
e) Include wildlife assessment in land development programs for Taninthayi Division.	Myanmar Govt.	WCS	✓				
f) Develop education programs to improve awareness about wildlife for local people living in and around forest reserves in Taninthayi Division.	WCS	Myanmar Govt.		✓			
5. Establishing protected areas, ecological corridors and priority management areas to protect wild tigers and their habitat							
a) Revise or create management plans for the Hukaung Valley and Htamanthi to include specific actions for conserving tigers, including recommendations in 2, 3, and 4, and below.	Myanmar Govt. & WCS		✓				

Action	Organisation delivering		Timeframe / to be completed by				
	Lead	Other possible relevant partners	2003	2004	2005	2006	2007
b) Expand Htamanthi Wildlife Sanctuary to increase its size to at least 3,000 sq. km to ensure long-term survival of tigers.	Myanmar Govt.	WCS		✓			
c) Create a dedicated tiger reserve including the Hukaung Valley and adjacent forest reserves. The reserve will serve to link tiger populations in India with those in Myanmar. Expand the eastern border of Hukaung Valley Wildlife Sanctuary to protect potential tiger habitat in the Sumprabum area.	Myanmar Govt.			✓			
d) Establish limited human use zones (buffers) that will "soften" the edges of Hukaung Valley and Htamanthi reserves reducing the risk of mortality for tigers.	Myanmar Govt.			✓			
e) Create new protected areas or special tiger management zones in the Taninthayi Division, including the Lenya River, Greater and Lesser Taninthayi River catchments. These sites will protect tigers and their habitats and allow limited human use of natural resources around the reserves in a manner complementary to tiger conservation.	Myanmar Govt.						✓
f) Use existing GIS capabilities in the FD to identify and demarcate special management zones and corridors for tigers.	Myanmar Govt. & WCS		✓				
6. Improving international cooperation and establish cooperative management of contiguous protected areas along borders to maintain connectivity of tiger habitat across international boundaries							
a) Conduct wildlife conservation and awareness training for 100 government personnel, including military, customs, police, immigration and local administrative staff, stationed near or on country borders. This would include basic training in identifying wildlife listed in the Myanmar Protection of Wildlife and Protected Areas Law 1994, and knowing their protection status.	Myanmar Govt. & WCS		✓				
b) Hold 2 internal workshops involving local government officials to discuss transborder issues including trade, trafficking and wildlife, and develop plans to suppress the trade.	Myanmar Govt.	WCS	✓				
c) Recruit local government officials on both sides of the Thailand border to suppress transborder wildlife trade at Mawdaung-Prachuap Kiri Khan, Kaleinaung-Ban I Tong, Kawthaung-Ranong (especially Tha Htay Island), Myawaddy-Mae Sot, Three Pagoda Pass, and Tachileik-Mae Sai, and prevent access by professional poachers from Thailand.	Myanmar Govt. Thailand Govt.	WCS		✓			
d) Create a tiger reserve in Taninthayi Division opposite Thailand protected areas that support large populations of tigers, Western Forest Complex and Kaeng Krachan National Park.	Myanmar Govt.			✓			
e) If possible expand the reserve or create new reserves to form a corridor between these two Thai reserves.	Myanmar Govt.						✓
f) Develop a spatially explicit tiger conservation database for the Huai Kha Khaeng - Thung Yai Naresuan TCU (Level I TCU 73).	Myanmar Govt. & WCS, Thailand Govt.	WCS			✓		
g) Where possible coordinate antipoaching patrols and/or wildlife surveys on both sides of the Thailand-Myanmar border.	Myanmar Govt.				✓		
7. Monitoring the status of the tiger and prey population to assess the effectiveness of conservation efforts.							
For Hukaung Valley landscape;							
a) Identify critical habitats and core areas for tigers and prey across the landscape.	Myanmar Govt. WCS		✓				
b) Estimate numbers of female tigers within the landscape and ascertain that there is a reproductively viable population of tigers.	Myanmar Govt. WCS		✓				

Action	Organisation delivering		Timeframe / to be completed by				
	Lead	Other possible relevant partners	2003	2004	2005	2006	2007
c) Document the current threats, demographics, and range of human activities that must be taken into account if the proposed landscape is to be successful and sustainable in the long term.	Myanmar Govt. & WCS		✓				
d) Create a GIS map and database to show current land use patterns, possible future land use trends, and tiger and prey source areas.	Myanmar Govt. & WCS		✓				
For Taninthayi Division landscape;							
e) Train local foresters how to identify tiger and prey via sign surveys, in use of camera-traps for wildlife survey, and methods for making observations and recording data.	WCS			✓			
f) Determine occupancy of habitats in accessible sites across the landscape, including Myintmoletkat and Lenya River areas, away from sites where tigers are known.	Myanmar Govt. & WCS				✓		
g) Determine prey abundance using line transect sampling.	Myanmar Govt. & WCS				✓		
h) Determine tiger abundance using double-sided camera-trap sampling.	Myanmar Govt. & WCS				✓		
For sites in Paletwa and Kaladan river catchment, Sumprabum, Khaunglanphu, Paunglaung, Momeik-Mabain,Central Bago Yoma, Rakhine Elephant Range, Saramati Taung area;							
i) Train local foresters how to identify tiger and prey via sign surveys.	WCS		✓				
j) Determine occupancy of habitats at the sites using sign surveys.	Myanmar Govt. & WCS		✓				
k) Establish a logbook to record observations of tiger and prey, and encourage use of the logbook.	Myanmar Govt. & WCS		✓				
8. Improving public awareness of the importance of tiger conservation to increase support from local people							
a) Develop wildlife education programs to discourage hunting by local people in and near tiger reserves. Where possible recruit local people, especially ex-hunters to help implement these programs.	WCS			✓			
b) Involve 50 local people in wildlife survey and research activities to make positive use of their local or indigenous knowledge.	WCS	Myanmar Govt.	✓				
c) Collaborate with authorities in charge of development projects to include wildlife conservation as a component of those projects and resolve any potential conflicts between the needs of people and wildlife.	Myanmar Govt. & WCS		✓				
d) Produce a documentary about tiger conservation in Myanmar and broadcast it on National Television.	WCS			✓			
e) Dub existing wildlife documentaries about Myanmar into local language and broadcast.	WCS		✓				
f) Adapt WCS education materials about tigers into Myanmar language and implement a special training program for school children at selected high schools in Yangon, and adjacent to tiger reserves.	WCS			✓			
9. Defining roles and responsibilities of personnel responsible for tiger conservation							
a) Provide special training for managers of tiger reserves in management techniques, including leadership skills, decision-making, planning, protection, use of information and technology, and personnel management.	WCS		✓				
b) Invite managers of tiger reserves to observe the day-to-day operations in selected tiger reserves in India and Thailand.	WCS	Thailand India Govts.		✓			
c) Define roles for junior staff in Hukaung Valley and Htamanthi Wildlife Sanctuaries, and for Taninthayi Division junior forestry staff, and staff in other areas in conducting field monitoring of tigers and prey.	Myanmar Govt.		✓				

Action	Organisation delivering		Timeframe / to be completed by				
	Lead	Other possible relevant partners	2003	2004	2005	2006	2007
c) Document the current threats, demographics, and range of human activities that must be taken into account if the proposed landscape is to be successful and sustainable in the long term.	Myanmar Govt. & WCS		✓				
d) Create a GIS map and database to show current land use patterns, possible future land use trends, and tiger and prey source areas.	Myanmar Govt. & WCS		✓				
For Taninthayi Division landscape;							
e) Train local foresters how to identify tiger and prey via sign surveys, in use of camera-traps for wildlife survey, and methods for making observations and recording data.	WCS			✓			
f) Determine occupancy of habitats in accessible sites across the landscape, including Myintmoletkat and Lenya River areas, away from sites where tigers are known.	Myanmar Govt. & WCS				✓		
g) Determine prey abundance using line transect sampling.	Myanmar Govt. & WCS				✓		
h) Determine tiger abundance using double-sided camera-trap sampling.	Myanmar Govt. & WCS				✓		
For sites in Paletwa and Kaladan river catchment, Sumprabum, Khaunglanphu, Paunglaung, Momeik-Mabain,Central Bago Yoma, Rakhine Elephant Range, Saramati Taung area;							
i) Train local foresters how to identify tiger and prey via sign surveys.	WCS		✓				
j) Determine occupancy of habitats at the sites using sign surveys.	Myanmar Govt. & WCS		✓				
k) Establish a logbook to record observations of tiger and prey, and encourage use of the logbook.	Myanmar Govt. & WCS		✓				
8. Improving public awareness of the importance of tiger conservation to increase support from local people							
a) Develop wildlife education programs to discourage hunting by local people in and near tiger reserves. Where possible recruit local people, especially ex-hunters to help implement these programs.	WCS			✓			
b) Involve 50 local people in wildlife survey and research activities to make positive use of their local or indigenous knowledge.	WCS	Myanmar Govt.	✓				
c) Collaborate with authorities in charge of development projects to include wildlife conservation as a component of those projects and resolve any potential conflicts between the needs of people and wildlife.	Myanmar Govt. & WCS		✓				
d) Produce a documentary about tiger conservation in Myanmar and broadcast it on National Television.	WCS			✓			
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a) Provide special training for managers of tiger reserves in management techniques, including leadership skills, decision-making, planning, protection, use of information and technology, and personnel management.	WCS		✓				
b) Invite managers of tiger reserves to observe the day-to-day operations in selected tiger reserves in India and Thailand.	WCS	Thailand India Govts.		✓			
c) Define roles for junior staff in Hukaung Valley and Htamanthi Wildlife Sanctuaries, and for Taninthayi Division junior forestry staff, and staff in other areas in conducting field monitoring of tigers and prey.	Myanmar Govt.		✓				

PART 1: INTRODUCTION

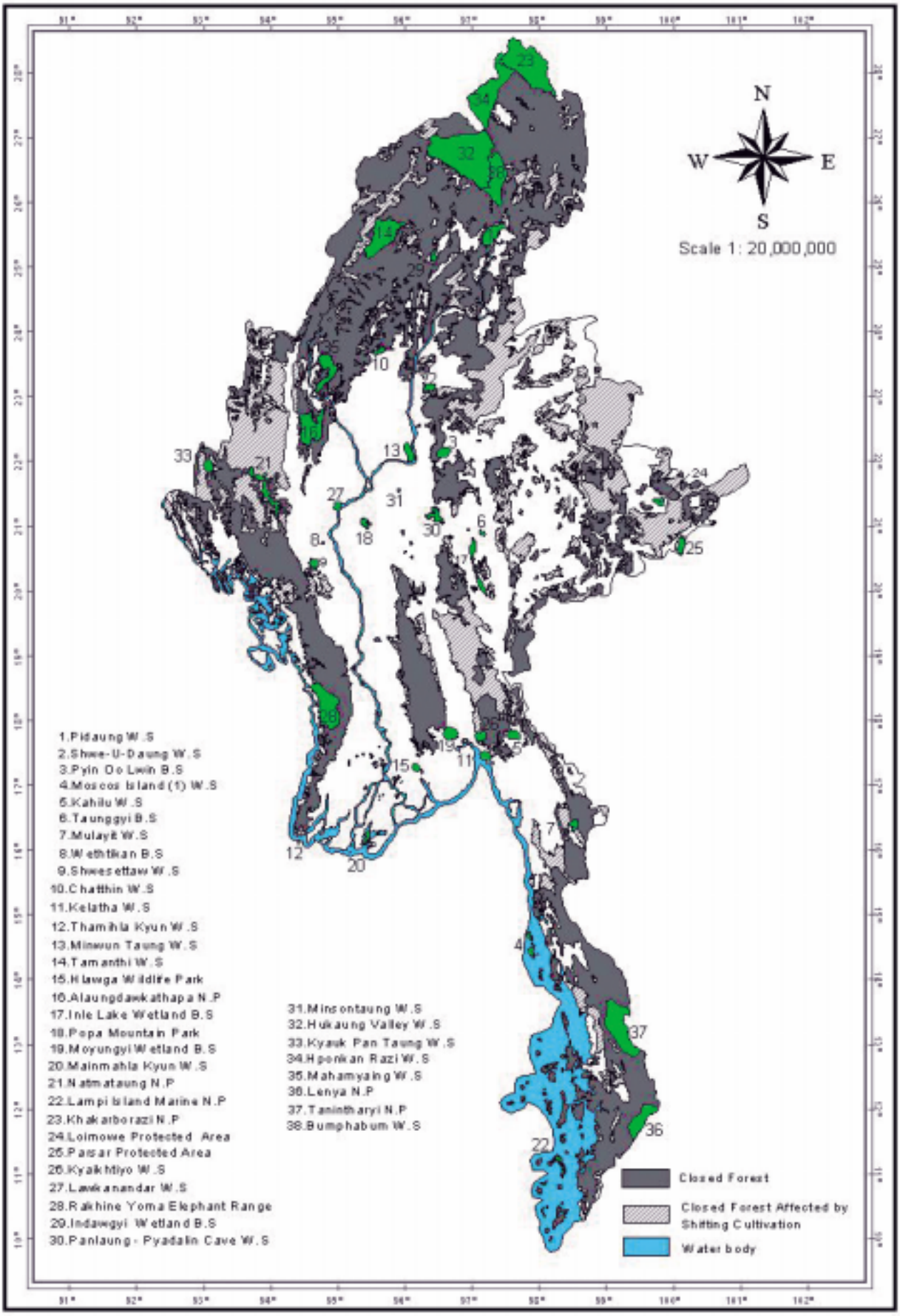
Myanmar is a high priority country for biodiversity conservation in Asia with extensive forested landscapes, high species diversity and endemism (Wikramanayake et al. 2001). This diversity ranges from rich alpine floras and tropical pine forests in the north, to dry dipterocarp and mixed deciduous forest in central dry zone, to tropical rainforests in the Peninsular. Coral reef ecosystems in the Myeik Archipelago are among the least disturbed in the region.

Unique to the region natural forests in Myanmar cover a third of the country, including large intact expanses with low human inhabitation (UNEP 1995). Prior to 1994 the country had <1% of lands in protected areas but by 2002 this had increased to just under 5% (Fig. 1), a 500% increase in size in less than a decade. While most reserves in the system are too small to support tigers, later additions to the system include large expanses of forest and corridors between areas that are more than enough to support tigers as well as other species with large area requirements.

Deforestation in neighbour countries brought about by unsustainable land-use practices has led to pressure on Myanmar's natural resources, especially in border areas in the far north and south which contain high biodiversity but are difficult to access and monitor. Logging, extraction of forest products, loss and fragmentation of forests and hunting have reduced wildlife populations and their habitats.

The remainder of this essential reading section includes a review of the pressing threats to tigers in Myanmar (Part 2), a review of the history of conservation planning for tigers (Part 3), a summary of the current status and distribution of tigers in the country (Part 4), and a rationale for the National Tiger Action Plan (Part 5), with proposed solutions for addressing the threats, for recovering tiger populations and guiding future conservation efforts in the country.

FIG. 1. FOREST COVER, EXISTING AND PROPOSED PROTECTED AREAS OF MYANMAR – 2002.



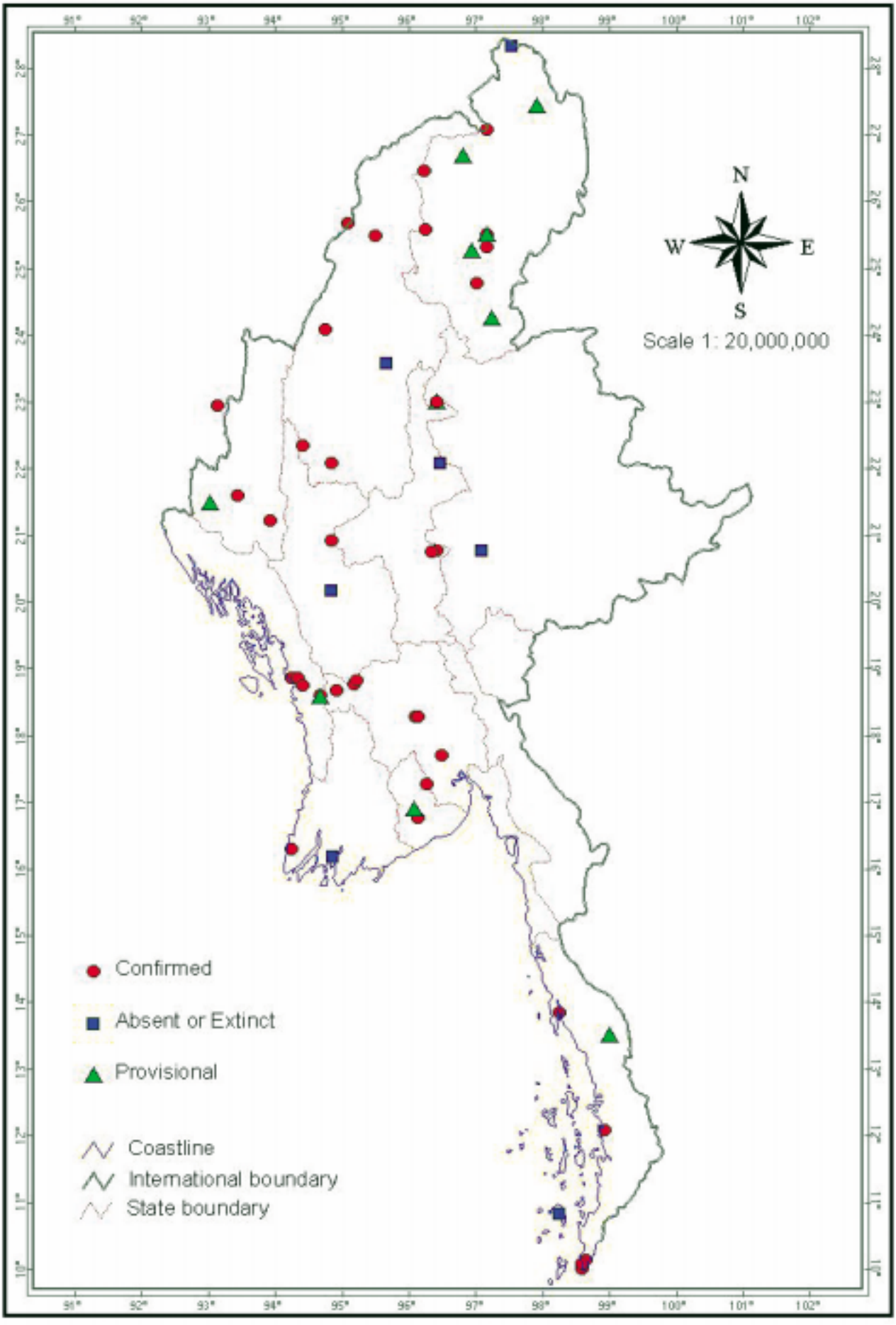
PART 2: THREATS TO TIGERS

Although the tiger is potentially found over a wide range of habitat and disturbance conditions, it is sensitive to a variety of human influences. The prospects for tiger survival in places where they occur in Myanmar are affected by a number of key threats;

2.1 Hunting for commercial trade in tiger products – The hunting of tigers has a long history in Myanmar–(Pollok & Thom 1900). Tigers were traditionally considered pests and until 1931 the government provided licences and rewards for killing them. This led to depopulation on a massive scale through sport hunting. For example, during a 4 year period from 1928-1932, 1,382 tigers were reported killed in British Burma (Prater 1940), an order of magnitude larger number than the current tiger population in Myanmar. Tigers were historically widespread in Myanmar (Fig. 2) although their densities were not uniform across intact habitat, possibly a result of variation in hunting pressures from place to place (Prater 1940). More recently, declining tiger populations across the range combined with increasing prosperity of Asian countries, have led to an increasing demand for tiger products for traditional Chinese medicines. Various tribal groups hunted tigers to supply the trade (Rabinowitz 1995) leading to their extirpation in some areas (Rabinowitz 1998). The sale of tiger products was banned by CITES since 1975 but thrives in the black market, especially in some border areas where it is uncontrolled (Fig. 3a). Although it is difficult to measure the size of the trade, at least 10,000 kg of tiger bone representing 500-1,000 tigers was imported by East Asian countries between 1970 and 1993 (Hemley & Mills 1999). Tiger hunting continues in those areas that still contain tiger(Fig 3b.). As the population declines every tiger killed makes the harvest an increasingly unsustainable one. To demonstrate the efficiency of the trade, Myanmar shopkeepers on the Thai border claim they can provide a tiger within 3 days for a deposit of US$12. Direct hunting of tigers threatens to drive the Myanmar population to extinction. Improved domestic legislation combined with monitoring of markets and law enforcement can contribute to reducing the trade in tiger parts.

2.2 Prey depletion - Because it is dependent on a relatively large intake of food to support its metabolism, tigers are sensitive to loss of prey through hunting (Karanth & Stith 1999). The erosion of available energy has a "bottom-up" effect on ecosystem structure (Seidensticker 2002). Myanmar's per capita income in 1998 was US$1,200, making it one of the poorest countries in the world. People living in and around forested areas traditionally hunted wildlife for subsistence. More recently local people hunt to supplement increasingly meagre incomes from farming. This trend is widespread (Rabinowitz 1995) occurring in up to 70% of protected areas (Rao et al. 2002). Trade in tiger prey species occurred near all the places where the National Tiger Team conducted field surveys during 1999-2002.The illegal trade in wildlife is globally worth $7 billion a year, only less than the trade in arms and drugs (Kanwatanakid et al. 2000). Myanmar is a part of the trade in Asia with a network of markets and routes established to supply the demand in China and Thailand. Markets for the sale of wild meat and trophies, of tigers and prey species have existed along the Thai border at Tachileik, Myawady, Three Pagodas Pass and Maung Daung for a long time and continue to offer wildlife prohibited by CITES (Bradley-Martin & Redford 2000; Hill 1994; International 1999; Bennett and Rao 2002). The volumes of wildlife in the trade fluctuate according to the security situation, and decreased following the cancellation of Thai logging concessions after 1993, and escalation of hostilities between KNU and the Myanmar government after 1996 (International 1999). There is some evidence to suggest that some of the Thai border wildlife trade may have moved to Yangon. As an example, several restaurants

FIG. 2. HISTORICAL RECORDS (PRE-1999) OF TIGER OCCURRENCE IN MYANMAR.



and shops in central Yangon offers a range of wild meat dishes, and tonics made from animal parts (A.J. Lynam personal observation). In contrast, wildlife trade is rampant and uncontrolled in Shan State, especially towns near the China border (Than 1998)(Fig. 4.). Prey and tiger populations may be restored in the wild if they can be protected from hunting and wildlife trade (Madhusudan & Karanth 2002).

2.3 Habitat loss, degradation and fragmentation – Myanmar had an estimated 46.6% closed forest cover in 1990, with 37.4% remaining in 1997 (FAO 2000), one of the highest levels in the Asia - Pacific region. The net deforestation rate between 1989 and 2000 was 0.21% (Brunner et al. 2002), a fraction of the deforestation rate in Thailand during the same period. Deforestation is highly concentrated and is largely a result of logging in forest reserves (Rao et al. 2002)(Fig. 5). While forests are easily cut down they are only restored with great investments of time and resources (Elliott et al. 2000), usually beyond the capacity of forestry budgets. Except in parts of Shan State, where remaining forest resembles the highly fragmented situation in Thailand, large extensive tracts of closed forest characterize the Myanmar landscape providing good potential tiger habitat (Fig. 1). Disturbance that degrades or destroys natural forests, including grazing by domestic animals, shifting and permanent cultivation, mining, permanent human settlements, and plantations occur in 90% of protected areas (Rao et al. 2002). These threats could be reduced by improved agricultural and animal husbandry practices, and improved land-use planning.

2.4 Harassment and displacement – Rural development has progressed slowly in Myanmar so that dams, roads, pipelines, power lines, and settlements – infrastructure that disrupt wildlife populations by creating barriers to dispersal (Goosem 1997) – have had localized effects on tiger populations. For example, roads occur in only 25% of Myanmar protected–areas (Rao et al. 2002) (Fig. 6) and most are non-paved and seasonal access only. However, roads whatever their condition provide improved access to forests for poachers. Because tigers often use non-paved roads as movement corridors, this potentially increases the chances of encounter with humans. Aside from human infrastructure, the disturbance caused by local people entering forests to engage in the extraction of non-timber forest products (Fig. 7.) can have adverse affects on tiger behaviour. Such disturbances occur in 85% of protected areas (Rao et al. 2002), and probably reflect the incidence in non-protected forests, so the effect may be considerable. Improved land use planning and zoning in forest reserves can reduce the threat from internal fragmentation.

2.5 Genetic erosion – A number of studies have shown that small populations are more likely to go extinct that large ones. One of the reasons is that at small size, survival rate or reproductive rate of a population is reduced because its members have difficulty finding mates, sex ratios are skewed, and they tend to breed with related individuals (Allee 1931). This results in a net loss of genetic variation, sometimes expressed by an increase in expression of deleterious mutations through homozygosity. Fitness is often reduced in the process. Despite this, many populations have persisted for long-periods of time with low levels of genetic variation e.g. cheetahs (Caro 2000). It is likely that genetic and demographic processes interact so that as populations decline it is increasingly harder to recover them (Gilpin & Soule 1986). Tigers in severely fragmented habitats in Myanmar would fall into this category. Maintaining natural corridors between forest patches inhabited by tigers can reduce this threat.

2.6 Protected area management – Myanmar is one of the least externally funded and internally protected tropical countries in Asia (Balmford & Long 1995). As a result while forests have been conserved for timber production for almost 150 years (Bryant 1997), and the earliest protected area was gazetted in 1918, legislation to protect both wildlife and their habitats was only introduced in 1994. Wildlife training for protected area staff was initiated in 1995 with only a third of staff having received training (Rao et al. 2002)(Fig. 8). Only since 1998 have protected areas been designed to protect entire landscapes and the ecological processes within. Consequently, many of the older protected areas e.g. Pidaung Wildlife Sanctuary, no longer support tigers and other wildlife because of large-scale degradation and loss of habitat inside them. A recent review found that human activities incompatible with conservation occur in every protected area (Rao et al. 2002). Extraction of non-timber forest products occurred in 85% of the areas, hunting in up to 70%, while buffer zones for the protection of core forest zones were generally lacking. The combined effect is a loss of habitat quality for tigers. Myanmar protected areas (Fig. 1.) currently do not provide adequate representation of the diversity of habitats inhabited by tigers. Reserve managers need training to understand threats to wildlife, and how to best manage available resources to enable effective conservation of wildlife. In general, the roles and responsibilities of protected area staff need to be carefully defined so that available personnel cover important tasks.

2.7 Social perception – Where tiger populations have been decimated, their long-term recovery can be ensured only by a combination of political will and acceptance by people living in and around tiger areas. If tigers are worth more dead than alive to local people, then efforts to preserve tigers in the human dominated landscape will fail. Awareness and education of the importance of tigers can be improved through dedicated learning programs.

Fig. 3a.Tiger skin for sale in Tachileik market, Shan State.

Fig 3b. Poacher recorded by camera-trap at Paunglaung Catchment, Mandalay Division. Poaching of tigers was the single most important factor causing the demise of tigers in Myanmar in the past.

Fig. 4. Wildlife for sale at Mongla market, Shan State.

Fig. 5. Logging reduces available habitat, and alters habitat quality for tigers and their prey.

Fig. 6. Road construction opens up the forest facilitating access to poachers.

Fig. 7. The extraction of rattan and other non-timber forest products is often done on a massive scale and affects habitat quality for tigers and their prey.

Fig. 8. Myanmar foresters undertaking basic wildlife training with the author, Alaungdaw Kathapa National Park, December 1998.

PART 3: BRIEF HISTORY OF CONSERVATION PLANNING FOR TIGERS IN MYANMAR

Previous attempts to estimate the Myanmar tiger population were based on habitat models. Using information on existing forest cover (Collins 1991), and assuming tiger densities of 0.6-1.0 individuals/100 km2 from other places (Rabinowitz 1993a), a conservation plan estimated 600-1,000 tigers for Myanmar across 12 priority areas and other fragmented populations (Myanmar Forest Department 1996). A previous tiger action plan recommended surveys to estimate population sizes in the priority areas, creation of tiger reserves, strengthening of institutional capabilities to protect tigers, a national policy and long-term action plan, increasing public awareness and cooperation with other tiger range countries.

Uga and Than (1998) revising this plan considered the original population estimates as overestimates and suggested the true numbers might be in the range 250-500. They considered tigers probably occurred in potential areas defined by Tiger Conservation Units (TCU's) (*sensu* Dinerstein et al. 1997). They defined a set of priority actions for tigers including training of government staff, mapping of habitats, field assessments to identify critical tiger populations inside and outside of protected areas, and actions to preserve these populations, including tiger reserves and protection of corridors, and the formation of mobile education units to provide awareness. This set the stage for the development of a new updated National Tiger Action Plan that was proposed to the Myanmar Government in June 1998 (WCS 1998).

A number of important actions were taken as part of the new project;
1. A special tiger survey and conservation-training course was provided to 23 protected area and forestry staff at Alaungdaw Kathapa National Park, during December 1998.
2. A 7-member National Tiger Survey Team was selected from the training participants to be responsible for spearheading research and conducting tiger surveys within Myanmar.
3. Priority areas for tiger surveys were located and mapped.
4. Surveys to determine tiger presence-absence and prey relative abundance were done in high priority areas, and threats to tigers documented for these areas.
5. A tiger information database was created from current and historical data for use with designing tiger conservation activities and decision-making.
6. Official meetings were held with Myanmar government officials, to present information on tiger status in order to draft and produce a National Tiger Action Plan for the Union of Myanmar.

PART 4: STATUS AND DISTRIBUTION OF TIGERS IN MYANMAR – 2002

Direct field surveys for tigers were done at 17 sites (Fig. 9; see also Appendix I for site descriptions). Although the survey efforts covered only 1.3% of areas with forest cover, these sites were places where tigers were known historically, and where the most recent available evidence, including reports from foresters and local people, suggested tigers might still be found. The surveys provided new and unique records of occurrence for 19 globally threatened species, 25 CITES listed species and 45 Myanmar protected species (Appendix II).

4.1 Tiger status and distribution - Tigers were reported present at 88% of sites, but confirmed by direct survey in just 23% of sites (Table 2). The rate at which tigers were "caught" (detected) by camera-traps was just over 3,000 trap nights of sampling per photo-record. For example, if 30 camera-traps were placed in the field each for 100 days, one might expect on average 1 photo-record of tiger from the survey effort. In comparison, using a similar survey design in Thailand (Lynam et al. 2001), tigers were reported at all seven potential tiger sites, and detected at 86% of the sites, for a capture rate of just over 200 trap-nights per photo-record. For example, of 20 camera-traps were placed for 10 nights, one might expect to get a single photo-record of tiger. The survey effort required to find a tiger at the Myanmar sites was an order of magnitude higher than at the Thailand sites.

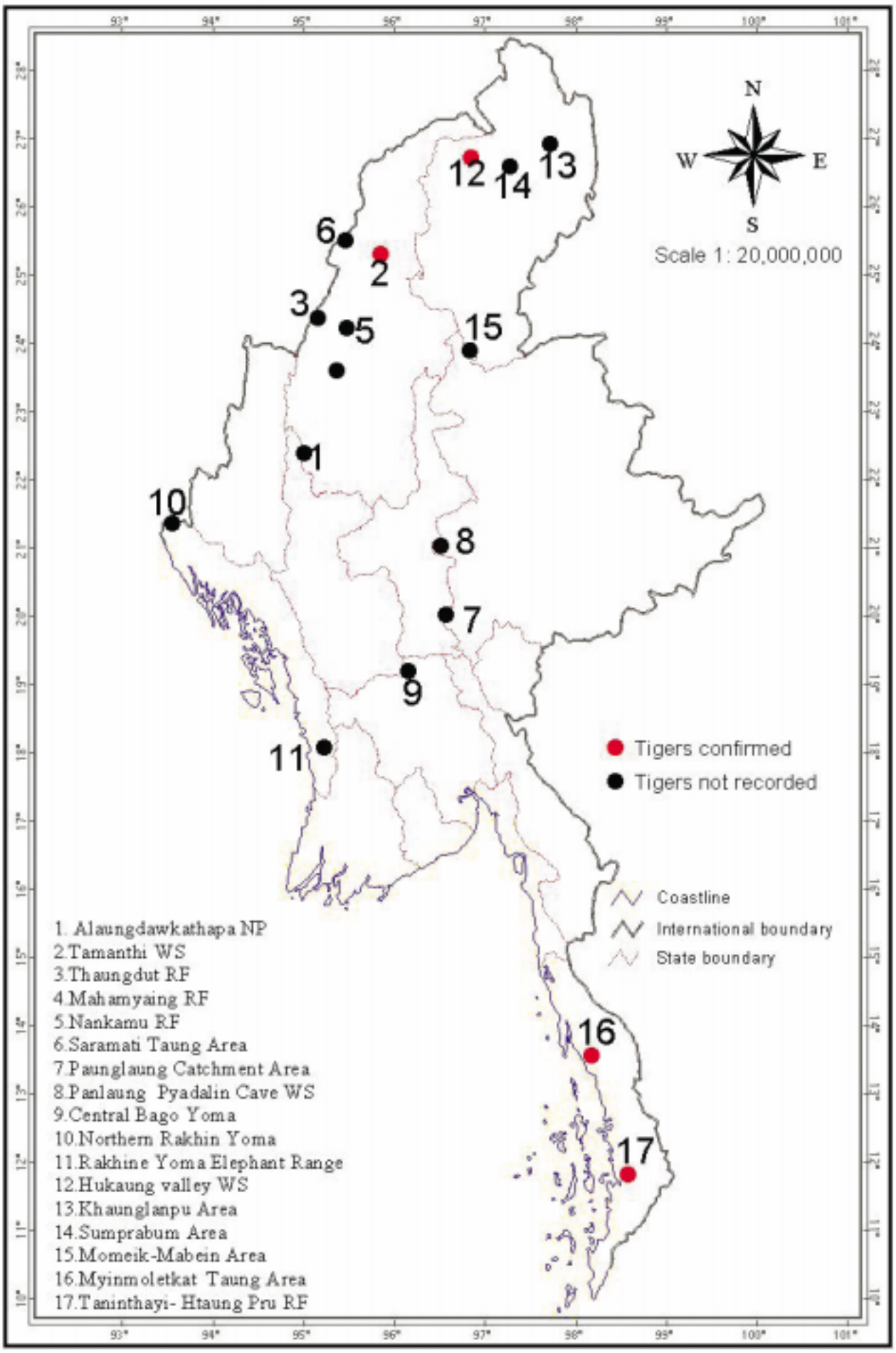
Table 2. Comparison of tiger survey results in Myanmar and Thailand.

Results of survey	Myanmar (17 sites)	Thailand (7 sites*)
1. Reports of tigers (Sites)	88%	All
2. Tiger confirmed	23%	86%
3. Capture rate – tigers (Days per capture)	3,112	217
4. Capture rate – large mammals (")	5	5
5. Species richness (large mammals)	16.4 ± 1.3	15.2 ± 1.8
6. Human traffic (Walk pasts per 100 days)	2.3	3.4

* All Thailand sites were in long-established protected areas

Several features of the data warrant further explanation. Firstly, tigers were detected at a low proportion of sites where tigers where they were reported. Some local people living in and near forest areas apparently perceive other animals in the forest as tigers. For example, in Alaungdaw Kathapa National Park, rangers mistook tracks of Golden cat and Asiatic leopard for tiger, and because these two species were abundant near park headquarters, the rangers reported tiger as common (Lynam et al. 1999). As a result, a conservation agency mounted a campaign to "Save the Tigers of Alaungdaw Kathapa", when direct survey efforts across 25% of the park found no tigers. A wider monitoring of habitats found no further evidence of tigers suggesting that they are now extirpated from the Park. Clearly, some rangers and local people cannot resolve tiger track and sign from other cat species, and need further training to be able to do so with some degree of confidence.

FIG. 9. SURVEY SITES FOR TIGERS IN MYANMAR, 1999-2002.



Almost a third of the reports of tigers were of direct sightings made after 1990 (Appendix III). The two extreme explanations are that all local people made mistakes in identifying tigers e.g. they saw something else but reported tiger, or that all local people actually saw tigers when they reported seeing tigers. The truth probably lies somewhere between the extremesIt is possible, at least for more disturbed sites, that tigers are no longer resident but populations instead consist of transient individuals that hold no territory or defined home range (G. Schaller pers. comm., 2002). These transient individuals might cover relatively large areas in search of food and mates, returning to a place only after a lengthy period of time. This would explain their absence during the surveys but infrequent recent reports from locals.

Differences in survey technique or skill levels are unlikely to explain the differences between tiger occurrence at Myanmar and Thailand sites. Training for field staff was standardized and given by the same trainer (A.J. Lynam). Sign surveys were conducted with the same degree of rigor and camera-trap locations chosen in the same ways by teams in the different countries. If tigers were present they should have turned up in the surveys in Myanmar. However, if tigers are absent or not continuously present at a site, then their probability of detection by any survey method would be less than one. Where tigers occur at very low density e.g. <0.38tigers/ 100 sq. km, a mammoth survey effort is required with camera-traps to detect tigers (Carbone et al. 2001). That tigers were found in only three of 17 areas surveyed, whereas other large mammals were detected at frequencies similar to the Thai reserves, suggests that the observations are real. Tigers were either absent or non-resident, or occurred at very low density at most of Myanmar survey sites, at the time of survey. Since the sites chosen were the best potential sites given all the information available prior to the surveys, the suggestion is that the tiger in Myanmar has suffered a range collapse and is in an advanced state of decline towards extinction.

Important to note is that the Thailand sites were all established protected areas with a history of protection. Only two Myanmar sites were protected areas, and tigers were found in one of the areas. Protection at Thai sites, combined with a lower intensity of directed poaching for tigers there explains why tigers have persisted there better than at Myanmar sites. Despite the differences in occupancy patterns for tigers, sites in both countries had similar richness and abundance of large mammals, suggesting similar availability of prey for tigers. Therefore, Myanmar sites have good potential for the recovery of tiger populations.

4.2 Tiger population size - It is impossible to know the true number of tigers remaining in Myanmar and difficult to estimate numbers. Because of their rarity and cryptic behaviour, tigers cannot be directly counted, and sampling is required to estimate numbers. However, it is impossible to sample every square mile of every potential habitat using camera-traps.

Despite these limitations, the Tiger Team attempted to estimate very roughly how many tigers might be present across the suite of available habitats. They did this not by considering the extent of available habitat, assuming a density and a correction factor, and extrapolating tigers numbers (Rabinowitz 1993; Uga and Than, 1998). Instead they used a subjective approach, by sitting down at a table, poring over maps, and field notebooks, considering information from sign surveys and locations of camera-trap captures, and the most reliable interview data, and arriving at a consensus among themselves. Given their expert knowledge - they know more about the recent natural history of the study sites than any other workers - they estimated the numbers in Table 3. These numbers are one estimate of the remaining tiger population Myanmar.

In the absence of independent verification, the numbers are educated "guesstimates". However, it is possible to independently estimate tiger numbers for the Hukaung Valley using a modification of the approach of Rabinowitz (1993), and the estimate of tiger density (0.91"– 1.29 tigers/100 sq. km; see section 6.8.7). If one assumes a 50% reduction in tiger density because of direct poaching of tigers within the reserve (the most serious threat to tigers in Myanmar), and an additional 20% reduction due to hunting, forest fires, smaller settlements and human access provided by the Ledo Road, the number of tigers in the reserve (6,460 sq. km) is 18 – 25. This estimate is strikingly similar to that derived by the consensus approach (15 – 20; Table 3). While the estimates may have some validity, carefully designed mark-recapture studies will however be needed to determine the size of tiger subpopulations in the areas in Table 3.

Table 3. Status of tigers in Myanmar*

Tiger status	Sites (estimated numbers)
1. Tigers confirmed	Htamanthi (5); Hukaung Valley (15-20) and adjacent areas (15-20); Htaung Pru (5), Pe Chaung (5), other areas of N. and S. Taninthayi Division (55)
2. Tiger not recorded but possibly present in low numbers	Paletwa and Kaladan river catchment area (3-5), Sumprabum (3-5), Khaunglanphu (1-2), Paunglaung (2-4), Momeik-Mabain (2-3), Central Bago Yoma (2-3), Rakhine Elephant Range (1-2), Saramati Taung area (5-7), Shan Yoma (Kayah-Kayin)**(5-7), S. Kachin** (3-5)
3. Tigers not recorded and assumed absent	Alaungdaw Kathapa, Thaungdut, Mahamyaing, Nankamu, Panlaung-Pyadalin

* Numbers are estimates based on consensus approach of Myanmar Tiger Team surveyors.
** Indicates areas that were not surveyed. Evidence for tigers comes from unconfirmed reports from local people and foresters

PART 5: RATIONALE FOR A NATIONAL TIGER ACTION PLAN FOR MYANMAR

Potentially tigers are recoverable to their former abundance across their range in Myanmar. In practice however, full recovery is unlikely. This section describes a Plan for recovering tigers to a semblance of their former abundance in key parts of their range where they still exist, and restoring areas where tigers have been lost so that natural recolonization might in future occur in those places. Broadly, the Plan will work towards increasing tigers, prey and habitat, which are "measurable currencies" for tiger conservation (Ginsberg 2001).

The Plan will be implemented over a 5-year period between 2003-2007. This will allow a number of targets to be achieved over spatial scales relevant to tiger conservation (Ginsberg 2001);

• Site (an area containing at least several breeding female tigers) e.g. Htamanthi Wildlife Sanctuary is a tiger site.

• Landscape (a larger area containing several populations of females and habitat connections between the populations) e.g. the Hukaung Valley, and forest reserves in Taninthayi Division are tiger landscapes.

• Tiger Conservation Units (TCU's) (areas encompassing several landscapes) e.g. the Northern Triangle TCU (60) which contains Hukaung Valley, Huai Kha Khaeng'– Thung Yai Naresuan TCU (73) which includes Taninthayi Division.

The targets for tiger conservation will vary according to timeframes and spatial scales but fit into the general framework given in Table 4. By the end of the implementation period, the short-term targets should be realized. An annual review of progress is suggested with a comprehensive review of progress towards achieving the short-term goals at the end of 2007. Success at reaching the short-term targets will set the stage for meeting the longer-term (10 – 20 years) targets. Important to recognize is the fact that efforts to save tigers in Myanmar are part of a larger global effort to save the species. The recovery of tigers in Myanmar will contribute towards the larger goal of species recovery across the range.

The Plan addresses the key threats to achieving these goals for tigers in Myanmar, described in section 3 (above); (a) Hunting for commercial trade in tiger products, (b) Prey depletion, (c) Habitat loss, degradation and fragmentation, (d) Harassment and displacement, (e) Illegal trade in tiger products, (f) Genetic erosion, (g) Protected Area management, (h) Social perception.

Specifically, implementation of the Plan will reduce the key threats by,
1. Suppressing all killing of tigers, and the illegal trade in tiger products.
2. Reducing killing of tiger prey species, suppress associated illegal trade.
3. Improving forestry management to stop further loss of tiger habitat and to restore degraded habitat.
4. Improving forestry management to reduce intrusions of local people into tiger habitat, and improve planning to avoid development in tiger critical areas.
5. Establishing protected areas, ecological corridors and priority management areas to protect wild tigers and their habitat.

6. Improving international cooperation and establish cooperative management of contiguous protected areas along borders to maintain connectivity of tiger habitat across international boundaries.
7. Monitoring the status of the tiger and prey population to assess the effectiveness of conservation efforts.
8. Improving public awareness of the importance of tiger conservation to increase support from local people.
9. Defining roles and responsibilities of personnel responsible for tiger conservation.

Table 4. Targets for tiger conservation with various time and spatial scales (*adapted from Ginsberg, 2001*).

	Targets	
	Short Term (2-5 years)	**Long Term (10-20 years)**
SITE (An area containing several breeding females)e.g. Htamanthi Wildlife Sanctuary, forest reserves in Taninthayi Division	• Maintain occupancy of tiger habitat • Define critical areas within sites • Stabilize present tiger populations • Prevent loss of tigers	• Maintain potentially breeding populations of tigers at maximum density • Maintain expanding population (at r>1) • Strictly protect core areas
LANDSCAPE (A larger area containing several populations of breeding females)e.g. Hukaung Valley, Taninthayi Division	• Maintain potential for dispersal between sites	• Maintain ecologically functioning viable tiger populations • No human intervention required to achieve stable/ growing populations • Recolonization of empty habitat
TIGER CONSERVATION UNIT (An area containing several landscapes)e.g. the Northern Triangle TCU (60), Huai Kha Khaeng – Thung Yai Naresuan TCU (73)	• Maintain integrity of intact habitat • Maintain sufficient prey base • Maintain multiple landscapes including transboundary landscapes in each TCU • Coordinate establishing protected areas across boundaries • Promote tiger friendly conservation in each country in TCU	• Re-establish connections between sites and landscapes to ensure genetic exchange • Maintain heterogeneity of ecoregion

Specific issues and action items for achieving the targets of tiger conservation in Myanmar are detailed as follows. For ease of reference the action items are also listed in Table 1 along with a proposed timetable for their implementation, and responsible agencies.

5.1 Suppressing all killing of tigers and the illegal trade in tiger products

5.1.1 Key issues

a) The trade in tiger products is part of the illegal trade in wildlife worth an estimated US$7 billion annually (Bennett and Rao 2002).
b) Myanmar is one of the countries supplying the tiger trade and has a well-developed network involving poachers, middlemen and trafficking routes to move tiger products from forest to market (Bennett and Rao 2002).
c) The hunting of tigers to supply the trade has been the ultimate cause of extirpation of wild tigers from multiple forest and nature reserves e.g. Alaungdaw Kathapa, and entire regions e.g. northern Myanmar (Rabinowitz 1998).
d) Knocking off the top predator can have destabilizing effects at lower trophic levels in tropical ecosystems (Seidensticker 2002).
e) Tiger populations that exist today are being decimated by hunting and face certain extirpation in the short-term if action is not taken (Kenney et al. 1995; Seidensticker et al. 1999).

5.1.2 Key actions

a) Amend the Protected Wildlife and Protected Areas Law (SLORC, 1994) to enable the enforcement of international laws within Myanmar.

This would include laws prohibiting the sale or purchase of products suggesting or implying content of tiger bone, hair, organs, blood, teeth, claws or hide. Completion date: December, 2003

b) Impose heavy fines for offenders and use partial proceeds towards implementing international legislation. Completion date: December, 2003
c) Conduct wildlife conservation and awareness training for 100 government personnel, including military, customs, police, immigration and local administrative staff in Yangon, Mandalay, Myitkyina and other internal transit points for wildlife. This would include basic training in identifying wildlife protected by domestic and international legislation, and knowing their protection status. Completion date: December, 2003
d) Conduct wildlife conservation and awareness training for all protected area staff. Completion date: December, 2003
e) Recruit local government staff to help identify tigers in trade and encourage them to report their observations to relevant authorities. Completion date: December, 2003
f) Create a Wildlife Investigations Unit to investigate and suppress crime against wildlife, including trade, trafficking, illegal killing and capture, habitat destruction, and other persecution. The unit will enforce domestic and international legislation. The unit would include staff of the Ministries of Home Affairs, Forestry and Tourism and would report directly to the Minister of Forestry. Completion date: June, 2004
g) Train and recruit government staff to join the Wildlife Investigations Unit. Form mobile units to suppress wildlife crime across the country. Completion date: June, 2004

5.2 Reducing killing of tiger prey species and associated trade.

5.2.1 Key issues

a) "Tigers cannot survive where they lack access to ungulate prey that is at least about half their own body mass because of mass-specific energy needs.""(Seidensticker 2002)
b) Because tropical forests support ungulates at relatively low densities, the killing of prey has been the proximate cause of the decline in tiger populations in Mainland Asia (Karanth and Stith 1999).
c) Few if any ethnic communities rely on large mammals as a subsistence source of protein but trade in wild meat, horns, fur, hides and other products is part of a massive illegal trade in Myanmar, and is well developed in border areas where enforcement is difficult (Rabinowitz 1998; Martin and Redford 2000).
d) The commercial farming of wildlife provides a potential legal mechanism for the poaching of wild individuals to supply the trade and may contribute to the extirpation of some species.
e) Evidence suggesting that hunting can be sustainably managed exists for only a few tropical wildlife species but evidence that wildlife harvest is unsustainable exists for a vast number of species (Robinson and Redford 1994; Robinson, and Bennett 1999).
f) Protected areas are currently understaffed and ill equipped to prevent the loss of wildlife to poachers (Bennett and Rao 2002).
g) The presence of forest guards in sufficient numbers can mitigate against hunting of wildlife (Bruner et al. 2001).
h) Outside of protected areas, laws governing wildlife are difficult to enforce because staffing is low and capacity is low.

5.2.2 Key actions (in addition to those described above for tigers but are generally relevant)

a) Amend the Protected Wildlife and Protected Areas Law (SLORC 1994) to enable the enforcement of international laws within Myanmar. Modify Chapter V, Article 15 to recognize the international classifications of wildlife species, and their associated protection status. Completion date: June 2003.
b) With the view to protecting tiger prey species, allow the commercial farming of only selected wildlife species only in facilities designated by the Forest Department. Completion date: June 2003.
c) Allow thw hunting of wildlife species only when scientific evidence proves it can be done sustainably. Completion date: June 2003.
d) Take action to stop all killing of prey species at places where tigers are currently or potentially found. Completion date: December 2007.
e) Train all government staff at Hukaung Valley and Htamanthi, in anti-poaching and anti-trafficking techniques. Where possible involve local military personnel as instructors. Completion date: December 2003.
f) Recruit teams of EcoRangers whose sole responsibility is protection. Numbers of EcoRangers should at least 3 guards/100 sq. km for effective management. Provide EcoRangers with necessary equipment, and salary incentives to motivate them to combat poaching. Completion date: June 2004.
g) Develop systematic patrolling inside all protected areas using EcoRangers. Make patrolling a mandatory management activity with a monthly schedule and budget. Completion date: December 2004.
h) Update the Wildlife Law to include protection for wildlife outside protected areas, and empower government staff to enforce the legislation. Completion date: December 2004.

i) Outside protected areas, study patterns of hunting and consumption of wildlife to determine its sustainability, especially for prey species. Completion date: December 2005.
j) In the List of Protected Animals (Ministry of Forestry, 1994), promote the following tiger prey species from Protected status to Completely Protected status; Wild water buffalo (*Bubalus bubalis*). Completion date: June 2003.
k) In the List of Protected Animals (Ministry of Forestry, 1994), promote the following tiger prey species from Seasonally Protected status to Protected status; Hog deer (*Axis porcinus*) and Common barking deer (*Muntiacus muntjak*). Completion date: June 2003.
l) Wildlife conservation and awareness training for all wildlife offenders. Completion date: June 2003.
m) Impose fines for wildlife offenders in tiger areas with proceeds towards supporting tiger conservation activities. Completion date: June 2004.

5.3 Improving forestry management to stop further loss of tiger habitat and to restore degraded habitat

5.3.1 Key issues.

a) Extraction of non-timber forest products, fuel wood collection, shifting cultivation and livestock grazing disturbs tigers, damage tiger habitat, and depletes prey resources (Rao et al. 2002).
b) Clear cutting of plantations, and cutting of other economically valuable hardwoods may seriously compromise tiger habitats (Rao et al. 2002).
c) There exist no economic incentives for conducting environmentally sound forest use practices.

5.3.2 Key actions

a) The National Code of Forest Harvest Practice involves 30-year cutting cycles, and use of elephants for removal of logs reduces environmental damage over other practices. Apply this traditional method of forest harvest effectively in all concessions in the country. Completion date: December 2005.
b) Ban the hunting of wildlife in forest harvest areas. Completion date: June 2004.
c) Provide wildlife conservation awareness education training to timber harvest staff. Completion date: December 2004.
d) Define Strict Conservation Zones for Hukaung Valley and Htamanthi where no human use of natural resources is allowed. Create buffer areas to allow restricted use by local people including extraction of non-timber forest products, fuel wood collection, and livestock grazing. Ban shifting cultivation and hunting of all kinds in the buffer area. Use EcoRanger patrol teams to enforce the restrictions. Completion date: December 2003.

5.4 Improving forestry management to reduce intrusions of local people into tiger habitat, and improve planning to avoid development in tiger critical areas

5.4.1 Key issues

a) Plantations and mines open up forest areas (Rao et al. 2002), encourage markets that wipe out tiger prey, and allow tigers to be hunted more easily.
b) Permanent camps and settlements seriously compromise tiger habitat (Rao et al. 2002).
c) Road construction internally fragments and damages tiger habitat, facilitates intrusions by poachers, and opens up remote areas to wildlife trade (Bennett and Rao 2002; Rao et al. 2002)..

5.4.2 Key actions

a) Reclaim plantations and revoke all mining licences in Hukaung Valley and Htamanthi Wildlife Sanctuaries. Completion date: December 2007.
b) Consider the location of government camps and permanent settlements outside of these reserves. Completion date: December 2007.
c) Ban the construction of roads in protected areas and forest reserves. Completion date: December 2004.
d) Close or limit access along logging roads in Taninthayi Division to reduce the risk of collisions with tigers. Completion date: December 2005.
e) Include wildlife assessment in land development programs for Taninthayi Division. Completion date: December 2003.
f) Develop education programs to improve awareness about wildlife for local people living in and around forest reserves in Taninthayi Division. Completion date: December 2004.

5.5 Establishing protected areas, ecological corridors and priority management areas to protect wild tigers and their habitat

5.5.1 Key issues.

a) The minimum area required to support a genetically viable population of large predators would be the area that supports 300 breeding females (Barbault & Sastrapradja 1995).
b) If female tigers in Myanmar have home ranges the size of Nepali tigers (10-50 sq. km; (Smith 1987)), the area required would be 3,000 – 15,000 sq. km.
c) Landscapes of this size exist in Myanmar but most are not yet protected for wildlife. The largest intact forest expanses in Myanmar are in Kachin State, Sagaing and Taninthayi Divisions.
d) Tigers may use forest reserves as movement corridors between the Hukaung Valley and Sumprabum, and possibly as far east as Kaunglamphu; within Taninthayi Division, and across the Thai-Myanmar border, and; between north-eastern Sagaing Division and western Kachin State.
e) There is a lack of landscape level planning and analysis for wildlife conservation in Myanmar (Rao et al. 2002).
f) Management plans for sites containing tigers do not specifically define actions necessary to conserve tigers.

5.5.2 Key actions

a) Revise or create management plans for the Hukaung Valley and Htamanthi to include specific actions for conserving tigers, including recommendations in 5.2.2, 5.3.2, and 5.4.2, and below. Completion date: December 2003.
b) Expand Htamanthi Wildlife Sanctuary to increase its size to at least 3,000 sq. km to ensure long-term survival of tigers. Completion date: December 2004.
c) Create a dedicated tiger reserve including the Hukaung Valley and adjacent forest reserves. The reserve will serve to link tiger populations in India with those in Myanmar. Expand the eastern border of Hukaung Valley Wildlife Sanctuary to protect potential tiger habitat in the Sumprabum area. Completion date: June 2004.
d) Establish limited human use zones (buffers) that will "soften" the edges of Hukaung Valley and Htamanthi reserves reducing the risk of mortality for tigers. Completion date: June 2004.

e) Create new protected areas or special tiger management zones in the Taninthayi Division, including the Lenya River, Greater and Lesser Taninthayi River catchments. These sites will protect tigers and their habitats and allow limited human use of natural resources around the reserves in a manner complementary to tiger conservation. Completion date: December 2007.
f) Use existing GIS capabilities in the Forest Department to identify and demarcate special management zones and corridors for tigers. Completion date: December 2003.

5.6 Improving international cooperation and establish cooperative management of contiguous protected areas along borders to maintain connectivity of tiger habitat across international boundaries

5.6.1 Key issues

a) Trade and trafficking in tiger and other wildlife products is often associated with the trade in drugs and arms (Bennett and Rao 2002).
b) In Myanmar the trade is concentrated in areas with weak enforcement, especially along the border with China and Thailand (Bennett and Rao 2002). The trade is fuelled by the disparity in economies between neighbour countries, creating an underground economy and a drain on Myanmar's wildlife.
c) Local government officials in border areas are unaware of the Wildlife Law or the importance of wildlife, and sometimes supplement their incomes from wildlife trade.
d) Local militias effect law enforcement in border areas but National laws are only weakly enforced or not enforced at all.

5.6.2 Key actions

a) Conduct wildlife conservation and awareness training for 100 government personnel, including military, customs, police, immigration and local administrative staff, stationed near or on country borders. This would include basic training in identifying IUCN and CITES protected wildlife species. Completion date: December 2003.
b) Hold internal 2 workshops involving local government officials to discuss transborder issues including trade, trafficking and wildlife, and develop plans to suppress the trade. Completion date: December 2003.
c) Recruit local government officials on both sides of the Thailand border to suppress transborder wildlife trade at Mawdaung-Prachuap Kiri Khan, Kaleinaung-Ban I Tong, Kawthaung-Ranong (especially Tha Htay Island), Myawaddy-Mae Sot, Three Pagoda Pass, and Tachileik-Mae Sai, and prevent access by professional poachers from Thailand. Completion date: December 2004.
d) Create a tiger reserve in Taninthayi Division opposite Thailand protected areas that support large populations of tigers, Western Forest Complex and Kaeng Krachan National Park. Completion date: December 2004.
e) If possible expand the reserve or create new reserves to form a corridor between these two Thai reserves. Completion date: December 2007.
f) Develop a spatially explicit tiger conservation database for the Huai Kha Khaeng – Thung Yai Naresuan TCU (Level I TCU 73). Completion date: December 2005.
g) Where possible coordinate antipoaching patrols and/or wildlife surveys on both sides of the Thailand-Myanmar border.. Completion date: December 2004.

5.7 Monitoring the status of the tiger and prey population to assess the effectiveness of conservation efforts

5.7.1 Key issues

a) The success of the Plan will need to be assessed by monitoring tiger and prey populations.
b) The Hukaung Valley landscape will be a target for an extensive monitoring program.
c) Landscapes not yet protected but containing tigers e.g. Taninthayi Division, should be targets for medium intensity monitoring.
d) Sites where tigers were not found but are suspected to occur (Table 3) should be targets for low intensity monitoring (Karanth and Nichols 2002).
e) Specific methods used for monitoring will depend on the level of knowledge available for tigers (Karanth and Nichols 2002)(Table 5).

5.7.2 Key actions

For Hukaung Valley;

a) Identify critical habitats and core areas for tigers and prey across the landscape. Completion date: June 2003.
b) Estimate numbers of female tigers within the landscape and ascertain that there is a reproductively viable population of tigers. Completion date: December 2003.
c) Document the current threats, demographics, and range of human activities that must be taken into account if the proposed landscape is to be successful and sustainable in the long term. Completion date: June 2003.

For forest reserves in Taninthayi Division;

d) Create a GIS map and database to show current land use patterns, possible future land use trends, and tiger and prey source areas. Completion date: December 2003.
e) Train local foresters how to identify tiger and prey via sign surveys, in use of camera-traps for wildlife survey, and methods for making observations and recording data. Completion date: December 2004.
f) Determine occupancy of habitats in accessible sites across the landscape, including Myintmoletkat and Lenya River areas, which away from sites where tigers are known. Completion date: December 2005.
g) Determine prey abundance using line transect sampling. Completion date: December 2005.
h) Determine tiger abundance using double-sided camera-trap sampling. Completion date: December 2005.

For sites in Paletwa and Kaladan river catchment, Sumprabum, Khaunglanphu, Paunglaung, Momeik-Mabain, Central Bago Yoma, Rakhine Elephant Range and Saramati Taung area;

i) Train local foresters how to identify tiger and prey via sign surveys. Completion date: June 2003.
j) Determine occupancy of habitats at the sites using sign surveys. Completion date: December 2003.
k) Establish a logbook to record observations of tiger and prey, and encourage use of the logbook. Completion date: December 2003.

5.8 Improving public awareness of the importance of tiger conservation to increase support from local people

5.8.1 Key issues

a) Local government officials encourage local people to hunt tigers and split profits from the sale of wildlife products.
b) Professional hunters and hill tribal people (Kachin, Lisu, Naga, Khanti Shan) who consume wildlife live in villages adjacent to the Hukaung Valley, and pose a threat to wildlife.

c) Little public information exists about wildlife in Myanmar.
d) Wildlife education essentially does not exist in schools.

5.8.2 Key actions

a) Develop wildlife education programs to discourage hunting by local people in and near tiger reserves. Where possible recruit local people, especially ex-hunters to help implement these programs. Completion date: December 2004.
b) Involve 50 local people in wildlife survey and research activities to make positive use of their local or indigenous knowledge. Completion date: December 2003.
c) Collaborate with authorities in charge of development projects to include wildlife conservation as a component of those projects and resolve any potential conflicts between the needs of people and wildlife. Completion date: December 2003.
d) Produce a documentary about tiger conservation in Myanmar and broadcast it on National television. Completion date: June 2004.
e) Dub existing wildlife documentaries about Myanmar into Myanmar language and broadcast. Completion date: June 2003.
f) Adapt WCS education materials about tigers into Myanmar language and implement a special training program for schoolchildren at selected high schools in Yangon, and adjacent to tiger reserves. Completion date: June 2004.

5.9 Defining roles and responsibilities of personnel responsible for tiger conservation

5.9.1 Key issues

a) Wildlife conservation is hampered by a lack of understanding of roles and responsibilities of government staff.
b) The efficiency of protected area management can be improved by defining tasks and expectations for staff.
c) Park managers need leadership training to be able to perform their jobs successfully, and to direct human resources to effect conservation.

5.9.2 Key actions

a) Provide special training for managers of tiger reserves in management techniques, including leadership skills, decision-making, planning, protection, use of information and technology, and personnel management. Completion date: December 2003.
b) Invite managers of tiger reserves to observe the day-to-day operations in selected tiger reserves in India and Thailand. Completion date: June 2004.
c) Define roles for junior staff in Hukaung Valley and Htamanthi Wildlife Sanctuaries, and for Taninthayi Division junior forestry staff, and staff and in other areas in conducting field monitoring of tigers and prey. Completion date: December 2003.

Table 5. A guide to research methods for tiger conservation

Knowledge Base	Goal	Technique
No information	Determine occupancy	Sign surveys for tigers[1]
	Determine occupancy but sign survey inappropriate	Camera trap surveys for tigers
	Potential carrying capacity (K) for tigers	Line transect for prey Dung surveys for prey
Tigers present	Determine occupancy	Sign surveys for tigers
		Camera trap survey for tigers using single camera sets
	Determine tiger and prey abundance	Camera trap survey using single camera sets
		Line transect sampling for prey/dung
	Determine abundance of tigers	Camera trap survey for tigers using double camera sets
		DNA population estimation
	Determine K for tigers	Line transect sampling for prey/dung
Abundance/distribution data available	Habitat analysis	GIS to extend results of intensive habitat surveys
	Monitoring	Camera trap monitoring of tigers
		Calibrated sign surveys
	Ecological Studies	Radio telemetry
		Diet studies
		Demographic studies
		GIS

[1] 'for tigers' implies that sampling is designed to maximize the probability of encountering tigers

PART 6. HISTORICAL DATA, FIELD SURVEY METHODS AND DATA ANALYSIS.

This section is optional reading for researchers and others interested in the historical distributions of tigers, specific field methods used to collect information on current distributions, and data analysis techniques. All of this material provided the background for developing the Action Plan described in the previous section.

6.1 Past distributions of Tiger in Myanmar. In order to provide a framework for understanding the current situation for tigers, information on where tigers used to occur and the factors that brought about their decline was considered. For the purposes of this report, historical records were considered as those pre-1999, when this study began. A number of sources were used to reconstruct former distributions of tigers in Myanmar:

1. Published scientific papers. Prior to 1999, few biological surveys had been attempted in the country. Milton and Estes (1963) conducted the first dedicated biological surveys in the early 1960's. They identified declining wildlife populations in areas such as Pidaung Wildlife Sanctuary. Then during the 1980's a series of wildlife assessments were done in the context of assessing areas for forest protection by UNDP/FAO (1985). These reports prescribed the formation of new protected areas as critical for the future conservation of wildlife. In the 1990's WCS made efforts to document and define new areas for inclusion in the protected area system.

2. Hunter records. The majority of historical records come from published reports and books written by hunters. Game hunting was popular during the period of occupation by the British (pre-1948). These publications describe in detail the circumstances in which tigers were shot, trapped, snared or otherwise encountered by humans.

3. Survey reports. A number of reports by foresters and surveyors attest to the former occurrence of tigers.

6.2 Quality and reliability of information. A gazetteer was assembled from historical tiger records. The information was categorized as follows;

(a) Confirmed presence - where there was no reasonable doubt the observation was of tiger. These observations were from direct sightings, tigers killed, or reports of attacks by tigers on humans or livestock;

(b) Provisional presence - where there was a possibility that leopard or other species was in fact observed but was mistaken for tiger. These were observations of tracks and sign, or reports from other sources e.g. villager reports.

(c) Provisional absence - where a lack of evidence of tigers was reported. True absence over a given area can only be confirmed through monitoring over a periods of time ranging from several months to several years (depending on the size of the area) but except for recent efforts at Alaungdaw Kathapa this has yet to be attempted at any of the study sites.

Verbal reports were not considered as historical records due to the persistent problems with identifying large cats from track and sign (Duckworth & Hedges 1998; Lynam 1999) and because reports not written down at the time of observation invariably change in content and accuracy and become unreliable.

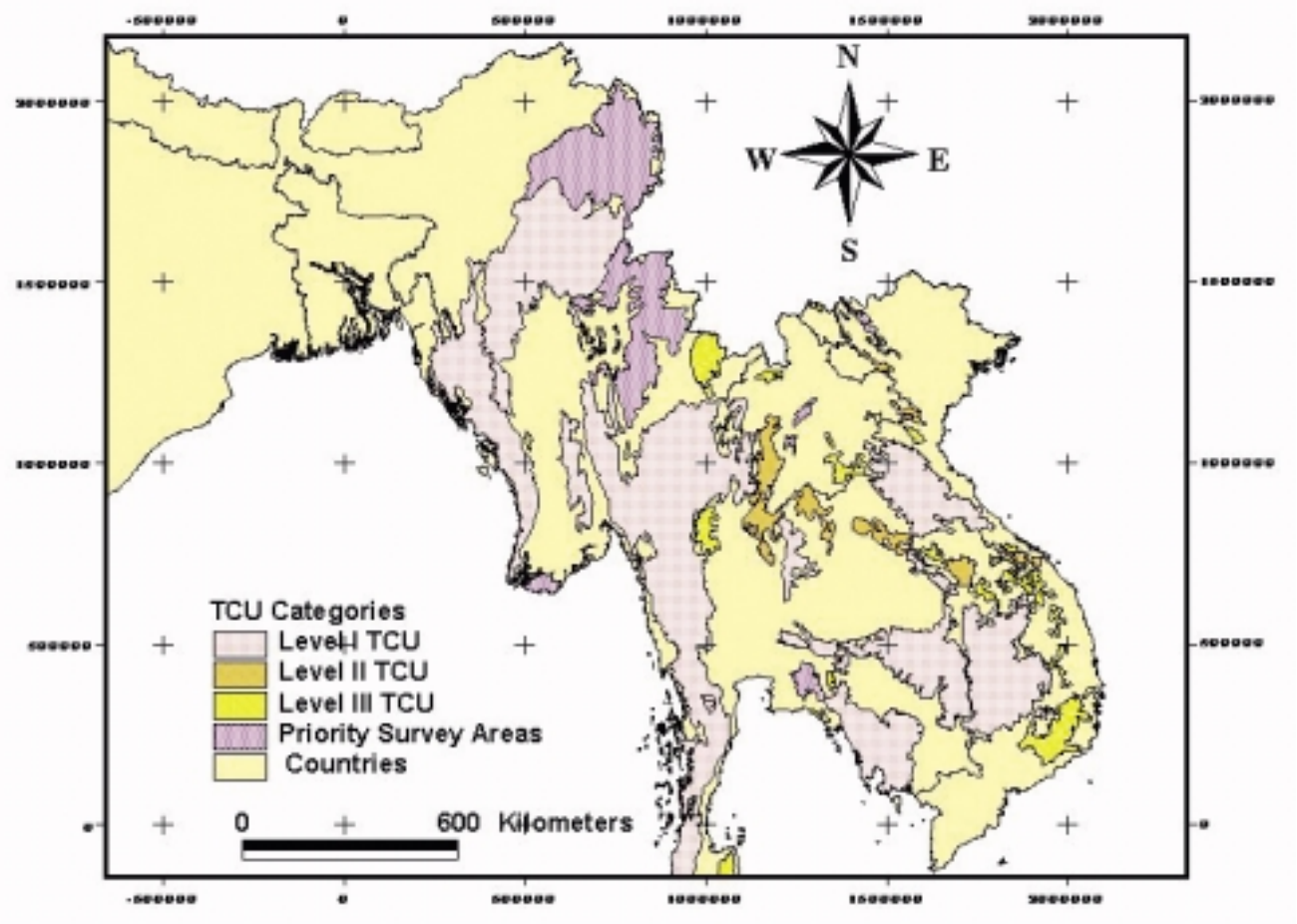
6.3 Characteristics of past distribution. A total of fifty-eight observations provided an historical record of tigers for the period 1903-1999 (see Fig. 2.; Appendix IV). Tigers were historically recorded from all areas but gaps in information exist for the delta area, the central east (Shan State) and the far north. The absence of records probably reflects that tiger was not reported rather than it never existed in these places. Tigers can survive in mangrove forests although the habitat is sub optimal (U. Karanth, pers.comm. 2002). Similarly, the absence of documented records from Shan State is due to the inaccessibility of the area rather than lack of tigers. Rabinowitz (1998) reported tigers had disappeared from the far north but evidence from hunters suggests their existence there in the past.

6.4 Potential tiger areas. During the early 1990's with the advent of new techniques for assessing population viability through consideration of genetics, the focus on conserving tigers shifted towards'a small population paradigm (*sensu* Caughley & Gunn, 1996). The idea was that tigers were fast being driven towards extinction in the wild so that captive breeding and genetic management would be necessary to save them'(Tilson et al. 1995). There is no doubt that for some critically endangered species such as Guam rail, Black footed ferret and Arabian oryx, and the subpopulation of tigers in southern China, species survival depended primarily on successful management in zoos. However, this approach ignored the fact that potentially viable populations of tigers still existed across most of their range in the wild but that their status remained unknown (Rabinowitz 1999), so that effective conservation planning could not happen. In an attempt to refocus attention on the plight of wild tigers, WWF and WCS attempted a geographic assessment of the extent and availability of habitat, and potential prey resources (Dinerstein et al. 1997). This analysis identified a series of potential areas – Tiger Conservation Units (TCU's) - in which tigers could conceivably occur. For example, it was considered that tigers might occur across large expanses of potential habitat.

In Myanmar, four areas with the greatest potential for tigers (Level I TCU's) are large and relatively intact forest transboundary forests in the west along the Myanmar-Bangladesh and Myanmar-India frontier, Upper Chindwin and Upper Ayeyarwaddy, and along the Thai-Myanmar frontier, and forests in central Bago Yoma (Fig. 10). A series of much smaller, highly fragmented forest areas provide lower potential for tigers. These are termed Level II and III areas. According to the analysis, forests in the far north, central east and delta areas had unknown occupancy for tigers. These areas were considered priorities for immediate survey reflecting large gaps in historical information on tiger occurrence.

Several characteristics of the potential tiger habitats are worthy of mention. Firstly, despite the relative intactness and contiguity of forests in the Level I category, tigers may not be uniformly found across available habitat (Prater 1940; Rabinowitz 1995). Secondly, the Level I TCU's include areas of degraded or completely cleared habitats. Tigers if occurring there would likely be non-breeding transient individuals (G. Schaller pers. comm., 2002), a small percentage of the population that are prepared to risk movement across hostile areas in the landscape to cross between forest patches. Finally, the TCU analysis was a very useful exercise because it did two things; it refocused attention on the plight of wild tiger populations, defined areas where information on the status of the wild populations was lacking.

FIG. 10. TIGER CONSERVATION UNITS (TCU'S) FOR MYANMAR AND NEIGHBOUR COUNTRIES.



6.5 Rationale for tiger status survey program. Despite the past distributions and current potential areas for tigers, areas of natural vegetation available for wildlife declined from 75% of land area to 50% in 50 years (Collins 1991; FAO 2000). Land use patterns changed after 1948 when traditional forest management regimes that regulated and systematized harvest were replaced with less regulated and in some cases opportunistic clearance. For example, while good management of natural forest occurs in most areas, foreign logging companies clear-cut or felled timber outside concessions in near the border during the period 1989-1993 (International 1999).

By the early 1990's hunting and illegal trade had reduced tiger populations to an unknown subset of the potential areas. Some areas with apparently suitable habitat were devoid of tigers (Rabinowitz 1999). Prior to the commencement of this project in 1999, the state of knowledge of tigers amounted to reports of tiger occurrence from a limited number of areas (Rabinowitz 1999). Hunting of tigers has been going on for a very long time (Pollok & Thom 1900). More recently with reduced supply of tigers and tiger parts in the marketplace, demand has increased (Hemley & Mills 1999) with unmeasured effects on wild tiger populations.

In order for effective conservation planning to take place, there was an urgent need to know where tigers existed across the vast landscapes of Myanmar, and what was the condition of tiger subpopulations. A field program was mounted to satisfy the following objectives:

1. To train government field staff in tiger assessment methods.
2. Using information on potential tiger areas from historical records and local knowledge to determine tiger presence-absence across these areas, and limits of tiger distributions.

3. To define threats to tigers and their habitats.
4. To redefine priority areas for future tiger conservation.

6.6 Training and selection of Tiger Team members. The capacity of field staff to conduct independent wildlife survey and research is generally poor in Asia and this has led to problems with interpreting basic information on species occurrence and abundance for protected areas (Duckworth & Hedges 1998). Park staffs are generally unfamiliar with animal track and sign thus making reports of tiger occurrence unreliable. As an example of this, at Alaungdaw Kathapa National Park, historically one of the better-known tiger areas (UNDP/FAO 1982), park staff reported tigers as common in 1998 but plaster casts of tracks purported to be of tiger were on inspection found to be of Asiatic leopard and Golden cat (Lynam et al. 1999). Part of the problem in Myanmar is a general one across Asia in that training of government staff has traditionally focused on production forest management and silviculture. Protected area conservation is a relatively new task for foresters and wildlife training is generally unavailable at the college or university level.

Wildlife training for Myanmar foresters began with a WCS program in 1995. The training, based on a standard curriculum (Rabinowitz 1993b), provides instruction in techniques for observing and recording wildlife, and basic survey and analytical techniques. Since 1995, 270 protected area field staff, and local NGO staff have received the WCS basic training. Smithsonian Institution, and the California Academy of Sciences provided other specialist training in wildlife monitoring techniques to Forest Department staff.

As a starting point for the National Tiger Action Plan project, the Wildlife Conservation Society - Myanmar Programme in collaboration with the Myanmar Forestry Department provided a training course in tiger survey techniques and conservation at Alaungdaw Kathapa National Park, from December 7-21st, 1998. The objectives of this training were,

1. To train junior forestry staff in basic techniques of map and compass, wildlife observation and data recording.
2. To provide specialized training in describing tiger habitats, conservation and census techniques for tigers and tiger prey species.
3. To identify talented Forest Department staff for inclusion in a National Tiger Survey Team (NTST).

WCS staff from New York, Thailand and Myanmar conducted the training. Dr Alan Rabinowitz, Director of Science, Asia Programs, an expert on large carnivore conservation ecology, and the author, lectured to the trainees and directed a variety of classroom based and field based training activities. WCS Myanmar Country Programme Coordinator U Saw Tun Khaing and Research and Training Coordinator U Than Myint supported them. This was the first time this kind of training had been done in Myanmar, and the first time anywhere in Southeast Asia.

Twenty trainees and three observers attended the 14-day training (Fig. 8.). These staff came from twelve national parks and sanctuaries, the Institute of Forestry, and the Forest Resources and Environment Development Association (FREDA). The trainees were assessed on their participation in group assignments and a 4-day field project, and on their individual performance in class and practical assignments, a comprehensive exam, and overall level of participation in the training.

From the training a group of six talented young forestry professionals were selected to form the first roving tiger field survey team to participate in field assessments for tigers at selected forest sites across Myanmar.

6.7 Methodology. The surveys were intended to determine presence-absence for tigers, and relative abundance for prey species, so as to permit the evaluation of study areas for their potential for tigers. The surveys were not intended to determine numbers of tigers in the reserves.

Tigers, like other tropical mammals, are generally difficult to observe directly due to their rarity, cryptic behaviour, partial nocturnality and avoidance of humans (Griffiths & van Schaik 1993; Schaller 1967). A combination of indirect and direct survey methods was used to detect tigers and other large mammals; potential prey species.

Field observations of tigers can be categorized so as to facilitate interpretation of their ecological status. Four types of observations are given in Table 6. Tigers may be detected or not detected by a given survey technique. The detection of tigers confirms presence but may or may not indicate a reproductive population. Where tigers are not recorded, this could indicate problems with sampling, for example where tigers are missed due to extreme rarity, or true absence.

Where tigers occur at densities under 0.38 tigers/100 square kilometre, very large amounts of sampling with camera-traps (>1,000 trap nights) needs to be done in order to detect them (Carbone et al. 2001). In this study sampling of >1,000 trap nights were not feasible so that tigers might not be recorded at some low-density sites even though they were present.

Table 6. Interpretation of Tiger Population Status from Field Observations.

Observation	Population Status	Interpretation
1a Tigers recorded	Reproductive population	Indicated by observations of pregnant females, juveniles and/or cubs
1b Tigers recorded	Present but not necessarily reproductive	Indicated by observations of adult male or non-pregnant adult female individuals
2a Tigers not recorded	Low density, ecological effective absence	Tigers may be present at low density but are not recorded due to sampling errors e.g. tigers not present in survey area. A tiger population may be disrupted, sex ratios skewed, or individuals have difficulty finding mates so that reproduction is not possible (Allee effect)
2b Tigers not recorded	True absence	Tigers are not recorded over a period of monitoring at a site

6.7.1 *Choice of study areas* – Given the time frame of the project (3 years) it was not possible to investigate tiger occurrence in all forest areas. Using information from historical records and potential tiger areas, 17 sites with the highest probability of supporting tigers were chosen for survey (Fig. 9.). These areas represented a non-random subset of available landscape and habitat options for tigers spanning the geographic extent of the country from approximately 11°-27°N, and 93°-99°30'E.

1. Alaungdaw Kathapa National Park (AKNP)
2. Htamanthi Wildlife Sanctuary (HTM)
3. Thaungdut Reserve Forest (TD)
4. Mahamyaing Reserve Forest (MHM)
5. Nankamu Reserve Forest (NKM)
6. Saramati Taung (SRMT)
7. Paunglaung Catchment (PGL)
8. Panlaung Pyadalin Cave Wildlife Sanctuary (PPDL)
9. Central Bago Yoma (BGY)
10. N. Rakhine (RN) or Paletwa and Kaladan river catchment
11. Rakhine Elephant Range (RER)
12. Hukaung Valley (HKV)
13. Khaunglanphu (KLP)
14. Sumprabum (SBP)
15. Momeik-Mabain (MB)
16. Myintmoletkat (MMLK)
17. S. Taninthayi (TNTY)

Descriptions of each site are given in Appendix I.

6.7.2. *Interview surveys* - Interviews of people living in suspected tiger areas are potentially useful because they draw upon local knowledge of wildlife accumulated over long periods of time, and may help determine the status and identify threats to tigers and other mammals (Rabinowitz 1993b). However, the reliability of information to be gained depends upon a number of factors, especially the correct interpretation of local information by the interviewer (Duckworth 1999), the manner and disposition of the interviewer, and how the interviewee perceives this. An interview protocol (Appendix V) was designed during the tiger-training course (Lynam et al. 1999) and this was used by Myanmar-speaking interviewers to gain indirect evidence on tiger occurrence in the 17 potential areas. Direct survey was done in and around locations of the most recent reliable reports of tigers from interviewees.

6.7.3 *Track and sign* - Large mammals produce tracks, faeces, scrapes, scratches, kills and other sign so that under certain circumstances the substrates on wildlife trails, streambeds, and ridges may indicate their recent presence (Wilson et al. 1996). However, there is significant variation in the size, shape and appearance of tracks and sign of some groups; including large cats (Duckworth & Hedges 1998; Kanchanasakha et al. 1998) so that tiger may be confused with other species (Lynam et al. 1999). For these reasons sign was considered not sufficient for the identification to species level for cats, dogs, civets, deer, muntjac, wild

cattle, and otters. However, the abundance of sign was generally indicative of the level of mammal traffic in an area. Ungulate sign was additionally used to indicate possible areas of carnivore activity, and as such to help guide the placement of camera-traps for detecting the latter (below).

Standardized datasheets were used to record date, time of day, weather, location (latitude/longitude) type of sign, dimensions of track/sign, probable species/genus identity, age, substrate, and habitat type (Appendix VI). Locations where mammal sign was encountered were recorded with a Global Positioning System (GPS) device capable of resolving position information beneath tree canopies, accurate to ± 100 m* (Garmin 12XL, Garmin Corporation, Kansas USA). Feline tracks with total length 120mm or pad width 7cm, and scat 3.5cm in diameter were considered to be indicative of tigers (A.J. Lynam, A. Rabinowitz & R.K. Laidlaw unpublished data; Cutter 1999; Duckworth & Hedges 1998). Where the size of a feline track was ambiguous because of the substrate or age of a track, the track was identified only as "large cat" meaning either tiger or leopard. Other species were identified using a field guide to Thai mammal tracks (Green World Foundation 1999). An index of abundance "Encounter Rate (CR)" was estimated from sign surveys as ER = No. Sign detected/hr.

6.7.4. *Camera-trapping* - Remote camera methods have been used successfully to photographically record wildlife in tropical Asian forests (Chapman 1927; Griffiths & van Schaik 1993). Although these devices are relatively expensive they offer a reliable method for inventory of species that are cryptic nocturnal or rare, including tigers (Lynam et al. 2001). Passive infrared-based camera-traps (Camtrak South Inc., Georgia USA)(Fig. 11.) were used in all surveys.

Fig. 11. Infrared-based camera-traps were used to detect tigers and prey species.

To achieve the best possible resolution of species identity from photographs, camera-traps were secured to trees 0.4m above the ground, 3-5 m from a wildlife trail. All camera-traps were set to allow continuous recording of wildlife movements day and night. Traps were left in place for at least 24 days to allow for adequate sampling of large mammal species richness (A.J. Lynam unpublished data) and at least 1,000 trap nights to correctly determine tiger presence or absence (Carbone et al. 2001). For example, tigers were considered absent from a site if they were not recorded in any trap, with absence referring to the particular area effectively sampled for the particular sampling period. The sampling effective area at a site was estimated by placing a buffer around the outermost locations of camera-traps with the length of the buffer equivalent to half the mean distance between camera-traps. A time delay of 3 or 6 minutes prevented entire rolls of film being taken by groups of animals lingering in front of the camera-trap. An index of abundance "Capture Rate" (CR) was estimated from camera trapping as CR = No. Photo records/100 camera-trap nights.

6.7.5. *Survey design* - Two survey designs were employed for tigers (Fig. 12.). In both cases, the primary intention was to gain information on (1) tiger presence-absence, (2) tiger and prey micro distribution and activity in each study area.

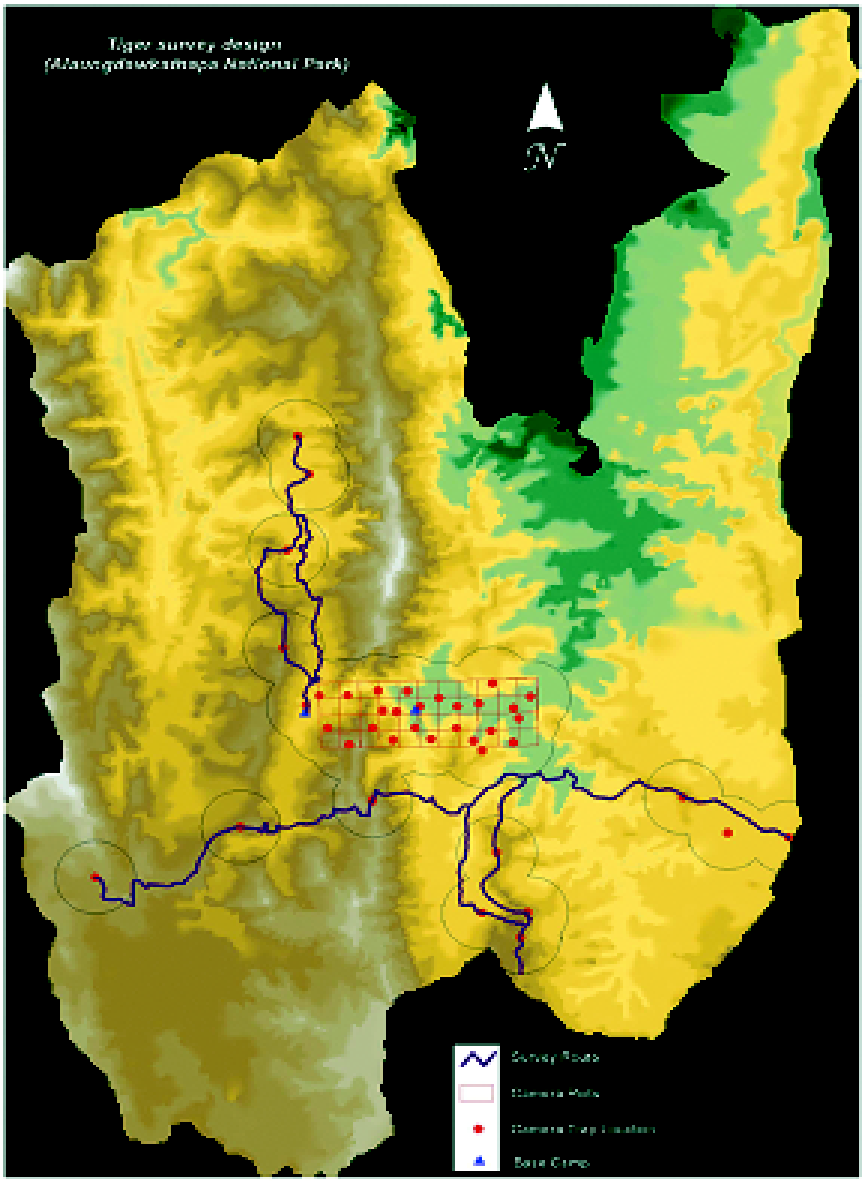


Fig. 12. Tiger survey design (see text for details).

First, camera-traps were placed at random locations within 10 x 4km sampling grids, in alternative 1km^2 grid blocks. This was termed the *plot-based* survey design (Lynam et al. 2001). The random locations were reached using Global Position System (GPS) receivers (Garmin 12XL, Garmin Corp. Kansas USA). Traps were established on trails or other suitable positions within 100m of random locations. Grids were located in areas where interviews suggested tigers occurred, or where tiger occurrence could not be determined, in the part of a study area least disturbed by humans. Tigers require a core area of undisturbed habitat for their survival (Schaller 1967) although this may be a small part of their entire home range (Miquelle et al. 1999). If tigers are present in an area they are likely to at least frequent a core undisturbed area and should be detectable there.

In the second design, camera-traps were deliberately placed along trails and roads where sign of tigers, large cats or their prey species were recorded. This was termed the *trail-based* survey design (Lynam et al. 2001). Sampling locations where capture probabilities for tigers are highest (Karanth and Nichols 1998) increases the likelihood of their detection at a site.

Because the stripe patterns of tigers are unique to an individual (Schaller 1967) but are different on left and right sides, camera-trap photographs of both sides of an animal must be used to distinguish it from other tigers (Franklin et al. 1999) While specific methods are available for estimating tiger density from double-sided camera-trap designs (Karanth 1995) this was not the purpose of this study. However, to gain information on the minimum number of tigers known to be alive (MNKA) inside the survey area, pairs of camera-traps were placed on opposite sides of animal trails, staggered by 2 - 3 m at locations where field staff considered tigers were likely using e.g. because of presence of sign of tiger and/or large ungulates These "checkpoint" arrangements were established to gain double-sided photographs of tigers.

In summary, the surveys obtained four types of indices: i) tiger presence-absence, (ii) minimum numbers of tigers known alive (MNKA); (iii) minimum ranges of individual tigers from linking outermost points of locations where tigers were captured in camera-traps or identifiable from tracks and sign; (iv) an index of abundance (traffic) of large mammal species, i.e. Capture Rate = No. Captures/ 100 trap nights

6.7.6 *Survey personnel.* At all sites surveys were done by Myanmar Forest Department staff in collaboration with WCS personnel (except in Taninthayi Division), and local forestry or other government staff. Local people were hired as porters to carry equipment and assist with field logistics. In security areas teams of military personnel joined the survey team. The size of the field survey teams was 3 - 7 key staff with 10 – 40 support staff. The average cost of each survey was US$3,600.

6.7.7. *Survey effort, constraints and coverage.* In most cases, the survey areas were remote and difficult to access, and surveys required special permissions and clearances. Surveys were constrained by a number of factors including extremes of weather, topography, and security considerations. The particular sites where camera-trap surveys were done at MMLK and TNTY were *not* optimal sites, and were in fact selected by security personnel assisting the team. At each site, field staff attempted to obtain the maximum coverage of the area suspected in tiger survey. All surveys were conducted on foot and consumed 26 ± 5 days (range: 15 – 100) to reach the survey area, and 86 ± 12 days (range: 10 – 207) to complete a survey from start to finish. Total survey coverage was 3,432 sq. mi (5,491 km^2), or 202 ±

29 sq.mi (range: 91 – 525 sq. mi). At Alaungdaw Kathapa and Htamanthi the areas covered by survey (244 and 329 sq. mi, respectively) were each one-quarter the size of the protected areas. Interviews of a total of 990 people, or 58 ± 17 interviews (range: 5 – 276) per site were done to determine areas for direct survey. A total of 1,382 hrs, or 81 ± 9 hrs (range: 32 – 171) per site were spent searching for track and sign of tigers. Camera-traps were established in a total of 430 locations, or 25 ± 3 locations per site (range: 0 – 45) to detect tigers.

6.7.8. *Data recording and storage* - Standardized data recording forms were employed to record all field data from surveys (Appendices VI-VIII). In the field, staff recorded information on camera-trap operation, measured a suite of microhabitat characteristics at survey locations, and records of track and sign taken along survey routes. All records of wildlife were spatially referenced in UTM grid format using GPS. Following camera-trap retrieval, films were developed at a laboratory in Yangon, and slides catalogued and scored, with records entered into a spreadsheet. Slides were scanned at low resolution and archived.

In order to manage the volume of information arising from the field program, to facilitate analyses of data, and to develop a clearinghouse of baseline information on tiger and other wildlife for the 17 survey areas for use in future management efforts, an electronic database was developed for the project. This database, written in Microsoft Access by U Myint Thann, contains 15,021 records including all results of track and sign and camera-trap surveys, as well as measurements of microhabitat structure.

In addition to the Access database, a spatial database was developed using Arcview 3.1 software (ESRI Systems, Inc., Redlands, USA) with the assistance of the Myanmar Forest Department (FD) GIS Facility. The database includes information on forest cover and land use, locations of survey sites, drainages, topography, human settlements, roads and other human infrastructure. In the future, the two databases will be linked to allow quick retrieval of information from surveys directly from the spatial database. This GIS could serve as a template for a National Wildlife Database to which other information on biodiversity might be archived in the future.

6.8 Results

6.8.1. *Camera-trap operation.* A total of 4,099 photo records were made by camera-traps including 3,341 records (88%) of wildlife, 358 records (9%) of humans, and 112 records (3%) of domestic animals (Appendix II). A total of 19 globally threatened species and 3 globally near-threatened species, 12 CITES Appendix I, 6 Appendix II, and 7 Appendix III species. Eighty-three percent were Myanmar protected species, with 40% totally protected species

The mean failure rate per site was 17± 3% (range: 1 – 33, N=15). Camera-traps failed to work for a variety of reasons ranging but were mostly a result of mechanical failure. Extremes of heat, cold and moisture may cause internal circuits and sensors to stop working in the field. Theft, and damage from animals, especially elephants, were secondary reasons for trap failure.

6.8.2. *Species richness.* Camera-traps revealed a diverse assemblage of fauna at fifteen sites (Appendix II). Forty-two species of large mammals were recorded with an average 16.4 ± 1.3 species (range: 6 – 22, N=15) per site (Appendix IX). Six species were recorded at MB, the least rich site, while at four sites, AKNP, TMT, RN and SPB, 22 species were documented.

In addition, sixteen species of birds, small mammals and reptiles were recorded. However, these fauna were likely to be recorded as accidents of sampling in camera-traps so that the surveys were not representative of their richness.

6.8.3. *Wildlife traffic.* Surveys indicated a range of levels of wildlife traffic across sites. Only large mammal species are considered here. From camera-traps, sites had a mean capture rate of 15.0 ± 2.6 animals/100 trap nights (N=17). MB had the lowest capture rates (5.7 animals/100 trap nights) with BGY and RN having the highest capture rates (36.2 and 34.2 animals/100 trap nights, respectively). From track and sign surveys, the mean encounter rate of wildlife sign was 4.1 ± 0.5 signs/hr. PPDL had the lowest encounter rates (1.7 signs/hr) with NKM the highest (8.3 signs/hr).

6.8.4. *Human traffic.* Levels of human traffic also varied across sites. From camera-traps, sites had a mean capture rate of 2.1 ± 0.7 photorecords/100 trap nights (N=17). TMT and SRMT had the lowest human traffic (0.15 and 0.18 photorecords/100 trap nights) with PPDL having the highest traffic (11 photorecords/100 trap nights, respectively). From track and sign surveys, mean human traffic was 0.3 ± 0.05 signs/hr. TMT and RER had the lowest encounter rates (<0.1 signs/hr) with TNTY the highest (0.7 signs/hr).

6.8.5. *Occurrence of carnivores.* One or more of the large carnivores – tiger, Asiatic leopard (*Panthera pardus*), Malayan sunbear (*Helarctos malayanus*) and Asiatic black bear (*Selenarctos thibetanus*) and Asian dhole (*Cuon alpinus*) were recorded by camera-traps at all 17 survey sites (Appendix IX.). Sunbear occurred at all but two sites, SRMT and PPDL, making it the most frequently occurring large carnivore species. Dhole occurred at all but four sites, TMT, SRMT, PLG, and MB. Leopard occurred at just over half the sites. Asiatic black bear occurred at just under one-quarter of sites.

6.8.6. *Occurrence of tigers across study sites*

Interviews. A total of 990 local people were questioned about the occurrence of tigers and other wildlife at the 17 sites (Appendix III). These individuals were local villagers, hunters, and government officials living in or around forest areas. Two hundred and thirty eight (24%) individuals interviewed reported having either seen tigers, encountered sign, or heard tigers. One hundred and seven (45%) records were direct sightings. Eighty-seven (81%) of these eyewitness accounts were made after 1990.

Direct survey. Signs of large cats (tiger or leopard) were recorded at all survey sites. Tigers were confirmed by camera trapping at four of 17 sites, TMT, HKV, MMLK and TNTY (Appendix IX; Fig. 13.).

1. TMT: a single photo of a tiger was recorded during October 1999 along with two sets of tracks during the trap retrieval exercise. After the survey team left the area, a tiger was reported killed by hunters from an area adjacent to the survey site.
2. HKV: Fresh sign was found on both sides of upper and lower Shipak Hka between Tarung Hka and Brangbram Hka, and at Numpraw Hka on 3rd February 2002, during the camera-trap set up exercise. Three photos of tiger were recorded by camera-traps on 11.2.01, 10.3.01, and 11.3.01. Tigers are thought to be resident in the upper Brangbram Hka, upper Tanaing Hka, Maingkwan and surrounding area, and around Shingbweyang.
3. MMLK: Fresh tracks were found during the camera-setup (26.9.01 – 4.10.01) and retrieval exercises (7.11.01-14.11.01) and plaster cast records made. A single photo

of a tiger was recorded from a camera-trap unit set up on a trail on 10.10.01. Nine of 25 units failed to operate so more photo-records might have been made.

4. TNTY; a set of tracks was encountered during the camera-setup operation (17-20.1.02) and a plaster cast made. Although no photo records were made local people reported a killing of a tigress on 17.1.02 at Kyachaung Village, 2 mi S of Manoron

(Footnotes)*

As of 1 May 2000 the United States Department of Defence, the agency that controls GPS satellites, turned off Selective Availability (SA) or "scrambling" of GPS satellite signal information. Prior to this date the accuracy of GPS position fixes was limited to ±100 m. Most recreational GPS devices are now capable of real time position fixes accurate to ±20 - 25m.

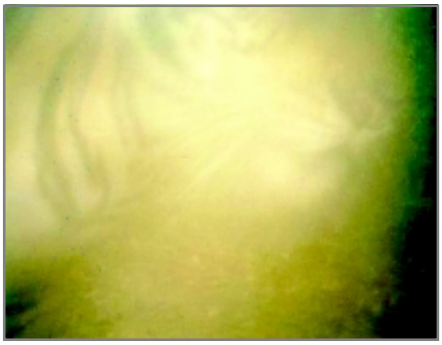
Fig. 13. Camera-trap photo records of tiger from 17 survey sites in Myanmar, 1999-2002.

1. Tiger recorded by camera-trap at Thayet Chaung Township, Dawei District, Taninthayi Division, 10.10.01

2. Tiger recorded by camera-trap at Hukaung Valley, Kachin State, 10.3.01

3. Tiger recorded by camera-trap at Hukaung Valley, Kachin State, 11.2.01

4. Tiger recorded by camera-trap at Hukaung Valley, Kachin State, 11.3.01



5. Tiger recorded by camera-trap at Htamanthi Wildlife Sanctuary, Sagaing Division, 10.99

6.8.7. Tiger density. (Karanth & Nichols 2000) estimated tiger density for multiple sites in India. One of their study sites – Bhadra – is similar in topography and vegetation to northern Myanmar forests. Using information from single sided captures, tiger density was estimated for the Hukaung Valley, where captures of two individual tigers were made. Using a mark-recapture approach (Karanth and Nichols 1998) and assuming a capture probability for tigers (0.788) and a sampling buffer (2km), densities were estimated for the tiger populations at HTM, HKV and MMLK (Table 7).

6.8.8. Occurrence of other large mammals. Large (>1 kg) herbivores were recorded from all survey sites (Appendix IX.). Common muntjac (*Muntiacus muntjak*) was the most abundant species in camera-traps and was found at all sites. Wild cattle were recorded at all sites except SRMT, PPDL, and MMLK. Banteng (*Bos javanicus*), a globally threatened species was found at 3 sites, AKNP, MHM and BGY. Sambar (*Cervus unicolor*) was present at all sites except SRMT, PPDL, and MB. Serow (*Capricornis sumatraensis*) was recorded at just fewer than 50% of sites.

6.8.9. Human traffic within study sites.
Camera-traps recorded suspected poachers at 8 (47%) of sites (Appendix IX.) with villagers recorded at all but three sites, HKV, SPB, MB. Traps at AKNP recorded park rangers on patrol, while traps at MMLK and TNTY recorded military personnel on patrol.

Table 7. Tiger Densities at Some Rainforest and Evergreen Forests in Myanmar and Other Southeast Asia Countries.

Country	Site	No. tigers detected	Density est.* (tigers/100km2)	Min density	Max density
India	*Bhadra*	*7*	*3.42*	*2.58*	*4.26*
Thailand	Kaeng Krachan	4	2.82	1.96	3.67
Thailand	Hala	3	2.68	2.42	2.93
Thailand	Bala	2	1.79	1.50	2.07
Malaysia	*Temenggor*[1]	*2*	*1.78*	*0.94*	*2.63*
Indonesia	*Bukit Berisan*[2]	*9*	*1.60*	*1.2*	*3.2*
Myanmar	**Hukaung Valley**	**2**	**1.10****	**0.91**	**1.29**
Myanmar	**Myintmoletka**	**1**	**0.67****	**0.38**	**0.96**
Thailand	Phu Khieo	1	0.62**	0.35	0.88
Myanmar	**Htamanthi**	**1**	**0.49****	**0.28**	**0.70**
Thailand	Khao Yai	1	0.38**	0.22	0.54

* Single sided M-R estimates using Program CAPTURE
** No recaptures. Density (D) = No. tigers (N) /Area, where N = No. tigers detected/p, and p=0.778 (from Badhra, India; Karanth and Nichols, 2000)
[1] R. Laidlaw and DWNP (unpublished data)
[2] O'Brien et al. ms

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APPENDIX I. DESCRIPTIONS OF 17 MYANMAR TIGER SURVEY SITES

1. Alaungdaw Kathapa National Park (AKNP)

Location: Lies between 22°14' - 22°29'N and 94°17' - 94°36'E between the Chindwin River floodplain and Myittha River valley in Sagaing Province, approximately 100 mi (160 km) west of Mandalay.

Elevation: 100 - 3,440' (30 - 1048m).

Survey area: Centred on Mindon Camp covering an area of 152 sq. mi (390 km^2).

Description: The area is dissected by a number of high elevation 2000-4000+' (700-1219m) ridges that run in a north-south direction, and is drained by the Patolon and Taungdwin Rivers that flow northwards into the Chindwin River.'

Vegetation: Varies from Dry Upper Mixed Deciduous (DUMD) forest on the high ridges and slopes to Moist Upper Mixed Deciduous (MUMD) forest on lower slopes. Bamboos are common in the under storey on lower slopes. Semi-Indaing forest, high Indaing forest or Pine forest occur in patches on the tops of some high ridges.

Access: Alaungdaw Kathapa is accessed from the east by road from Yinmarbin, and via a newly constructed road that links India with Mandalay and cuts through the northwest of the park. Walking distance from the nearest road was 1 day.

Rainfall: The area is subject to two monsoons, a southwest monsoon which brings most of the yearly rainfall between May and October, and heaviest between August and September. Mean annual rainfall is 588" (1,507mm). Water is available year round in the major drainages with smaller tributaries mostly drying up by the end of March.

Human impact and landuse: The park is surrounded almost completely by cultivated land but inside the park the only settlements are of park staff, mahouts and a monastery. Government camps and religious pilgrimages pose threats to wildlife. Other threats are hunting for wildlife trade, extraction of non-timber forest products, livestock grazing and fishing.

2. Thaungdut (TD)

Location: Lies Lies between 24°17' - 24°30'N and 94°30' - 94°43'E inthe Homalin Township, Sagaing Division and includes with Kabaw Valley.

Elevation: 432 - 2,314' (130 - 695m**).**

Survey area: Covers an area of 82 sq. mi. (210 km^2) 10mi (16km) from Thuangdut village.

Description: The survey area is surrounded by Thaungdut Reserve Forest in the east, southeast and by Kabaw Valley in the north and northwest. The Nantanyit Chaung runs south to north between Minthamee Mountain 1,871'(570m) and Nantanyit Mountain 3,545' (1,080m) and enters the Chindwin River near Thaundut village.

Vegetation: Varies from DUMD forest, MUMD forest, to Indaing forest. Bamboos such as Myin Wa, Tin Wa, Wa Bo, Wa Nipa, Theik Wa, Kya Khet Wa, as well as rattan are common.

Access: Thaungdut village is accessible by boat along the Chindwin River year-round. It takes about 2 days travel by boat from Monywa. From Thaungdut village the survey area can be accessed by elephant or on foot.

Rainfall: 74 - 99" (188 - 251mm) of rain per annum.

Human Impact and Landuse: Timber extraction has occurred in the area for several years, with the Myanmar Timber Enterprise still extracting hard wood, mainly Teak. Hunting, timber cutting, and intrusions by elephant workers and fishermen are threats

to wildlife in this area. There were no signs of human settlements or cultivation in the area at the time of survey.

3. Htamanthi Wildlife Sanctuary (TMT)

Location: Lies between 25°16' - 25°44'N and 95°19' - 95°46'E It is bounded to the N by Nampilin Chaung, to the E and SE by Pali Taung, Temein Taung, and New-ta-mein Taung 1,000 - 2,000' (304 - 609m) and the Uyu River, to the S by numerous streams, and to the W by the Chindwin River.

Elevation: 490 - 1,100' (149 - 335m).

Survey area: Covers an area of 205sq. mi (526 km^2).

Description: Vegetation is primarily tropical evergreen forest with dense bamboo and rattan undergrowth. Mixed deciduous teak forest is also found on higher slopes in the eastern part of the sanctuary.

Access: The area is accessible by boat from Homalin, the nearest town, 57 mi. (91km) and a 2 day journey away.

Rainfall: 136" (3,491mm) per annum. The area is drained by the Nampilin, Nam Emo, Nam Ezu, Nam Pagan and Nam Yanyin all of which flow W into the Chindwin River.

Human impact and landuse: No permanent human settlements exist inside the sanctuary but the area is used by Lisu hill tribes who hunt wildlife, and by local people who fish and extract non-timber forest products. Oil drilling occurs in the area.4. Mahamyaing (MHM)

Location: Lies between 23°31' - 23°43'N and 94°51' - 94°57'E. The area includes parts of Lawthar, Pyaungtha, Maingwan, Mahamyaing and Nonsabai Reserve Forests.

Elevation: 226 - 2,071' (68 - 631m).

Survey area: 78 sq. mi. (200 km^2).

Description: The landscape is characterized by evergreen, mixed deciduous and Indaing (Dipterocarp) forests. The area is drained in the W by the Kaedan Chaung which originates at Honan Taung Dan 2,017" (614m) and flows into the Chindwin River. In the E the Pyaungthwe Chaung drains into the Mu River.

Access: Reached on foot from Aungchanthar Village, 20mi. (32km) away on the Monywa-Khanti highway

Rainfall: 46 - 69" (117 - 175mm) per annum.

Human impact and landuse: Timber extraction from the surrounding areas has taken place since 1973. At present two private companies are extracting dipterocarp timber from part of the area. Numerous current and old settlements occur in the area. Cattle grazing is taking place. Oil drilling occurred in the past.

4. Mahamyaing (MHM)

Location: Lies between 23°31' - 23°43'N and 94°51' - 94°57'E. The area includes parts of Lawthar, Pyaungtha, Maingwan, Mahamyaing and Nonsabai Reserve Forests.

Elevation: 226 - 2,071' (68-631m).

Survey area: 78 sq. mi. (200 km2).

Description: The landscape is characterized by evergreen, mixed deciduous and Indaing (Dipterocarp) forests. The area is drained in the W by the Kaedan Chaung which originates at Honan Taung Dan 2,017' (614m) and flows into the Chindwin River. In the E the Pyaungthwe Chaung drains into the Mu River.

Access: Reached on foot from Aungchanthar Village, 20mi. (32km) away on the Monywa-Khanti highway

Rainfall: 46 - 69" (117 - 175mm) per annum.

Human impact and landuse: Timber extraction from the surrounding areas has taken place since 1973. At present two private companies are extracting dipterocarp timber from part of the area. Numerous current and old settlements occur in the area. Cattle grazing is taking place. Oil drilling occurred in the past.

5. Nankamu (NKM)

Location: Lies between 24°03' - 25°15'N and 94°57' - 96°12'E between Paungbyin and Pinlebu Townships. It includes parts of Sanda, Kaingshe and Paungbyin Reserved Forests. In the N it is bounded by the catchment of Thetla Chaung, a tributary of the Chindwin River, to the E by Zibu Taungdan 2,319 - 2,910'(706 - 886m), a catchment of the Mu River, to the S by the Namkawin and Kodan Chaung, tributaries of the Chindwin River.
Elevation: 186 - 2,100' (56 - 640m).
Survey area: 94 sq. mi. (243 km^2).
Description: Vegetation is dominated by moist upper mixed deciduous forest, with evergreen forest and Indaing forest.
Access: The area is accessible by the newly constructed Pinlebu-Paungbyin Road. Paungbyin Town is 300 mi (482km) from Monywa. The base camp was 25 mi (40km) from from Paungbyin.
Rainfall: Averages 91" (2,342 mm) per annum
Human impact and landuse: Teak extraction occurred in the area 15 years ago. Bamboo and mushroom collecting occurs along trails in the area.

6. Saramati (SRMT)

Location: Lies between 25°20' - 25°43'N and 94°50' - 95°40'E. To the N it is bounded by the Saramati Range, to the E by the Chindwin River and Laytin Ridge 5,790'(1,764m), to the S by Lawpe Mountain 8,455'(2,577m) and W by the Myanmar – India border.
Elevation: 410 - 12,553' (124 - 3,826m)
Survey area: 254 sq. mi. (650 km^2)
Description: Streams in the Saramati and Laytin catchments flow to the Nantalaik River, one of the principal tributaries of the Chindwin River. The survey area is contiguous with India's Shiloi Reserve Forest. Vegetation cover consists of evergreen, pine, moist hill evergreen and sub-tropical evergreen forest with bamboo under storey.
Access: The area is accessible by road from Layshi in the dry, or during the wet season on foot. Mt Saramati, in the N of the survey area is 40 mi (64km) from Layshi, accessible only on foot.
Rainfall: Averages 91" (2,342 mm) per annum
Human impact and landuse: Though sparsely populated, shifting cultivation occurs as high up as 7,000' (2,133m) elevation.

7. Paunglaung Catchment (PLG)

Location: Lies between 19°52' - 20°17'N and 96°24' - 96°35'E in Pyinmana Township, Mandalay Division. It is bounded to the N by Yamethin Township, to the E by Pinlaung Township, to the S by Pyinmana Township, and to the W by Tatkan Township.
Elevation: 500 - 6,252' (152 - 1,905m)
Survey area: 134 sq. mi. (343 km^2)
Description: Riverine evergreen and moist upper mixed deciduous (MUMD) forest occur in the lowlands with dry upper mixed deciduous (DUMD), Indaing (dipterocarp), grassland and alpine forest at higher elevations. The entire catchment is 1,779 sq. mi. (4,608 sq.km). A rugged mountain range dissects the area.

Access: Two days walk from Taunggya to the centre of the study area across a 6,000' (1,828m) mountain range.
Rainfall: 55 - 95" (140 - 241mm) per annum
Human impact and landuse: Numerous villages occur near the study area. Shifting cultivation occurs in the area, encroaching on the reserve forest. The area is sparsely populated owing to difficult access.

8. Panlaung Pyadalin Cave Wildlife Sanctuary
Location: Lies between 20°56' - 21°00'N and 96°16' - 96°27'E in Ywa Ngan Township, Shan State, 21 miles (33km) from Kinda Dam and Hydro Power Project
Survey area: Covers an area of 61 sq. mi. (157 km^2) in the Kinda Dam area and includes two reserve forest areas, Panlaung and Pyadalin.
Description: The area is bounded by the Kinda Dam in the north, Ywa Ngan Township in the east, Thazi township in the south and Wan Twin Township in the west, respectively.
Vegetation: Riverine evergreen forest, Moist deciduous forest, and Dry deciduous forest each with diverse bamboo communities, and rattan.
Access: Panlaung-Pyadalin is accessible by road from Kume village, Myittha Township, 1 hour by boat from the Kinda Dam, and one hour's walk.
Rainfall: No data available
Human Impact and Landuse: Temporary human settlements occur in the area. Bamboo collection for making chopsticks is practiced. Timber extraction, non-timber extraction, fishing, hunting and cultivation are threats to wildlife. Roads passing through the wildlife sanctuary are used for extracting timber and moving cattle.

9. Central Bago Yoma (BGY)
Location: Lies between 19°02' - 19°15'N and 95°53' - 96°59'E, and includes parts of Sabyin, West Swa and Kabaung Reserve Forests. It is bounded to the N and E by the Sabyin River, to the E by the Swa River, to the W by the Bago Yoma Range 1,865' (568m), and to the S by the Pyu Mountain 1,537' (468m) and the Kabaung River catchment.
Survey area: 130 sq. mi. (334 km^2)
Elevation: 330 - 1,885' (100-574m)
Description: The area is drained by the Sittaung River and its tributaries. Vegetation is characterized by DUMD forest, MUMD forest and evergreen forest. Bamboos are common in the under storey.
Access: The area can be reached by 3 days walk from Swa Dam, to the west of Swa Town on the Yangon-Mandalay highway about 200 mi. (320km) from Yangon by road.
Rainfall: 126" (3,235 mm)
Human impact and landuse: Large scale extraction of teak and other hardwood, and other signs of human encroachment including bamboo and rattan collection, hunting and fishing was observed during the study period. No evidence of cultivation or permanent human settlement was observed in the study area.

10. Northern Rakhine (RN) (Paletwa and Kaladan river catchments)
Location: Lies between 21°05' - 21°22'N and 92°21' - 92°29'E is located between and contains the northern Kalapanzin River catchment, Saingdin Ridge and northern Mayu Range.
Survey area: 69 sq. mi. (177 km^2)
Elevation: 710 - 2,494' (216-760m)

Description: The area is bounded to the N by the Myanmar –Bangladesh border, with the Saingdin River to the E, the Obru and Pairwan Rivers to the S, and the Mayu Range in the W. Vegetation is characterized by sporadic evergreen forest in ravines with extensive Kayin bamboo patches. Forest covers approximately 40% of the survey area. Bamboo is more common in shifting cultivation areas at lower altitudes with dry evergreen forest at higher elevations. Due to logging and bamboo cutting, degraded secondary growth occurs on undulating slopes.
Access: The survey area is accessible by boat along the Mayu and Kalapanzin Rivers, and during the dry season by 6' wide paths cleared by the UN.
Rainfall: (no data available)
Human impact and landuse: A number of tribal settlements occur in areas fringing the forest. The lower Kalapanzin River valley is fertile and supports large villages (100-1,000 households) of Bengali people. Hunting, shifting cultivation and extraction of non-timber forest products all occur in the area.

11. Rakhine Elephant Range (RER)
Location: Lies between 18°01' - 18°59'N and 94°36' - 94°45'E on the western side of the Rakhine Yoma Range.
Survey area: 57 sq. mi. (146 km^2)
Elevation: 252 - 3,416' (77 - 1,041m)
Description: The area is dissected by a series of tall ridges running north to south range from 2000"– 4000'. The area is drained by the Tandwe, Salu and Kyeintali Rivers that flow westwards into the Bay of Bengal. Vegetation includes semi-evergreen, mixed deciduous and secondary tropical moist forest, and bamboo brake.
Access: The study area was 3 days walk from Bogale Village, which is 48 mi. (77km) from Gwa by road. Gwa Town is 180mi (289km) NW of Yangon by car.
Rainfall: (no data available)
Human impact and landuse: Thirty-three villages surround the Elephant Range consisting of Rakhine tribes (82%) and Chin tribes (18%). They farm rice and groundnut, practice shifting cultivation, and practice commercial hunting of wildlife.

12. Hukaung Valley (HKV)
Location: Lies between 26°36' - 26°42'N and 96°34' - 96°53'E in the newly declared Hukaung Valley Wildlife Sanctuary (2,493 sq. miles; 6,459 km^2).
Survey area: 525 sq. mi. (840 km^2)
Elevation: 193 - 1,307' (59 - 398m)
Description: To the N an upland area 6,758' (2,060m) divides the Tarung-Tawan watershed and Gedu River catchment, with the Kumon Mountains to the E, the Nambyu and Nampyek River catchments in the S and the Tarung River and old Ledo Road to the W. Vegetation is predominantly dense lowland evergreen forest interspersed with meadows.
Access: The area lies 20 miles (32km) N of Tanaing and can be accessed during the wet season by boat and during the dry season by baggage elephant. The Ledo Road is paved for 90 miles (149km) of its length providing year-round access from Myitkyina.
Rainfall: 91" (2,339 mm)
Human impact and landuse: Apart from a 5 acre shifting cultivation area near Tawang River there were no permanent human settlements in the area.

13. Kaunglaungpu (KLP)

Location: The survey area is located in the Kran River and Phet River catchments between 26°44' - 26°53'N and 97°53' - 98°04'E.

Survey area: 127 sq. mi. (326 km^2)

Elevation: 200 - 9,080' (61 - 2,767m)

Description: These rivers along with the Shinyan and Hteei Rivers drain the area. The area is covered in natural forest (40%) consisting of tropical evergreen, subtropical hill, warm and cool temperate rainforest and alpine. The remainder (60%) is secondary forest damaged by shifting cultivation in former times. These areas are dominated by bamboo, teat trees, phetwin, and old woody lianas. Extraction of some hard woods was taking place.

Access: This area is reached from Putao by road to Mabweza (63mi.; 101km). The survey area is accessed by a 63mi. (8 day) walk on foot passing Sunnochat Mountain.

Rainfall: (no data available)

Human impact and landuse: Intensive shifting cultivation has transformed natural forests into secondary forests. Threats to tigers and prey include a new road built from the China border, timber extraction, non-timber forest product extraction, mining, subsistence hunting and wildlife trade with China.

14. Sumprabum (SPB)

Location: The survey area lies 9 mi. (15km) east of the Kumon Range and 10 mi. (17km) W of Sumprabum at 26°29' - 26°36'N and 97°21' - 98°28'E.

Survey area: 130 sq. mi. (334 km^2)

Elevation: 460 - 4,950' (140 - 1,508m)

Description: It is bounded to the N by the Chaukan Pass and hills that receive snow in winter. The Hukaung Valley lies to the W, with Myitkyina Township to the S. The area is drained by the Hpungchan, Hpung-in and Mali Rivers in the east and northwest, and from the south by the Magyeng River. Vegetation is tropical evergreen, sub-tropical moist hill forest, and subtropical wet hill forest. Bamboos and rattan species occur in the under storey. Some swampland occurs in the area.

Access: The area is reached on foot from Sumprabum. Sumprabum is 131 miles (210km) N by road from Myitkyina.

Rainfall: 91" (2,339mm)

Human impact and landuse:

The area is sparsely populated (3.8 people/sq. mi.; 2.5/sq.km), with local people practicing shifting cultivation.

15. Momeik-Mabain (MB)

Location: The survey area is located between 23°45' - 23°55'N and 96°43' - 96°51'E and includes parts of Manpon, Nampa and Namme Reserve Forests.

Survey area: 133 sq. mi (340 km^2)

Elevation: 426 - 1,965' (130 - 599m)

Description: It is drained by the Maingthar and Namme River. Alluvial plains dominate the survey area with some rugged, rocky peaks including Parhoke Mountain 3,101' (945m), Wantu Mountain 3,003' (915m) and Kweanung Mountain 2,393'(729m). Vegetation comprises evergreen, MUMD and Indaing forest.

Access: From Mabain the study area is accessed by boat (18 mi.; 29km), then by cart (12 mi.; 19km), then on foot (18mi.; 29km). Mabain is 38mi. (61km) by ferry from Momeik. Momeik is 156mi. (251km) from Mandalay.

Rainfall: 52" (1,338mm)

Human impact and landuse: Development of roads and infrastructure for gold mining has taken place since 1988 resulting in forest disturbance and pollution of natural drainages. Over 300 residents inhabit four goldmines in the forest. In the dry season, miners turn to bamboo and rattan cutting and resin tapping.

16. Myintmoletkat (MMLK)

Location: The survey area lies in the Htaung Pru Reserve Forest between 11°45′ - 11°38′N and 99°07′ - 99°03′E in Taninthayi and Bokpyin Townships, Myeik District.

Survey area: 120 sq. mi. (310 km^2)

Elevation: 110 - 2,264' (33 - 690m)

Description: The eastern portion is drained by the Naukpyan, La Mu, Tabalat, and Ngawun Streams which flow into the Little Taninthayi River. To the west the Monoron Stream flows into the Lenyar River to the south. The area is partially low-lying with swamp and grassland that is annually flooded, interspersed with mixed evergreen - bamboo forest groves on higher ridges. The area lies on both sides of the new Taninthayi-Bokpyin highway, and is partially under cultivation for rice and areca palm with some shifting cultivation.

Access: By road from Myeik (58mi).

Rainfall: The area has two monsoons with a prolonged wet season from June – November, and annual rainfall of around 160" (4,127 mm).

Human impact and landuse: Base camp was situated 3 miles (5km) S of Htaung Pru Village containing 15 households, with a further 38 households in adjacent Manoron Village.

17. S. Taninthayi (TNTY)

Location: The survey area lies in the Pe River Valley at 13°30'N and 98°38'E in Thayetchaung Township, Dawei District.

Survey area: 110 sq. mi. (285 km^2)

Elevation: 208 - 2,010' (63 - 612m)

Description: Pe River Valley is bounded to the N by the Mintha Reserve Forest, to the E by Myintmoletkat Mountain 6,801' (2,072m) to the S by the fork of the Pe and Plauk Rivers and on the W by Pe Mountain 2,720' (829m). Vegetation is characterized by a mosaic of riverine evergreen forest (30%) with sporadic secondary growth (30%) and shifting cultivation and orchard (40%). Areca palm and catechu plantations dominate the cultivated areas.

Access: The area is accessible from the Dawei-Myeik Highway, 53 mi. (85km) south of Thayetchaung, and on foot 15 mi. (24km) east of Pedat.

Rainfall: The area has two monsoons with a prolonged wet season from June – November, and annual rainfall of around 161" (4,127 mm).

Human impact and landuse: Due to the security situation, permanent settlements no longer exist in the area and farmers are permitted only weekly access to maintain and harvest their lands.

APPENDIX II. WILDLIFE RECORDED BY CAMERA-TRAP SURVEYS AT 17 SITES IN MYANMAR 1999-2002

Species	Scientific name	IUCN Status	CITES Status	Myanmar Status	No. records
Tiger	*Panthera tigris*	EN	App I	TP	5
Leopard	*Panthera pardus*	LR	App I	TP	92
Clouded leopard	*Neofelis nebulosa*	VU	App I	TP	50
Golden cat	*Catopuma temminkii*	LR/VU	App I	TP	34
Marbled cat	*Pardofelis marmorata*	DD	App I	TP	15
Leopard cat	*Prionailurus bengalensis*	EN	App II	P	80
Wild dog	*Cuon alpinus*	VU	App II	P	34
Small indian civet	*Viverricula indica*	-	App III	TP	6
Large Indian civet	*Viverricula zibetha*	-	App III	P	135
Large spotted civet	*Viverricula megaspila*	-	-	P	1
Common palm civet	*Paradoxurus hermaphroditus*	VU	App III	P	14
Three-striped palm civet	*Arctogalidia trivirgata*	EN	-	P	1
Masked palm civet	*Paguma larvata*	-	App III	P	3
Spotted Linsang	*Prionodon pardicolor*	-	App I	TP	2
Banded Linsang	*Prionodon linsang*	-	App II	TP	5
Binturong	*Arctictis binturong*	VU	App III	P	15
Malayan sunbear	*Harlarctos malayanus*	DD	App I	TP	72
Himalayan black bear	*Ursus thibetanus*	VU	App I	P	17
Yellow-throated marten	*Martes flavigula*	-	App III	P	16
Wild Pig	*Sus scrofa*	-	-	-	33
Hog badger	*Arctonyx collaris*	-	-	-	1
Myanma ferret badger	*Melogale personata*	-	-	P	1
Mongoose species	*Herpestes spp*	-	App III	P	22
Crab-eating mongoose	*Herpestes urva*	-	App I	TP	81
Elephant	*Elephas maximus*	EN	App I	TP	265
Gaur	*Bos gaurus*	VU		TP	38
Banteng	*Bos javanicus*	EN	App I	TP	3
Tapir	*Tapirus indicus*	VU		P	166
Sambar	*Cervus unicolor*	-	App I	TP	25
Serow	*Naemorhedus sumatraensis*	VU		SP	847
Common muntjac	*Muntiacus muntjak*	-		TP	2
Leaf deer	*Muntiacus putaoensis*	-			

Species	Scientific name	IUCN Status	CITES	Myanmar Status	No. Records
Larger mouse deer	*Tragulus napu*	EN		TP	9
Lesser mouse deer	*Tragulus javanicus*	-		TP	9
Malayan porcupine	*Hystrix brachyura*	VU		-	128
Brush-tailed porcupine	*Atherurus macrourus*	EN		-	32
Pangolin	*Manis javanica*	LR/NT	App II	TP	2
Rhesus macaque	*Macaca mulatta*	LR/NT		P	97
Pig-tailed macaque	*Macaca nimestrina*	VU		P	59
Capped leaf monkey	-	-		-	2
Phayres langur	*Prebytis phayrei*	-		P	1
Dusky leaf monkey	*Semnopithecus obscurus*	LR/NT	-	TP	1
Squirrel	*Ratufa spp*	-	App II	-	11
Other small mammal species	-	-		-	24
Blue Whisting Thrush	*Myiophoneus caeruleus*			SP	1
Green magpie	*Cissa chinensis*			P	1
Indian pied hornbill	*Anthracoceros albirostris*			TP	1
Jungle fowl	*Gallus gallus*			-	80
Laughingthrush species	*Garrulax spp*			P	1
Orange bellied leafbird	*Chloropsis hardwickii*			SP	17
Owl	*Strigiformes spp*			TP	2
Parrot	-			P	4
Pheasant species	-			TP	163
Black Stork	*Ciconia nigra*		App II	-	2
Quail	*Coturnix spp*			-	2
Monitor lizard	*Varanus spp*			P	1
Tortoise	-			P	1
Green viper	*Trimeresurus spp*			P	1
Unidentified					165
Human sign					
Domestic elephant					10
Domestic buffalo					29
Domestic cow					46
Domestic dog					27
Villagers					242
Suspected poacher					61
Military					30
Government staff					25
				Total	3811

APPENDIX III. RESULTS OF INTERVIEW SURVEYS FOR TIGERS AT 17 SITES IN MYANMAR

Site	Direct observation (sighting)	Track and sign	Heard	Total observ.	Date of most recent direct observation
AKNP	3	5	9	17	1998
BGY	2	10	1	13	1998
HKV	9	10	0	19	2001
KLP	6	21	0	27	Oct 2000
MB	16	1	1	18	2001
MHM	2	5	0	7	Dec 1998
MMLK	14	6	0	20	Oct 2001
PLG	9	20	1	30	Apr 2000
PPDL	6	7	1	14	2000
RER	6	1	3	10	Jun 2000
RN	7	4	0	11	Jan 2000
SPB	6	10	0	16	1998
TD	3	3	1	7	2000
TMT	4	5	1	10	1996
TNTY	14	4	1	19	Feb 2002
Totals	107	112	19	238	

APPENDIX IV. HISTORICAL RECORDS OF TIGER IN MYANMAR - PRE-1999

Record	Name of site	Latitude			LatN	Longitude			LogE	Date	Level of evid	Class of evidence	Notes	Reference
1	Shwe Dagon Pagoda, Yangon	16º 46'	16	46	16.7667	96º 8'	96	8	96.1333	3.3.1903	confirmed	Shot tiger	A tigress came from Gyophu Lake was shot by English Army	Colonel Hla Aung, large animals of cat family
2	Pitaung WS, Myitkyina District	25º 30'	25	30	25.5000	97º 10'	97	10	97.1667	1935	confirmed	Sighting	Tiger seen eating tortoise	Lar Shi Bauk (1959) The Burmese Forester 9:
3	Pitaung WS, Myitkyina District	25º 30'	25	30	25.5000	97º 10'	97	10	97.1667	1936-7	provisional	Sighting ?	Wildlife survey - 12 tigers	Kyaw Gyi WS, 1972
4	Pitaung WS, Myitkyina District	25º 30'	25	30	25.5000	97º 10'	97	10	97.1667	Sept, 1953	confirmed	Livestock kill, Tigers kille	Two bullocks were killed by tiger inside sanctuary. Family of 4 tigers, tig	Yin, T. (1953). _The Pidaung Game Sanctuary._ The Burmese Forester 3(2): 54-63.
5	Pitaung WS, Myitkyina District	25º 30'	25	30	25.5000	97º 10'	97	10	97.1667	Jan, 1952	confirmed	Tiger killed	Tiger trapped and killed by Nepali villagers	Yin, T. (1953). _The Pidaung Game Sanctuary._ The Burmese Forester 3(2): 54-63.
6	Pitaung WS, Myitkyina District	25º 30'	25	30	25.5000	97º 10'	97	10	97.1667	May, 1959	confirmed	Sighting ?	Wildlife survey (estimated) 4 tigers	Pyu (1955) The Burmese Forester 5(1)
7	Coupe no. 7, Nam Nar RF, Bahmo Dis	24º 15'	24	15	24.2500	97º 14'	97	14	97.2333	1951	provisional	Heard	The whole forest was silent after a tiger made sound loudly, witness by au	Saw Htun Aung (1951) The Burmese Forester 1(2)
8	Near Bhamo Myo, Bhamo District	24º 15'	24	15	24.2500	97º 14'	97	14	97.2333	1958	provisional	?	Some white tigers and one black tiger were found in old record	HG Handalay DFO, The Tiger. The Burmese Forester 8(1)
9	Nambu and Sinbo village, Kachin State	24º 46'	24	46	24.7667	97º 1'	97	1	97.0167	Oct '45 - Feb '4	confirmed	Tiger kills people, shot tige	Some 30 people from Nambu and Sinbo village village were killed by tiger. Police officer and villager shot the tiger (9 ft long, 2-3 ft tail)	
10	Betw Gyipin Lahar village and Yedwin	16º 54'	16	54	16.9000	96º 5'	96	5	96.0833	1954	provisional	Reports villager sighting	Villager saw tiger, ran back to village, got shock and sick for 3 days	Po Mu, Conservator, Believe it or not, The Burmese Forester 4(2)
11	Sitagaung, Rakhine Yoma, Lushe Taun	22º 56'	22	56	22.9333	93º 8'	93	8	93.1333	1946	confirmed	Tiger caught	One black tiger was caught	HG Handalay DFO, The Tiger. The Burmese Forester 8(1)
12	Taunggoke, Rakine Yoma	18º 51'	18	51	18.8500	94º 14'	94	14	94.2333	Oct, 1986	confirmed	Tiger trapped	Tiger trapping method of Chin people	Pe Myint, Kyar Sayar, Myanmar Timber Enterprise, Golden Jubilee Commemorative Issue, 1948-98
13	Mintup and Matupi Myo, Chin District	21º 35'	21	35	21.5833	93º 26'	93	26	93.4333	1959	confirmed	Sighting	Tiger seen by author	Hla Min, Ranger (Kyauktu), The Burmese Forester 4(2)
14	Shwe U Daung Taung WS	23º 0'	23	0	23.0000	96º 25'	96	25	96.4167	1962	provisional	Sighting?	Wildlife survey (estimated), 10 tigers	Kyaw Gyi WS, 1972
15	Indawgyi Naungmon Camp, Mokaung	25º 16'	25	16	25.2667	96º 56'	96	56	96.9333	Nov, 1997	provisional	track and sign	Track and sign of tigers near camp every day	Thein Lwin, Adviser, Myanma Forest Management, MFD
16	Htmanthi WS	25º 29'	25	29	25.4833	95º 30'	95	30	95.5000	1995	confirmed	track and sign	Estimated 15 tigers for sanctuary	Rabinowitz, A., G.B. Schaller and U. Uga. (1995). _A survey to assess the status of Sumatran rhinoceros and other large r
17	Mayan Chaung Village logging camp,	17º 15'.5	17	15.5	17.2583	96º 15'.5	96	15.5	96.2583	1998	confirmed	Tiger shot	Tiger attacked buffalo and shot by foresters	Khin Maung Aye, Yoma Kyar, Myanmar Forest School Centenary Commerative Issue
18	Pyinnyaung on the Thazi Lakaw railwa	20º 45'.5	20	45.5	20.7583	96º 25'	96	25	96.4167	1932	confirmed	Tiger kills buffalo, tiger sh	Buffalo killed by tiger. 3 days later another buffalo killed, then tiger was	Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
19	Kyawedatson village on the Thazi-Kal	20º 45'	20	45	20.7500	96º 20'	96	20	96.3333	1932	confirmed	Tigers eat kill	Mr Havelock, Excise Dept shot banteng, tigers eat kill	Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
20	Eastern bank of Irrawaddy, Singu Tow	20º 55'	20	55	20.9167	94º 50'	94	50	94.8333	12.6.1932	confirmed	Tiger kills domestic anima	Tiger attacked domestic animals at Ngapuin-in village. Beat officer Muat	Abbott, S. (1956). I shot a notorious tiger. The Burmese Forester 6(1):108-110.
21	Yinmabin, Lower Chindwin District	22º 5'	22	5	22.0833	94º 50'.4	94	50.4	94.8400	1932	confirmed	Tiger killed	Tiger killed by local sportsman	Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
22	Thayetchaung, Tavoy District	13º 50'.5	13	50.5	13.8417	98º 15'.2	98	15.2	98.2533	1961	confirmed	Tiger killed	Tiger shot by author	Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
23	Prome to Taungup Pass	18º 51'	18	51	18.8500	94º 20'	94	20	94.3333	Jan, 1942	confirmed	Sighting	During WWII, many Indian walk from the Arakan Yoma. 4,000 die of ch	Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
24	Prome to Taungup Pass	18º 45'	18	45	18.7500	94º 25'	94	25	94.4167	Feb, 1946	confirmed	Sighting	14 West Africans killed by tigers	Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
25	Prome to Taungup Pass	18º 35'.5	18	35.5	18.5917	94º 40'	94	40	94.6667	May, 1955	confirmed	Tigers shot	4 tigers shot by Kachin rifles	Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
26	Taungup to Prome, Padaung District	18º 40'	18	40	18.6667	94º 55'	94	55	94.9167	Sept, 1945	confirmed	Sighting	Woman dragged from hut in Arakan Yoma	Yin, T. (1958). The Burmese Forester 5(2)
27	Sinde Village, Prome District	18º 45'.5	18	45.5	18.7583	95º 10'.5	95	10.5	95.1750	1946-7	confirmed	Sighting	M.T.N. Martin Superintending Engineer encounters tiger	Yin, T. (1958). The Burmese Forester 5(2)
28	Prome District	18º 49'	18	49	18.8167	95º 13'	95	13	95.2167	1958	confirmed	Tiger shot	Three people killed by tigers, tiger shot	Yin, T. (1958). The Burmese Forester 5(2)
29	Namti Village, Kachin State, on Myitk	25º 19'	25	19	25.3167	97º 10'	97	10	97.1667	1945	confirmed	Tiger shot	Three people killed by tiger, tiger shot	Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
30	Bawni village, Pegu District	17º 42'	17	42	17.7000	96º 29'	96	29	96.4833	1962	confirmed	Tiger shot	Villager encountered sleeping tiger, shot it	Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
31	Hpakan, Myitkyina District	25º 35'	25	35	25.5833	96º 15'	96	15	96.2500	Aug, 1951	confirmed	Tiger kill mules	Two mules killed by tiger in broad daylight	Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
32	Saramati and Naga Hills	25º 40'	25	40	25.6667	95º 05'	95	5	95.0833	1959	confirmed	Sighting	Tigers are not uncommon and frequently come to the vicinity of the villag	Milton, O. (1960). _Mt. Saramati and Naga Hills Expedition 1959._ The Burmese Forester 10(1): 15-23.
33	Bankachon, Tenasserim	10 08	10	8	10.1333	98 38	98	38	98.6333	25.5.1915	confirmed	Tiger shot		Yin, T. (1962). The tigers of Burma. The Burmese Forester 12(1): 51-66.
34	S. Zamayi Reserve, S. Pegu Forest Div	18 17	18	17	18.2833	96 06	96	6	96.1000	14.12.1933	confirmed	Tiger shot		Yin, T. (1962). _The tigers of Burma._ The Burmese Forester 12(1): 51-66.
35	90 miles from Kawthaung	10º 05'	10	5	10.0833	98º 35'	98	35	98.5833	Nov, 2000	confirmed	Sighting	Tiger seen	Anonymous (2001). Myeik Archipelago Biodiversity Research Project (Tanintharyi Division) Season Report: November 2
36	24 miles north of Kawthaung	10º 00'	10	0	10.0000	98º 35'	98	35	98.5833	1997	confirmed	Tiger shot	Tiger carcass (photo)	Anonymous (2001). Myeik Archipelago Biodiversity Research Project (Tanintharyi Division) Season Report: November 2
37	Packchan River	10 05	10	5	10.0833	98 35	98	35	98.5833	<1878	confirmed	Tiger killed	Tiger killed by author	Fytche, A. (1957). _Extract from "Burma, Past and Present"._ The Burmese Forester 7(1): 75-76.
38	Hukaung Valley	26 40.686	26	40.686	26.6781	96 48.903	96	48.903	96.8151	May, 1999	provisional	Report from hunter		Khaing, S. T. and T. Myint (1999). Hukaung Valley Expedition: Tanaing, Kachin State. Yangon, Wildlife Conservation S
39	Kaserdoo WS (Karen)	13 30	13	30	13.5000	99 00	99	0	99.0000		provisional	Report from local people		Latimer, W., G. Hill, N. Bhumpakkaphan, C. Fehr (undated). Report and proposal for Kaser Doo Wildlife Sanctuary. Ban
40	Shwe U Daung	23º 0'	23	0	23.0000	96º 25'	96	25	96.4167	Jul-Aug, 1959	confirmed	Tracks	Author report	Milton, O. (1958). _A project for a wildlife conservation survey of Burma._ The Burmese Forester 8(2): 107-118.
41	Chaukan Pass	27 05	27	5	27.0833	97º 10'	97	10	97.1667	Jan-March, 196	confirmed	Tracks	Author report	Milton, O. (1958). _A project for a wildlife conservation survey of Burma._ The Burmese Forester 8(2): 107-118.
42	Mansun, Chindwin Rv area	26 27	26	27	26.4500	96 13	96	13	96.2167	Jan 21st, 1935	confirmed	Tracks	Author report	Morris, R. C. (1936). _The Vernay-Hopwood Upper Chindwin Expedition._ J. Bombay Nat. History Society 38(4): 647-6
43	Pidaung WS	25º 30'	25	30	25.5000	97º 10'	97	10	97.1667	1959	provisional	Estimated number	Est. 2 animals in sanctuary	Milton, O., D. Estes, and H.Z. Kimlai (1964). _Burma Wildlife Survey Report on the Pidaung Wild Life Sanctuary._ The
44	Chauklongyi Chaung, Tenasserim	12 05	12	5	12.0833	98 55	98	55	98.9167	Feb 26, 1960	confirmed	Tiger kill, tracks	Sambar carcass	Milton, O., D. Estes, and H.Z. Kimlai (1964). _Burma Wildlife Survey Report on the Pidaung Wild Life Sanctuary._ The
45	Ratbaw, N. Myanmar	27º 26'	27	26	27.4333	97º 55'	97	55	97.9167	1993	provisional	Tiger shot	Report from hunter	Rabinowitz, A. and S.T. Khaing (1998). Status of selected mammal species in North Myanmar. Oryx 32(3): 201-208
46	Hkakabo-Razi PA	28º 20'	28	20	28.3333	97º 30'	97	30	97.5000	1997	extinct	Tiger absent	No evidence found during survey	Rabinowitz, A. (1998). _Status of the tiger in North Myanmar._ Tigerpaper 25(1): 15-19.
47	Alaungdaw Kathapa NP	22º 20	22	20	22.3333	94º 25'	94	25	94.4167	1982	confirmed	Tiger observed	Tiger are unusually numerous	UNDP/FAO (1982). Proposed Alaungdaw Kathapa National Park: Report on a preliminary survey Dec 1981 - Jan 1982. F
48	Kyaithin WS	23º 35'	23	35	23.5833	95º 40'	95	40	95.6667	1982	extinct	Tiger not found	Tiger not found in area	UNDP/FAO (1982). Kyaithin Wildlife Sanctuary: Report on a survey of the area and a preliminary census of the thamin.
49	Pegu Yomas proposed PA	18 17	18	17	18.2833	96 08	96	8	96.1333	1982	confirmed	Tiger sign	Tracks often found in sandy beds. Several tigers have been shot	UNDP/FAO (1982). Proposed Pegu Yomas National Park, Report on Preliminary Surveys of the Yenwe Chaung Area, 19
50	Shwessetaw	20º 10'	20	10	20.1667	94º 50'	94	50	94.8333	1982	extinct	Tiger not reported after 19	Tiger no longer present	UNDP/FAO (1982). Shwesettaw Wildlife Sanctuary, Report on a Reconnaissance Survey and Evaluation. Rangoon, Burn
51	Taungghyi WS	20º 46'	20	46	20.7667	97º 05'	97	5	97.0833	1983	extinct	Tiger not reported	Sanctuary is not big enough to support popns of large mammals	UNDP/FAO (1983). A survey of the Inle Lake and adjacent areas of the Shan Plateau. Rangoon, Burma, Field Report to t
52	Natma Taung, Mount Victoria	21º 13'	21	13	21.2167	93º 55'	93	55	93.9167	1982	confirmed	Tiger kill human	Present in small numbers	Salter, R.E. (1983). A survey of Natma Taung (Mount Victoria) in Southern Chin Hills. Field Report to the Nature Conse
53	Irrawaddy Delta	16 11	16	11	16.1833	94 51	94	51	94.8500	1983	extinct	Not reported		UNDP/FAO (1983). Irrawaddy Delta: Potential for Nature Conservation and Recreation. Rangoon, Burma, Field Report t
54	Lampi Island	10º 50'	10	50	10.8333	98º 15'	98	15	98.2500	April, 1982	extinct	Lack of sign	absent	UNDP/FAO (1983). Report on a reconnaissance of part of the Pakchan Reserve Forest and Lampi Island, Tenasserim. UI
55	Maymyo Game Sanctuary	22 05	22	5	22.0833	96 28	96	28	96.4667	26-27 Mar, 198	extinct	Lack of sign	absent	Salter, R.E. (1984). Maymyo Game Sanctuary. Report on a reconnaissance survey and evaluation. Field Report to the Na
56	Mu-Chindwin Watershed	24º 05'-24º 30'	24	5	24.0833	94º 45'-95º 25'	94	45	94.7500	11 Nov-4 Dec, 8	confirmed	Tracks	Tigers are rare and tracks were seen on only 2 occasions	UNDP/FAO (1982). Preliminary survey of a part of the Mu-Chindwin Watershed together with a note on conservation pro
57	Southern Arakan	16º 17'-16º 16'	16	17	16.2833	94º 14'-94º 26'	94	14	94.2333	27 Dec - 7 Jan 8	confirmed	Tracks	Tiger tracks were found on only one occasion	UNDP/FAO (1983). Report on a preliminary survey of Thamihla Kyun and Southern Arakan. FAO, Rangoon.
58	Tanlwe-Ma-e Chaung, Central Arakan	16º 17'-16º 16'	16	17	16.2833	94º 14'-94º 26'	94	14	94.2333	2-12 Feb, 1983	confirmed	Individuals or sign observe	Common and widespread in the area	UNDP/FAO (1983). Report on a preliminary survey of Tanlwe - Ma-e Chaung Area, Central Arakan State. FAO, Rangoo
59	Taungup Pass, Arakan Yoma	18º 35'	18	35	18.5833		94	40	94.6667	24 Jan - 16 Feb,	provisional	Report	One escaped from a snare a few days before survey	UNDP/FAO (1983). Report on a preliminary survey of Arakan Yoma. FAO, Rangoon.
60	Kyaukpandaung, Arakan	21 29	21	29	21.4833	93 01	93	1	93.0167	27 Jan - 12 Feb	provisional	Report	Report from local guides tiger and leopard are present	UNDP/FAO (1983). Proposed Kyaukpandaung National Park. Report on a preliminary survey January - February 1983
														Zuckerman, S. (1964). _Burma wildlife survey report on the Pidaung Wildlife Sanctuary._ The Burmese Forester 14(1,2):
	Whole Burma, tigers reported shot									1928-1938	confirmed	997 tigers shot	Tigers killed	Prater, S. H. (1940). _The number of tigers shot in reserved forest in India and Burma during the year 1937-1938._ J. Bon
	Whole Burma									1958	provisional	?	Habitat, size, descriptive characteristics and conservation status of tigers i	HG Handalay DFO, The Tiger. The Burmese Forester 8(1)

APPENDIX V. TIGER INTERVIEW PROTOCOL

1. How long have you been in this village ?
2. What is your ethnicity ?
3. Where do you get bamboo and wood to repair your house ?
4. (If you get it from the forest) How far from your house to the forest ?
5. How many times do you go into the forest per month ?
6. Have you ever seen wild animals when you go inside the forest ?

If yes,

Sr.	Animal (Prey)	Quantity		Forest		Human disturbance		Remark
		Many	Few	Unclassified	Reserved	Yes	No	

Sr.	Animal (Predator)	Quantity		Forest		Human disturbance		Remark
		Many	Few	Unclassified	Reserved	Yes	No	

1. Do you have any experience with predators attacking humans or livestock ?

Sr.	Predator	Livestock						Time occur	Place occur	Remark
		Human	Buffalo	Cow	Goat	Pig	Others			

2. How do people use wild animal products in this area ?

Sr.	Animal	Products				Usage			Market situation			Remark
		Meat	Bone	Skin	Horn	Medi-cine	Food	Tradi-tional	Place	User	Price	

3. What hunting methods do people use ? What kinds of tools do they use for hunting ?

Sr.	Prey	Hunting methods				Tool						
		Trac-king	Smel-ling	Remnants of food	Info	Gun	Cross bow	Bow	Dogs	Snare	Trap	Digging hole

4. (If he/she does cultivation) How much land do you use ? What kinds of crops do you plant ? Do wild animals destroy your crops ? If yes, what animals are they ?

Sr.	Crops	Acres			Total acres	Animal that destroyed crops	Time occur		Remarks
		paddy field	Shifting cultivation	Extended land			Day		

1. What kind of animals do you raise ? How do you raise livestock ?
   (Free grazing / farming) How far from village to grazing field ? How many acres used for grazing / (estimate)
2. Have you ever seen a tiger ?
   (Yes - No Place...../ Time...../ Size.....)
   Have you ever heard a roar of a tiger ?
3. Have you ever seen track, scratch, and faeces of tiger ?
   If yes, how big is it ?
   (Showing a track of tiger) Have you ever seen a track like this ?
4. Have you ever seen a leopard ? Size ? Colour pattern ?
5. What is your opinion about the usages of tiger product medicine ?
6. How many tigers do you think live around this region ?
7. Is there any tiger product trade around this region ?
8. What is your feeling and opinion about tigers ?
9. Please show animals you have seen from these pictures ?
10. Please talk about tigers that your parents and grandfather/mother have talked about ?

General notes:

Myanmar Tiger Survey *Wildlife Conservation Society, Myanma Program*

Form No. 3
Track & Sign Data

Study Site: .....
Location: .....
Date: .....

Observation team: .....
Weather: .....
Time start: .....

Observors: .....
Forcast type: .....
Time finish: .....

.....
Compass bearing: .....
Length of trail: .....

Time (hh:mm)	Distance	Position GPS Latitude N Deg	Min	Longitude E Deg	Min	Altitude	Way pt. No	Macro habitat A	B	C	Direction/ location	Species name	Track/ signs	Sub- strate	Age F/O	Measurement (mm) L	W	PW	Dia	Remarks
:																				
:																				
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Use blue ink for entering data.
Editor should use red ink.

Entered by:
Checked & edited by:

Date:
Date:

Myanmar Tiger Survey *Wildlife Conservation Society, Myanma Program*

Form No. 2
Camera trap settings

Study Site: ..... Plot / Trail

			Position by GPS				At setting up of cameras									At camera retrieval				
			Latitude N		Longitude E															
Location (description)	Position ID	Camera ID	Deg	Min	Deg	Min	Date set	Time set	AA cells in?	C cells in?	Switch set (1.6)?	Screen displayed?	Infrared working?	Flash working/Film ID?	Pictures registered	Date Retrieved	Time retrieved	Pictures registered	Infrared working?	Flash working/Film ID?

Use blue ink for entering data.

Entered by:

Date:

Editor should use red ink.

Checked & edited by:

Date:

APPENDIX VIII. CAMERA-TRAP RECORD FORM

Camera Data Entry Format
PLOT: Alaungdaw Kathapa. Mindon Outcamp
MAPSHEET: 84J

Record	Position ID	Camera ID	Location (Description)	Position GPS		Data set	Data Retrieved	No. trap nights	No. trap days
				Latitude N	Longitude E				
1	AK-15C	28	Mindon	22_ 19.85'	94_ 27.57'	27.6.99	4.8.99	38	39
2	AK-8C	17	"	22_ 21.187'	94_ 27.143'	26.6.99	3.8.99	38	39
3	AK-14C	2	"	22_ 21.173'	94_ 38.048'	27.6.99	4.8.99	38	39
4	AK-CK 1	10	"	22_ 21.085'	94_ 25.529'	24.6.99	2.8.99	39	40
5	AK-13C	30	"	22_ 19.930'	94_ 28.637'	27.6.99	4.8.99	38	39
6	AK-21CK	23	"	22_ 19.835'	94_ 24.328'	25.6.99	3.8.99	39	40
7	AK-17CK	18	"	22_ 20.100'	94_ 26.420'	26.6.99	3.8.99	38	39
8	AK-CK2	29	"	22_ 21.764'	94_ 27.972'	26.6.99	3.8.99	38	39
9	AK-5C	8	"	22_ 21.450'	94_ 25.851'	24.6.99	2.8.99	39	40
10	AK-6C	5	"	22_ 21.162'	94_ 26.199'	23.6.99	2.8.99	40	41
11	AK-11C	11	"	22_ 21.093'	94_ 28.663'	27.6.99	4.8.99	38	39
12	AK-10C	25	"	22_ 21.485'	94_ 29.033'	27.6.99	4.8.99	38	39
13	AK-22C	6	"	22_ 20.471'	94_ 23.730'	25.6.99	3.8.99	39	40
14	AK-9C	24	"	22_ 21.468'	94_ 27.743'	26.6.99	3.8.99	38	39
15	AK-1C	26	"	22_ 21.369'	94_ 23.475'	25.6.99	3.8.99	39	40
16	AK-2C	20	"	22_ 21.409'	94_ 24.106'	24.6.99	6.8.99	43	44
17	AK-3C	19	"	22_ 21.442'	94_ 24.653'	24.6.99	3.8.99	40	41
18	AK-16C	1	"	22_ 20.425'	94_ 24.074'	27.6.99	2.8.99	36	37
19	AK-4C	15	"	22_ 21.091'	94_ 25.289'	24.6.99	2.8.99	39	40
20	AK-CK3	7	"	22_ 19.788'	94_ 27.906'	27.6.99	4.8.99	38	39
21	AK-7C	12	"	22_ 21.196'	94_ 26.671'	26.6.99	3.8.99	38	39
22	AK-18C	3	"	22_ 20.462'	94_ 26.030'	26.6.99	3.8.99	38	39
23	AK-12C	22	"	22_ 20.745'	94_ 28.814'	27.6.99	4.8.99	38	39
24	AK-19C	27	"	22_ 20.130'	94_ 25.939'	26.6.99	3.8.99	38	39
25	AK-20C	21	"	22_ 20.433'	94_ 24.863'	25.6.99	3.8.99	39	40
							Totals=	964	989

Record	Tiger	Leopard	Clouded leopard	Golden cat	Marbled cat	Jungle cat	Leopard cat	Fishing cat	Felis sp.	Asian dhole	Asiatic Jackal	Malayan sunbear	Himalayan black bear	Yellow-throated marten	Otter sp.	Small indian civet	Large Indian civet	Large spotted civet	Banded linsang	Common palm civet	Binturong	Three-striped palm civet	Banded palm civet	Civet sp.	Mongoose sp.
1																									
2		1																							
3																	1								
4		1																							
5																									
6							1																		
7							1						1												
8		1					3										3			1					
9																	2								
10																									
11																									
12							2						1												1
13																									
14																									
15													1												
16							1																		
17							1																		
18																	1								
19														1											
20		1								1										1					
21										1			1												
22													1												
23							1																		
24							1																		
25							1																		
Totals=	0	4	0	0	0	0	12	0	0	2	0	0	5	1	0	0	7	0	0	2	0	0	0	0	1

Record	Elephant	Tapir	Rhino sp.	Wild boar	Hog badger	Lesser mouse deer	Greater mouse deer	Common muntjac	Feas's muntjac	Leaf deer	Sambar	Gaur	Banteng	Serow	Goral	Malayan porcupine	Brush-tailed porcupine	Porcupine sp.	Pangolin	Pig-tailed macaque	Long-tailed macaque	Stump-tailed macaque	Rhesus macaque	Bamboo rat sp.	Other small mammal sp.	Pheasant sp.	Unidentified	Total animal traffic	Villagers	Military	Govt staff	Researchers	Other	Total human traffic	Failed trip	Total records
1				1				1			3	2														0		7						0	2	9
2	3			3				1				2														9	1	20						0	7	27
3																										2		3						0	10	13
4								4			1															0		6						0		6
5								2																		0		2			1			1	1	4
6								3				1				4										0		9						0	1	10
7																										0		2						0	4	6
8								4								2										0		14						0	1	15
9				2				3								1										0		8						0	2	10
10	1											1														0		2						0	1	3
11																										0		0						0	10	10
12					1			3					1	1		3							1		3	1		18						0	5	23
13								5								4										0		9						0	3	12
14								9																		0		9						0		9
15	2										1	4											1			0		9						0		9
16								5																		0		6						0	4	10
17								2																		0		3			2			2	13	18
18				2								5	2													1		11						0	1	12
19					1			1			2															0		5						0	2	7
20								3																		0		6						0	1	7
21				2				2			1	1														0	1	9						0		9
22	1			1				2																		4		9						0		9
23								4				2														0		7						0		7
24				1				5																		0		7						0		7
25				1								1														3		6						0		6
Totals=	7	0	0	13	2	0	0	59	0	0	8	19	3	1	0	14	0	0	0	0	0	0	2	0	3	20	2	187	0	0	3	0	0	3	68	258

APPENDIX IX.

a. Detections of wildlife from camera-trap surveys at 17 sites in Myanmar, 1999-2002

Study Site	Total no. of large mammal species	Tiger	Leopard	Clouded leopard	Golden cat	Marbled cat	Leopard cat	Wild dog	Small indian civet	Large Indian civet	Large spotted civet	Common palm civet	Three-striped palm civet	Masked palm civet	Spotted Linsang	Banded Linsang	Binturong	Malayan sunbear	Himalayan black bear	Yellow-throated marte	Wild Pig	Hog badger	Myanma ferret badger	Mongoose species	Crab-eating mongoose	Elephant	Gaur	Banteng	Tapir	Sambhur	Serow	Common muntjac	Leaf deer	Larger mouse deer	Lesser mouse deer	Malayan porcupine	Brush-tailed porcupine	Pangolin	Rhesus macaque	Pig-tailed macaque	Capped leaf monkey	Phayres langur	Dusky leaf monkey	Squirrel	Other small mammal species	Blue Whisting Thrush	Green magpie	Indian pied hornbill	Jungle fowl	Laughingthrush species	Orange bellied leafbird	Owl	Parrot	Pheasant species	Black Stock	Quail	Monitor lizard	Tortoise	Green viper	Unidentified	Domestic elephant	Domestic buffalo	Domestic cow	Domestic dog	Villagers	Poacher	Illegal elephant capture team	Military	Government staff	Test	Retriever	Failed trip	Grand total
AKNP	22		14	1	1		12	4	2	22		3						2	7	1	17	3			1	6	24	10		9	1	89				34			2						3				15					9			1			6				2	16	2			24	68	24	151	586
TMT	22	1	1	10	2	1	3			18		4		1			1	2	4		100	7				10	39			6		73				5	24		12	14					3				2			1		15						19					3					55	33	99	568
MHM	17			1	1		4	3	1	3								3		1	8							3		1	5	37					2		5	15	2							1	3					4						10	2			6	9					26	23	15	194
SRMT	14		3	1	7	1	7			1					1					1	5	1									2	51				6			1						1				3					18		1				6					1					53	30	25	226
PLG	17		18	2			4			14							2	7	4	2	46	10					67			6	2	103				18				8		1		2	1				3			1		18		1			1	23	1		3	1	12	6				71	33	32	523
PPDL	10		2				7	1				3								2	4				1							25							19	1				3	3				2		17		4							11		27	33	4	94	2				71	33	87	456
BGY	18		9		6		12	6		22								1		1	111				2	21	60	25		1		21				45			4	9			1						3					10						8	2			2	20				1	34	29	25	491
RN	22		38	14	1	12	8	6		31		1					1	29			75	11	1			28	15			2	7	65					6	2	1	1				1	1				8	1				19						16				1	11					37	22	52	524
RER	15			14	6		2	4		5							2	10			21					7	23			11	1	61				2			1										5					4						6					3					24	26	1	239
HKV	17	3		2			13	2	3	12				1			3	5			5				14	9	3			46		48				8				5				3			1		12					21						11	2						8			52	22	71	385
KLP	11			2	1		1	1										1			4						4			62	5	137				1																		1						7					28	8				29	23	8	323
SPB	22			3	8	1	5	1				1	1	1	1		4	8		5	4				2		11			5	2	62	2			1			49	6				2	5	1								40						16						12				44	24	63	390
MB	6		2															1			4	1					15					19																	1											3				1		5				17	14	1	84
MMLK	14	1			1			4		2		1				1		2		1	28				2					10		23		9		3									1															14			10	10	43	18		28		25	14	90	341
TNTY	20		5				2	2		5	1	1				4	2	1	2	2	11			1			4		3	7		33			9	5			3						6				23					4	2			1		9	3	2			2			2		22	20	45	244
Grand Total		5	92	50	34	15	80	34	6	135	1	14	1	3	2	5	15	72	17	16	443	33	1	1	22	81	265	38	3	166	25	847	2	9	9	128	32	2	97	59	2	1	1	11	24	1	1	1	80	1	17	2	4	163	2	2	1	1	1	165	10	29	46	27	242	53	8	30	25	628	370	765	5574

b. Detections of wildlife from track and sign surveys at 17 sites in Myanmar, 1999-2002

Study Site	Total no.of wildlife species	Big cat species	Medium cat species	Small cat species	Wild dog	Civet species	Binturong	Bear Species	Wild pig	Hog badger	Otter species	Mongoose species	Malayan weasel	Elephant	Gaur	Wild buffalo	Mython	Banteng	Tapir	Sambhur	Serow	Red goral	Common muntjac	Hog deer	Leaf deer	Pangolin	Rhesus macaque	Pig-tailed macaque	Long-tailed macaque	Hoolock Gibbon	Silvered leaf monkey	Langur species	Monkey	Porcupine species	Squirrel	Flying Squirrel	Jungle fowl	Pheasant species	Ruddy shelduck	Peacock	Horn bill	Lizard species	Tortoise	Domestic animal	Human	Poacher	Grand total
AKNP	**20**	10	23	20	8	5		13	57	1				61	102			22		75	3		58										8	5	1			1				1	1	1	18		494
TMT	**20**	2	3		1	1	1	5	85	3	3			40	22					23	1		39				3			4		1	3	1							2				6		249
TD	**15**	6	10	21	9	14		16	71		6			47	63					11			111				6			10			9											30		440
MHM	**17**	8	9	35	4	2		11	64	1				6	31					40	12		115			1				4			4	3										14		364
NKM	**18**	2	5	41	1	1		8	69	1					9			1		22	7		82				2			6			16	14			1							5		293
SRMT	**18**	34	18	74	1	3		54	77		1				20		11			58	62		121				1			11			1	15						1				29		592
PLG	**24**	35	6	19		4		34	63	7				58	163					48	12		54			4	4			32		1	6	8	2		2	1			6	2	4	4	39		618
PPDL	**19**	6	2	8	1	6		4	31	2				4				3		9	16		62				1						1	5			1				1	1		17	52		233
BGY	**16**	5	14	12				8	69		8			56	103			67		31	5		21										9	8								6	7		12		441
RN	**26**	47	4	17	4	6		20	98	11	2			32	22			1		22	27		69			2	1			11		1	2	8	2		1	1			4		1	12	32		460
RER	**14**	1	7	10	4			6	38		2			31	106					40	2		17							3		3												7		277
HKV	**28**	11	28	36	16	11	2	9	39		1	7	1	41	56	3				178		1	44	22			6			7		2		8	2			2	1	1	3	2		9	30	13	592
KLP	**14**	1	11	3	5			6	46					3	20					49	5		37							5	1			2										1	17	5	217
SPB	**20**	8			3	11		24	9		1			21	21					41	3	3	37		1		4	1		14		3			2			1			2			1	38		249
MB	**17**	4	3	5	1	2	1	5	28					6	63					24			39				4			10		1		2							5			5	19		227
MMLK	**12**	6		1		1		2	48		1				4				2	33	2		19											4										3	18		144
TNTY	**14**	2		3	2	11		2	33						5					39			14					1		3				4		1	1							12	19		152
Grand Total		188	143	305	60	78	4	227	925	26	25	7	1	406	810	3	11	94	2	743	157	4	939	22	1	7	32	1	1	120	1	12	59	87	9	1	5	7	1	1	24	12	13	65	385	18	6042

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for The Union of Myanmar

Myanmar Forest Department,
Ministry of Forestry, Myanmar

Wildlife Conservation Society,
International Program