A MONITORING PROGRAM FOR THE AMUR TIGER

THRITEENTH-YEAR REPORT: 1998-2010

In accordance with the Russian National Strategy for Tiger Conservation

A cooperative project conducted by representatives of:

Wildlife Conservation Society
All Russia Research Institute of Wildlife Management, Hunting, and Farming
Institute of Geography, Far Eastern Branch of the Russian Academy of Sciences
Institute of Biology and Soils, Far Eastern Branch of the Russian Academy of Sciences
Sikhote-Alin State Biosphere State Zapovednik
Lazovski State Zapovednik
Ussuriski State Zapovednik
Botchinski State Zapovednik
Bolshe-Khekhtsirski State Zapovednik
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THIRTEENTH-YEAR REPORT: 2010 WINTER

Executive Summary

Evidence from 13 years of the Amur Tiger Monitoring Program suggests that while absolute tiger numbers increased from 2009, overall there is still a negative trend in tiger numbers. Trends in tiger track densities indicate a significant negative decline over all 13 years of the monitoring program, and a slightly steeper decline since 2004, despite the increase in numbers from 2009 to 2010. Although tiger numbers on monitoring units increased from 56 in 2009 to 80 in 2010, this year's estimate is still well below the 13-year average (92), indicating that concern for the tiger population should not be lessened.

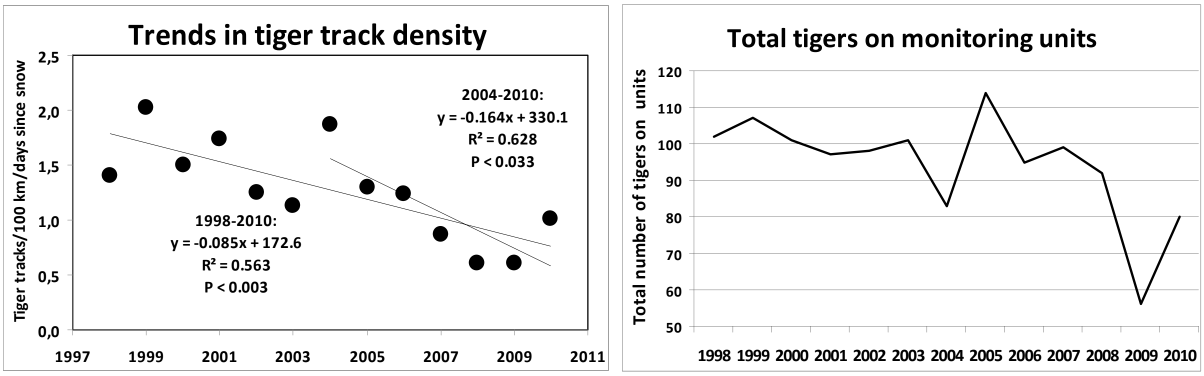


Figure i. Tiger track densities and expert assessments of tiger numbers summed across all 16 sites of the Amur Tiger Monitoring Program, 1998-2010.

As with estimates of tiger abundance, some species of ungulates also showed some signs of recovery. Track densities of both red deer and roe deer increased from the previous 3 years, but despite these increases, there were still significant declining patterns for both species over the past eight to nine years.

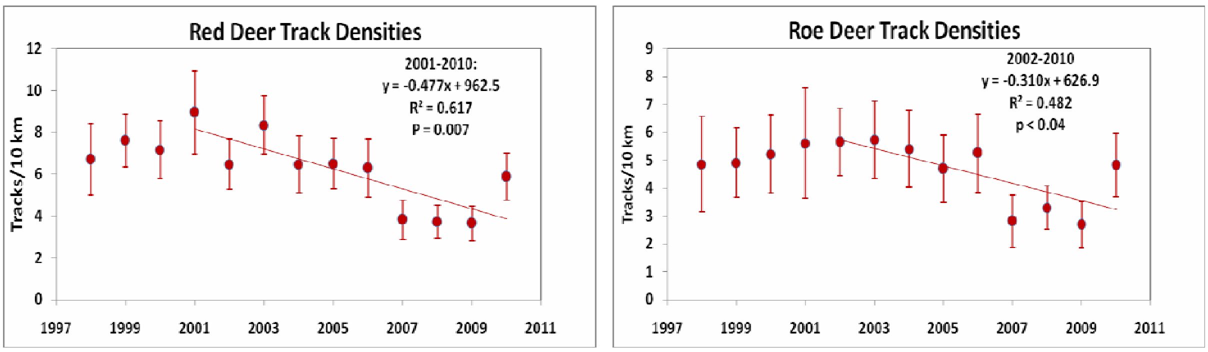


Figure i. Relative abundance of red deer and roe deer, based on track counts, averaged across all sites where they occur on the 16 monitoring units of the Amur Tiger Monitoring Program, 1998 through 2010. For both species, it appears that numbers were slightly increasing or stable from 1998 through 2001 or 2002, when numbers started to decline. Increases in 2010 occurred, but there still exist significant downward trends.

Overall, results for 2010 suggest that downward trends may not be as severe as data from recent years indicated, but that nonetheless there continue to be disturbing downward trends. Recommendations as proposed in 2009 are still urgently needed to ensure a recovery of tiger numbers.

I. INTRODUCTION

At the international level, the Amur tiger (*Panthera tigris altaica*) is considered in danger of extinction. With only a few individuals remaining in China and an unknown number in North Korea, preservation of this animal has become primarily the responsibility of the Russian government and the Russian people. Accordingly, Russia has taken many steps to conserve this animal, starting with a ban of hunting in 1947. The Russian Federal government has since listed the animal as endangered (Russian Red Data Book), and has developed a National Strategy for Conservation of the Amur Tiger in Russia.

The recovery of the tiger after near extinction in the first half of this century (following the 1947 ban) has been fairly well documented through a series of surveys (Kaplanov 1948, Abramov 1962, Kudzin 1966, Yudakov and Nikolaev 1973, Kucherenko, 1977, Pikunov et al. 1983, Kazarinov 1972, and Pikunov 1990). A range-wide survey in 1996 indicated that 415-476 individuals resided in the Russian Far East (Matyushkin et al. 1996). The most recent survey, conducted in winter 2005, reported 428-502 tigers were in Primorski and Khabarovski Krai (Miquelle et al. 2006). The slight difference between these two surveys was considered a result of more intensive survey effort in 2005, thus suggesting that the Amur tiger population had been stable during this 10-year interval.

Although these full range surveys provide fairly reliable information on tiger numbers, the logistical and financial levels of commitment make them infeasible to conduct on a regular basis. Therefore, despite the wealth of information provided by full range surveys in Russia, there remains a long standing need for a reliable and efficient means for monitoring changes in the tiger population on a yearly basis.

Such a monitoring program should serve a number of functions, including:

1. A monitoring program should act as an "early warning system" that can indicate dramatic changes in tiger abundance. Range-wide surveys, usually conducted between long intervals with no information, may come too late to allow a rapid response to a decline in numbers. Yearly surveys should serve to provide notice so that immediate conservation actions can be initiated.

2. Tiger numbers, or at least trends in the tiger population, should be used as a basis to determine the effectiveness of conservation/management programs. In Russia, there have been tremendous efforts and significant support from regional, Krai-wide, federal, and international levels for implementation of tiger conservation efforts that range from anti-poaching programs to conservation education. All these efforts are aimed at protecting the existing Amur tiger population in Russia, yet without an accurate monitoring program that can determine trends in tiger numbers with statistical accuracy, the ultimate effectiveness of these conservation programs will remain unknown.

3. Among other indicators, a monitoring program should provide information on reproductive rate of the population, which may act most effectively as a predictor, or early indication of imminent changes even before there are dramatic changes in actual tiger numbers.

4. Changes in ungulate populations, as primary prey for tigers, may also provide important clues to potential impacts on tiger numbers.

5. Other indicators that might influence the tiger population, including records of tiger poaching and natural deaths, as well as changes in habitat due to human and natural disturbances.

The tiger is a rare, sparsely distributed, and secretive animal that is distributed across at least 180,000 km^2 of Primorski and Khabarovski Krais in southern Russian Far East. This combination of attributes make it a particularly difficult animal to count reliably, and the financial burden and logistical problems associated with range-wide surveys make it practically impossible to conduct full-range surveys with sufficient frequency to track changes in tiger abundance.

In an attempt to address these needs and constraints, coordinators of the 1996 tiger survey worked in concert with government representatives to develop a reliable and effective monitoring program for Amur tigers. The task is a huge one, given the area involved and the logistics of working in a northern environment. The derived methodology has been tested over 13 years (1997-1998 winter through 2009-2010 winter season) and the results, as provided in the yearly reports, provides an indicator of the value of this program.

II. GOALS AND OBJECTIVES

The ultimate goal of this program is the yearly implementation of a standardized system for collecting data that can be used to monitor changes in tiger abundance, and factors potentially affecting tiger abundance, across their present range in the Russian Far East. The intent is to provide a mechanism that will assess changes in the density of tigers, as well as other potential indicators of population status, within their current range over long periods of time. This methodology should provide a means of assessing the effectiveness of current management programs, provide a means of assessing new programs, and provide an "early warning system" in the event of rapid decreases in tiger numbers.

Objectives

Specifically, the objectives of this monitoring program are to:

1. 2. Develop a standardized, statistically rigorous estimate of track density within count units as an indicator of trends in tiger numbers over time, and trends in differences in tiger abundance among survey units in the Russian Far East.

2. Develop an expert assessment of actual tiger numbers within count units as a second indicator of population trends over time.

3. Record presence of female tigers with young on count units across the range of tigers to monitor reproduction rates over time and identify areas of high/low productivity, and changes in reproduction over time.

4. Monitor trends over time in the prey base (large ungulates) of tigers within count units.

5. Record and monitor instances of tiger mortality within and in close proximity to count units.

6. Monitor changes in habitat quality.

III. METHODOLOGY

Complete details of methodology can be found in the 2009 report, and in Miquelle et al. 2006.

IV. RESULTS OF THE 2010 WINTER MONITORING PROGRAM

SUMMARY DATA ON COUNT UNITS AND ROUTES

As in previous years, in the 2010 winter the total area included in sixteen monitoring units was 23,555 km^2, or approximately 15-18% of the total area considered suitable tiger habitat, assuming either 156,571 (Matyushkin et al. 1996) or 127,693 km^2 (Miquelle et al. 1999, Table 19.3) of suitable habitat (Figure 1).

A total of 246 survey routes were sampled twice representing a total of 6135 km traversed (each route covered twice) (Table 1).

Table 1. Characteristics of units surveyed for Amur tiger monitoring program, 2010.

	Monitoring Site	Coordinator	Size of unit (km^2)	# survey routes	Total length of routes on 1st survey (km)	Total length of routes on 2nd survey (km)	Total of both surveys (km)	Average length of survey routes (km)	Survey route density (km/10 km^2)
1	Lazovski Zapovednik	Salkina, G. P.	1192,1	12	118,3	121,8	240,1	10,0	1,0
2	Lazovski Raion	Salkina, G. P.	987,5	11	128,1	138,8	266,9	12,1	1,3
3	Ussuriski Zapovednik	Litvinov, M. N.	408,7	11	105,2	105,2	210,4	9,6	2,6
4	Iman	Nikolaev. I. G.	1394,3	12	184	184	368	15,3	1,3
5	Bikin	Pikunov, D. G.	1027,1	15	188,6	188,7	377,3	12,6	1,8
6	Borisovskoe Plateau	Pikunov, D. G.	1472,9	14	194	193,7	387,7	13,8	1,3
7	Sandagou	Aramilev, V. V.	975,8	16	218,4	218,4	436,8	13,7	2,2
8	Khor	Dunishenko, Yu. M.	1343,8	19	209	209	418	11,0	1,6
9	Botchinski Zapovednik	Dunishenko, Yu. M.	3051	14	160	160	320	11,4	0,5
10	BolsheKhekhtsir Zapovednik	Dunishenko, Yu. M.	475,6	7	70	70	140	10,0	1,5
11	Tigrini Dom	Dunishenko, Yu. M.	2069,6	14	211,2	209,1	420,3	15,0	1,0
12	Matai	Dunishenko, Yu. M.	2487,6	24	392	392	784	16,3	1,6
13	Ussuriski Raion	Litvinov, M. N.	1414,3	12	173,6	171	344,6	14,4	1,2
14	Sikhote Alin Zapovednik	Zaumyslova, O. Yu.	2372,9	26	335,7	346,6	682,3	13,1	1,4
15	Sineya	Fomenko, P. V.	1165,4	15	151	151	302	10,1	1,3
16	Terney Hunting Lease	Kozichev, R. P.	1716,5	24	225,6	210,6	436,2	9,1	1,3
	Totals		23555,1	246	3064,7	3069,9	6134,6	12,5	1,3

In some sites a decision was made to conduct a third survey (Table 2). However, this process was not well organized, and the way data was collected was not coordinated (i.e. some collected data on ungulates, some did not). We have not included information from this third survey in this report. In terms of tiger numbers based on expert assessments, the change by including a third survey was only two animals (Table 2). However, adding these two animals to the total for 2010 would represent a bias, as in all previous years expert assessments were based on two surveys. Therefore, we used only two surveys to assess trends in both ungulates and tigers.

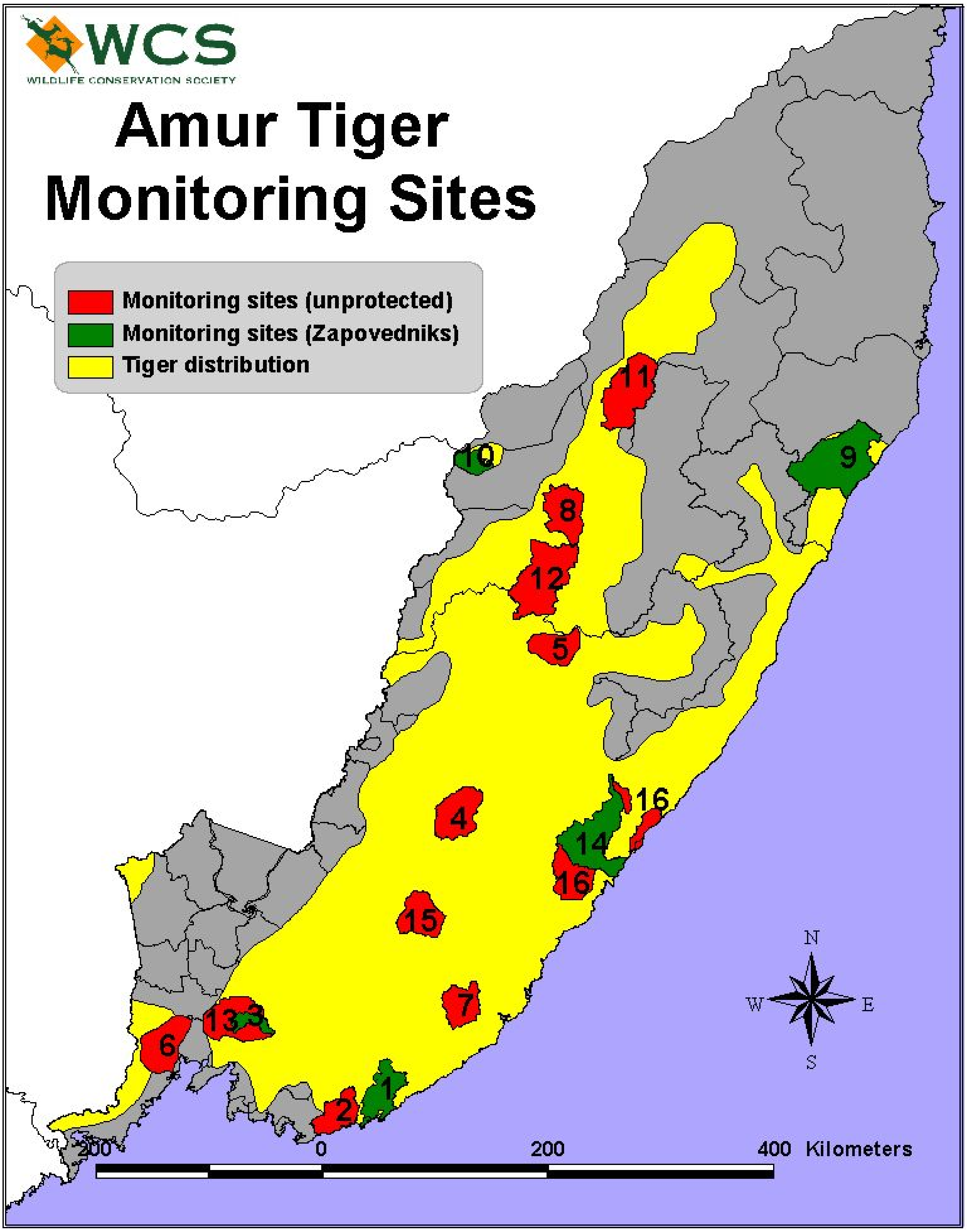


Figure 1. Location of the 16 sites used for monitoring Amur tigers in the Russian Far East. Numbers referenced in Table 1 and most other tables throughout text.

Table 2. Survey units in which survey routes were covered a third time, and the results (in terms of ungulate and tiger numbers) of this third count.

Monitoring unit	3rd survey: Tiger tracks	3rd survey: Tiger tracks - additional	3rd survey: Ungulate tracks	Tigers registered only in 3rd survey
Lazovsky Zapovednik				
Lazovsky Raion				
Ussuriisky Zapovednik				
Ussuriisky Raion				
Sikhote-Alin Zapovednik				
Terney Hunting Lease	3rd survey was not conducted			
Sandagoy				
Tigrini Dom				
Botchinsky Zapovednik				
Bolshe-Khekhtsirsky Zapovednik				
Bikin				
Sinyaya	registered	not registered	not registered	Female of unknown age
Iman	registered	not registered	registered	NO
Borisovskoe Plateau	registered	not registered	registered	NO
Mataiski Wildlife Refuge	registered	not registered	registered	Adult tiger of unknown sex
Khor	registered	registered	registered	NO

MEASURES OF TIGER ABUNDANCE

Tiger Track Density on Survey Routes

Mean track density, adjusted for the number of days since the last snowfall (see Methods), provides an indication of relative abundance of tigers on monitoring sites (Table 3). Overall track density for all sites combined showed an increase from the previous two years, up from 0.59 (2008) and 0.54 (2009) to 1.0 tracks/10 km in 2010. This increase is good news in that it suggests that the observed consistent decline since 2004 has halted (Figure 2). However, trend analyses, whether taken across all years of the monitoring program, or across the last 6 years, both still indicate longer-term significant declines in track densities (Figure 3). Average track densities in 2010 (1.01) were still below the overall average (1.27 tracks/10 km) although the difference is not statistically significant.

Averaged across all 13 years, Ussuriski Zapovednik still retains the highest track density of all 16 monitoring units. However, track density over the past 4 years in Ussuriski Zapovednik are much lower than in previous years, suggesting that tiger numbers may have fallen in this reserve (Table 3). No tracks were reported in Bolshekhekhtsirski Zapovednik for the 4th year.

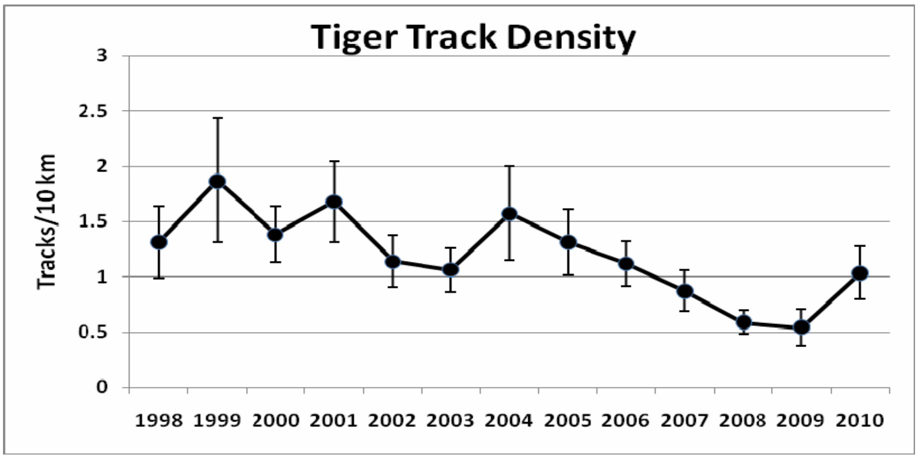


Figure 2. Density of tiger tracks (tracks/10 km/days since last snow) as an indicator of relative tiger abundance averaged across 16 sites included in the Amur Tiger Monitoring Program, winter 1998 through 2010. Yearly value is the average of all routes across all sites.

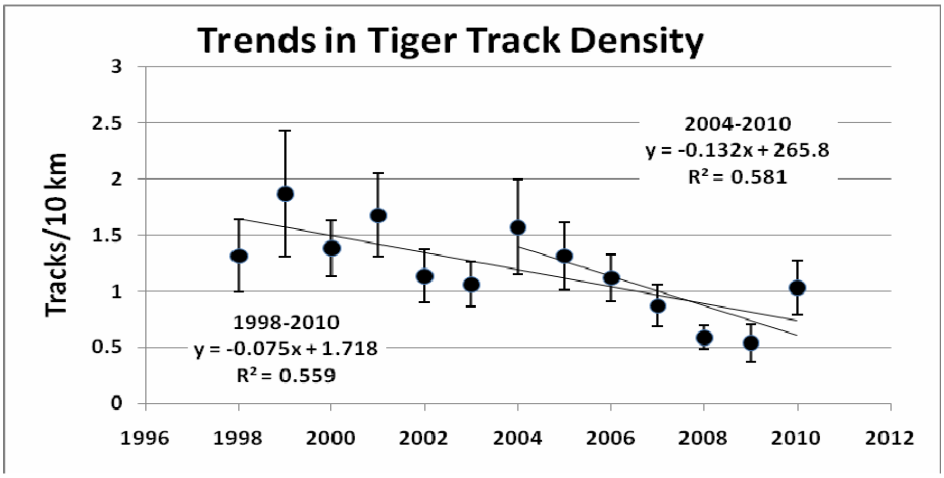


Figure 3. Trends in tiger track density show a long-term decline since the beginning of the monitoring program, and a significant decline since 2004, despite the increase in track density reported in 2010. Yearly value is the average of all routes across all sites.

Table 3. Track densities (tracks/10 km/last snowfall) based on two winter surveys per year, 1998-2010 on survey units of the Amur Tiger Monitoring Program. Yearly average (bottom row) is the average of all units combined.

Monitoring Site	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Lazovski Zapovednik	3,6	2,2	3,0	3,6	2,5	3,5	4,2	2,1	3,4	3,4	2,6	2,6	2,3	3,0
Lazovski Raion	1,4	0,7	1,0	1,0	1,6	0,9	1,3	0,4	1,3	1,6	0,8	0,5	1,2	1,1
Ussurisk Zapovednik	3,3	9,7	6,2	6,1	3,5	2,6	2,1	2,7	4,2	0,3	0,8	2,7	1,6	3,5
Iman	1,0	2,8	0,9	0,8	0,8	0,6	0,5	0,6	0,6	0,3	0,2	0,2	1,0	0,8
Bikin	3,6	7,7	0,9	3,7	2,3	2,6	6,3	0,6	2,2	1,2	1,0	0,5	1,6	2,6
Borisovskoe Plateau	0,5	0,8	1,4	0,6	0,5	1,2	0,7	0,7	1,2	0,3	0,8	0,7	0,6	0,8
Sandagoy	0,5	0,7	0,3	0,4	0,2	0,8	0,4	0,4	0,7	1,2	0,2	0,0	0,1	0,5
Khor	0,4	0,8	1,7	1,5	1,4	0,5	1,0	4,2	0,3	1,2	0,0	0,1	2,8	1,2
Botchinski Zapovednik	0,9	0,7	1,2	1,3	1,0	0,5	0,6	0,8	0,8	0,7	0,5	0,3	0,4	0,7
Bolshekhekhtsirki Zapovednik	2,0	0,9	0,8	0,7	0,7	0,4	7,1	1,8	0,3	0,0	0,0	0,0	0,0	1,1
Tigrini Dom	0,7	1,5	1,1	1,5	1,7	1,3	2,2	1,5	0,3	0,9	0,4	0,1	0,5	1,1
Mataiski Zakaznik	0,6	1,2	0,7	2,4	0,4	0,4	0,6	2,5	0,5	0,5	0,7	0,4	0,7	0,9
Ussuriski Raion	1,0	0,6	1,9	1,4	1,7	0,5	0,7	0,5	1,0	0,2	0,2	0,3	0,8	0,8
Sikhote Alin Zapovednik	2,0	1,3	1,5	1,2	0,9	1,0	1,1	0,9	0,9	1,2	0,6	0,5	1,2	1,1
Sineya	0,2	0,3	0,5	0,6	0,4	0,6	0,9	0,6	1,8	0,7	0,2	0,5	1,1	0,6
Terney Hunting Lease	0,8	0,6	0,7	0,9	0,4	0,6	0,2	0,4	0,3	0,2	0,5	0,3	0,5	0,5
Yearly average	1,41	2,03	1,50	1,73	1,25	1,13	1,87	1,29	1,24	0,87	0,60	0,60	1,01	1,27

Many monitoring sites showed increases in tiger numbers in 2010, including Iman, Bikin, and Sikhote-Alin Zapovednik (Table 3), but there were other sites that continued to demonstrate lower than average track densities, including Lazovksi and Ussuriski Zapovedniks, and Tigrini Dom.

Expert Assessment of Tiger Numbers on Monitoring Sites

The expert assessment of tiger numbers shows the same overall trend as track densities, in that, numbers appeared higher than the 2009 survey results, but nonetheless suggest that a decline in tiger numbers is underway (Figure 4). The total number of tigers reported on monitoring units (80) is second only to 2009 as the lowest in all 13 years (Table 4). If we estimate the running average for each year (the average number of tigers for all sites combined for all years prior to and including each year), we note a nearly continuous downward trend that is most precipitous after 2005 (Figure 5). These data indicate that while tiger numbers appear higher in 2010 than in 2009, there nonetheless appears to be a marked decline in tiger numbers.

No monitoring units have any indications that tiger numbers are increasing, based on expert assessments. At least six sites show significant declines (trend analysis in which are significant at p = 0.06).

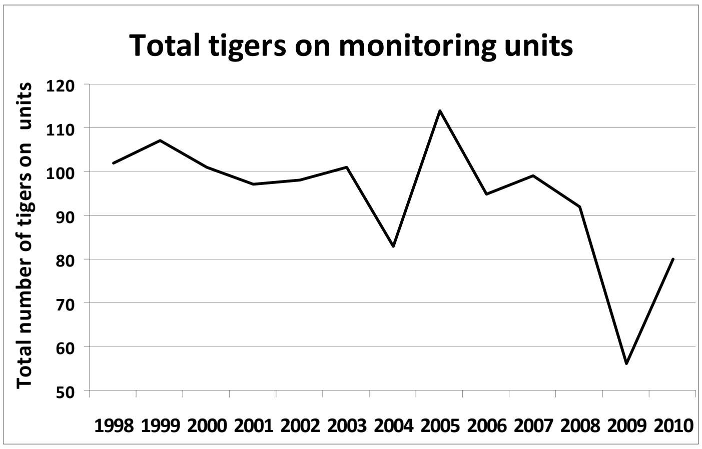


Figure 4. Total number of tigers reported on monitoring sites, based on expert assessments, during the Amur Tiger Monitoring Program, 1998-2010.

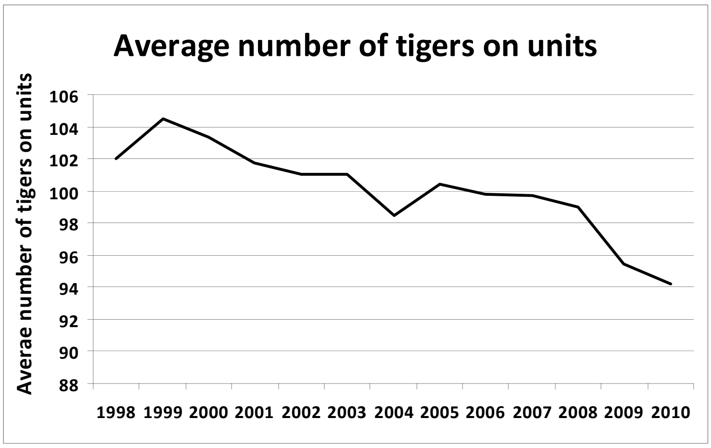


Figure 5. Running average number of tigers reported on monitoring sites during the Amur Tiger Monitoring Program, 1998-2010. The results suggest a continuous decline in tiger numbers on monitoring sites, based on expert assessments.

Table 4. Number of independent tigers (adults, subadults, and unknown tigers) based on expert assessments of tiger tracks from two surveys on 16 sites in the Russian Far East Amur Tiger Monitoring Program, 1998-2010

Monitoring Unit	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Lazovski Zapovednik	10	8	10	11	12	9	10	12	11	12	9	8	8	10,0
Lazovski Raion	8	4	5	5	6	5	4	6	6	5	5	4	5	5,2
Ussurisk Zapovednik	6	10	4	5	4	6	7	9	5	5	5	5	4	5,8
Iman	8	6	5	6	6	4	5	8	5	4	4	3	4	5,2
Bikin	3	10	7	6	7	8	5	5	4	6	5	3	4	5,6
Borisovskoe Plateau	4	5	4	3	3	5	3	2	3	3	2	2	3	3,2
Sandagoy	6	6	5	7	3	7	5	5	6	6	5	1	4	5,1
Khor	3	4	4	4	4	5	5	5	6	4	4	4	6	4,5
Botchinski Zapovednik	3	3	4	4	6	4	2	5	4	3	4	1	2	3,5
Bolshekhekhtsirki Zapovednik	2	1	2	1	1	1	2	2	1	1	0	0	0	1,4
Tigrini Dom	4	6	4	4	5	6	5	7	4	5	5	1	3	4,5
Mataiski Zakaznik	3	5	4	4	5	5	5	8	7	4	6	3	5	5,0
Ussuriski Raion	6	1	2	2	9	6	5	7	5	3	5	3	7	4,7
Sikhote Alin Zapovednik	21	21	23	17	17	16	12	19	16	26	20	8	14	17,7
Sineya	5	6	5	7	5	7	5	6	6	7	5	5	4	5,7
Terney Hunting Lease	10	11	13	11	5	7	3	8	6	5	8	5	7	7,6
Total	102	107	101	97	98	101	83	114	95	99	92	56	80	94,2

Table 5. Density of independent tigers (adults, subadults, and unknown tigers/100 km^2) based on expert assessments of tiger tracks on 16 sites in the Russian Far East Amur Tiger Monitoring Program, 1998-2010

Monitoring Unit	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Lazovski Zapovednik	0,84	0,67	0,84	0,92	1,01	0,75	0,84	1,01	0,92	1,01	0,75	0,67	0,67	0,84
Lazovski Raion	0,81	0,41	0,51	0,51	0,61	0,51	0,41	0,61	0,61	0,51	0,51	0,41	0,51	0,53
Ussuriski Zapovednik	1,47	2,45	0,98	1,22	0,98	1,47	1,71	2,20	1,22	1,22	1,22	1,22	0,98	1,41
Iman	0,57	0,43	0,36	0,43	0,43	0,29	0,36	0,57	0,36	0,29	0,29	0,22	0,29	0,38
Bikin	0,29	0,97	0,68	0,58	0,68	0,78	0,49	0,49	0,39	0,58	0,49	0,29	0,39	0,55
Borisovskoe Plateau	0,27	0,34	0,27	0,20	0,20	0,34	0,20	0,14	0,20	0,20	0,14	0,14	0,20	0,22
Sandagou	0,61	0,61	0,51	0,72	0,31	0,72	0,51	0,51	0,61	0,61	0,51	0,10	0,41	0,52
Khor	0,22	0,30	0,30	0,30	0,30	0,37	0,37	0,37	0,45	0,30	0,30	0,30	0,45	0,33
Botchinski Zapovednik	0,10	0,10	0,13	0,13	0,20	0,13	0,07	0,16	0,13	0,10	0,13	0,03	0,07	0,11
Bolshekhekhtsirki Zapovednik	0,42	0,21	0,42	0,21	0,21	0,21	0,42	0,42	0,21	0,21	0,00	0,00	0,00	0,29
Tigrini Dom	0,19	0,29	0,19	0,19	0,24	0,29	0,24	0,34	0,19	0,24	0,24	0,05	0,14	0,22
Mataiski Zakaznik	0,12	0,20	0,16	0,16	0,20	0,20	0,20	0,32	0,28	0,16	0,24	0,12	0,20	0,20
Ussuriski Raion	0,42	0,07	0,14	0,14	0,64	0,42	0,35	0,49	0,35	0,21	0,35	0,21	0,49	0,33
Sikhote Alin Zapovednik	0,88	0,88	0,97	0,72	0,72	0,67	0,51	0,80	0,67	1,10	0,84	0,34	0,59	0,75
Sineya	0,43	0,51	0,43	0,60	0,43	0,60	0,43	0,51	0,51	0,60	0,43	0,43	0,34	0,48
Terney Hunting Lease	0,58	0,64	0,76	0,64	0,29	0,41	0,17	0,47	0,35	0,29	0,47	0,29	0,41	0,44
Average	0,52	0,57	0,48	0,48	0,46	0,51	0,46	0,59	0,47	0,48	0,43	0,30	0,38	0,47

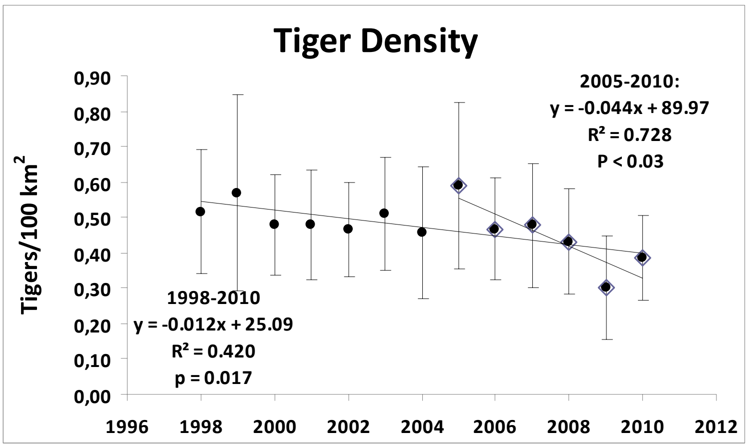


Figure 6. Density of independent tigers (adults, subadults and unknown tigers) counted on monitoring units, based on expert assessments for 16 sites in the Amur Tiger Monitoring Program, 1998 through 2010 winter seasons. Although tiger numbers are up from 2009, there is still a significant downward trend.

UNGULATE POPULATIONS ON MONITORING SITES

We use fresh track (< 24 hours old) density as an indicator of ungulate abundance on Amur tiger monitoring units because there is a clear linear relationship to absolute ungulate density (Chelintsev, 2000, Miquelle et al. 2006, Stephens et al. 2005), but is much easier to measure than true density itself. Red deer, wild boar, and sika deer are the primary prey of Amur tigers. Roe deer are taken relatively infrequently, and may be considered secondary prey. Therefore, we focus analyses primarily on these 4 species of prey.

Timing of Survey Routes

In 2009 there were extensive discussions about timing of winter surveys. Initial survey design called for the first survey to be conducted in early winter (December-January) and a second survey to be conducted in February. In 2007 it was suggested that surveys be conducted in close temporal proximity to avoid violating the assumption of population closure (no deaths, no immigration, no emigration) during the survey period. This assumption of population closure is important in assessing population numbers for both tigers and their prey. However, there was great concern from program coordinators about the impact of changing dates of surveys, especially in how it would affect estimates of ungulate numbers. This section is devoted to assessing the impact of varying timing of surveys in winter.

We first looked at the difference in estimate of track density for each route for the first and second survey, averaged across all sites and all years, for each of the four primary prey species of tigers. The results indicate that the track index is consistently higher in the first survey (Figure 7), i.e. if there were no difference between the two surveys, the average should be statistically indistinguishable from zero, but all values are well above zero. For each species, the average difference is statistically greater than zero (red deer: $t = 6.278$, $p < 0.0001$; Roe deer: $t = 9.91$, $t < 0.0001$; Wild boar: $t = 5.219$, $t < 0.0001$; Sika deer: $t = 3.701$, $p < 0.0001$). This analysis suggests that timing of surveys is important in estimating relative ungulate abundance, i.e. relying on only the first or second survey would provide different estimates of relative abundance.

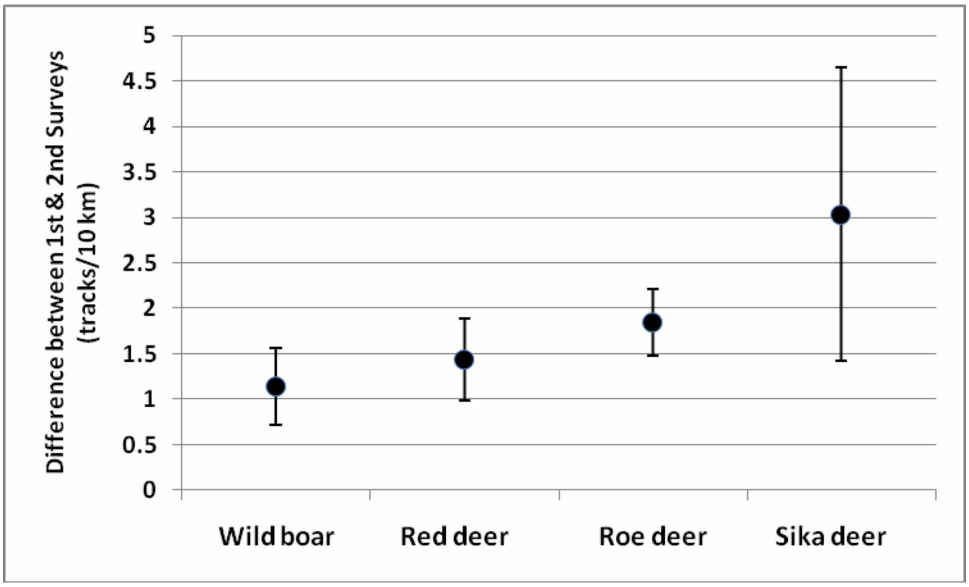
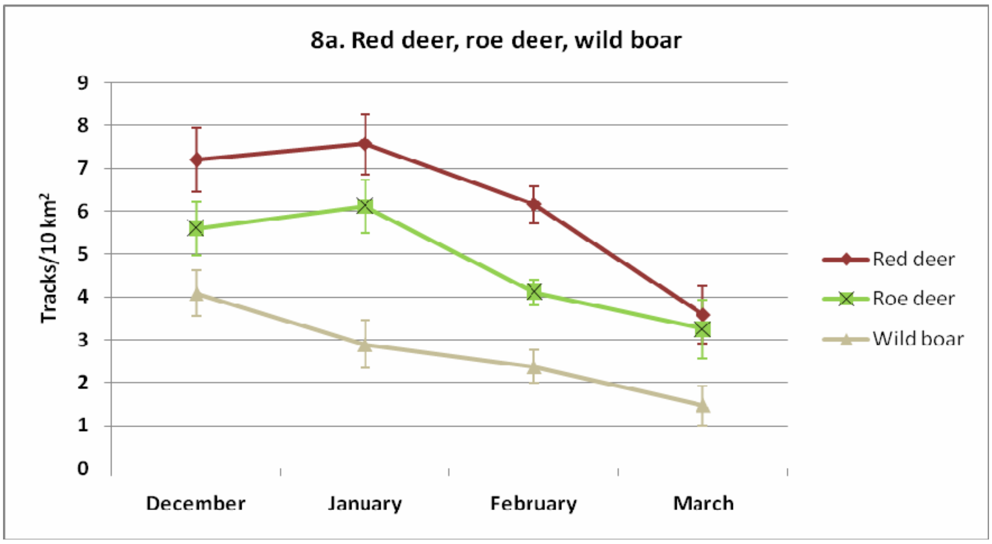


Figure 7. Difference (in tracks/10 km) between first and second surveys on each route, averaged over each of 13 winters for the primary prey species of tigers on units of the Amur Tiger Monitoring Program. Resutls indicate that estimates of track density are higher in the first survey (difference greater than zero) than the second survey.

Secondly, we looked at estimates of track abundance in relation to the month in which the data was collected (irrespective of whether it was the first or second survey). These results also indicated a very clear trend, although there is variation among species. Red deer track densities in December and January are statistically no different from each other (7.2 versus 7.6 tracks/10 km), but greater than February (6.1), which in turn is statistically greater than March, when a dramatic drop in track density was recorded (3.6 tracks/10 km) (Figure 8a, Table 6). Roe deer show an identical pattern, with December and January track densities statistically similar, and then dropping in February, and an even greater drop in March (Figure 8a, Table 6). Sika deer are slightly different. December and January track densities are similar, with an expected drop in February, but unlike the other ungulates, track densities do not continue to decline in March, but stayed roughly the same as in February (Figure 8b, Table 6). Wild boar have highest track densities in December, and then January and February have statistically similar track densities, with a drop in March. In summary, all three deer species show similar track densities in December and January with a decline in the second half of winter. Wild boar have higher track densities in December, probably in association with breeding, and then settle into a declining pattern.



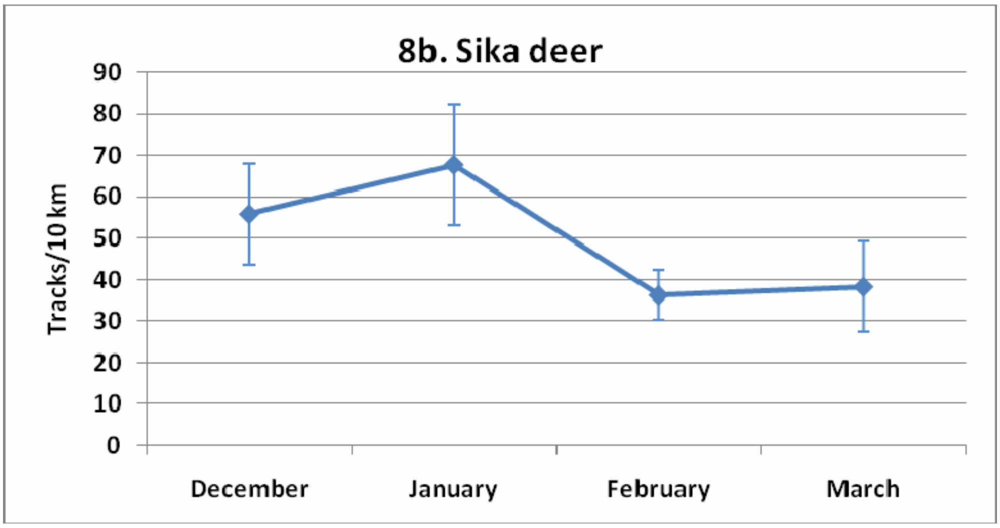


Figure 8. Average track density (tracks/10 km) based on month in which survey routes were conducted for the Amur Tiger Monitoring Program, 1998-2010 for a. red deer, roe deer, and wild boar, and b. sika deer (here only data from Lazovski Zapovednik, Lazo Raion, Ussuriki Zapovednik and Borisovkoe Plateau are used for sika deer). Results indicate a decline in track densities in the second half of the winter, but the pattern varies by species (see Table 6).

Table 6. Monthly average track density for four primary prey species of tigers in monitoring units of the Amur Tiger Monitoring Program, 1998-2010. For each species, months which are circled together are statistically no different from each other.

	December	January	February	March
Red deer	**7,2**	**7,6**	**6,1**	**3,6**
Roe deer	**5,6**	**6,1**	**4,1**	**3,2**
Sika deer[+]	**55,8**	**67,7**	**36,4**	**38,4**
Wild boar	**4,1**	**2,9**	**2,4**	**1,5**

[+] Sika deer estimate here include only Lazovski Zapovednik, Lazo Raion, Ussuriski Zapovednik, and Borisovkoe Plateau monitoring units.

Surveys provide more reliable estimates of both numbers and trends when basic survey principles are not violated. Extending the interval between surveys for the monitoring program has two fundamental problems. First, it increases the chances of death, immigration or emigration in both tiger and prey populations, making interpretation of data more difficult. Secondly, as these analyses indicate, they greatly increase the difficulty of accurately surveying ungulates. There appears a very well defined pattern in track densities, but that pattern varies amongst prey species. Conducting both surveys within a short time interval (one month) would allow combining both surveys into a single estimate of track abundance that would be much more statistically robust in determining real trends. When large intervals exist between winter surveys (more than a month) there is always at least one of the key prey species which demonstrates significant differences in track abundance – hence averaging these results will decrease accuracy of the estimate (there will be greater dispersion between the two estimates, and therefore less accuracy). The reason for this change is not completely clear, but it is likely due to lack of closure of the population (deaths or emigration occurring) and/or reduced activity levels as the winter progresses. In either case, combining both surveys to derive an average track density for each survey route increases error associated with that estimate, and decreases the ability to detect trends in prey numbers. Estimating track densities from only a single survey is an option, if it is consistently done in same month each year, but in this case the additionally information from the second survey is lost.

To assess how results may vary using a single survey versus two surveys, we calculated track densities using the first survey and for both surveys for both red deer (Figures 9a and 9b) and roe deer (Figures 10a and 10b). Both these sets of graphs demonstrate that the trends that are observed are very similar, whether the first survey alone is used (Figure 9a and 10a), or whether both surveys are averaged for a single value (Figures 9b and 10b). The actual value for each year varies, with the first survey being consistently higher in both instances, but the trends for both remain the same. It is also interesting to note that the confidence intervals appear smaller for those years for which surveys were done close to each other, but there are only a few years to make this comparison. Nonetheless, the evidence does suggest that conducting surveys temporarily close to each other will reduce confidence intervals, and allow better detection of trends.

For purposes of comparing to previous reports, we continue to use the average track density for both first and second surveys for reporting. However, it will be important to review this issue and determine the most effective approach for utilizing existing data, and defining how surveys should be conducted in the future.

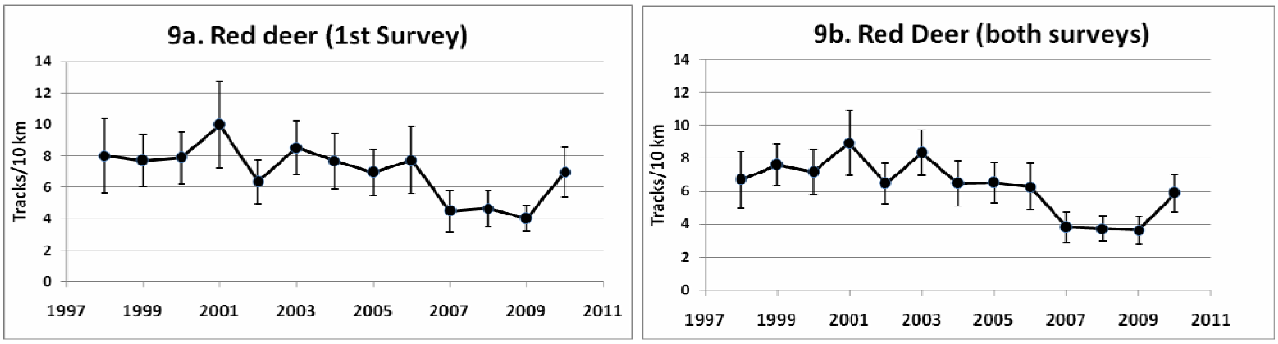


Figure 9. Estimates of track abundance (tracks/10 km) and 95% confidence intervals for red deer when a. only the first survey of each winter is used; and b. when the average of both surveys in each winter are used. Trends are very similar but actual values vary. Note small confidence intervals in 2007-2009 when surveys were conducted temporally close to each other.

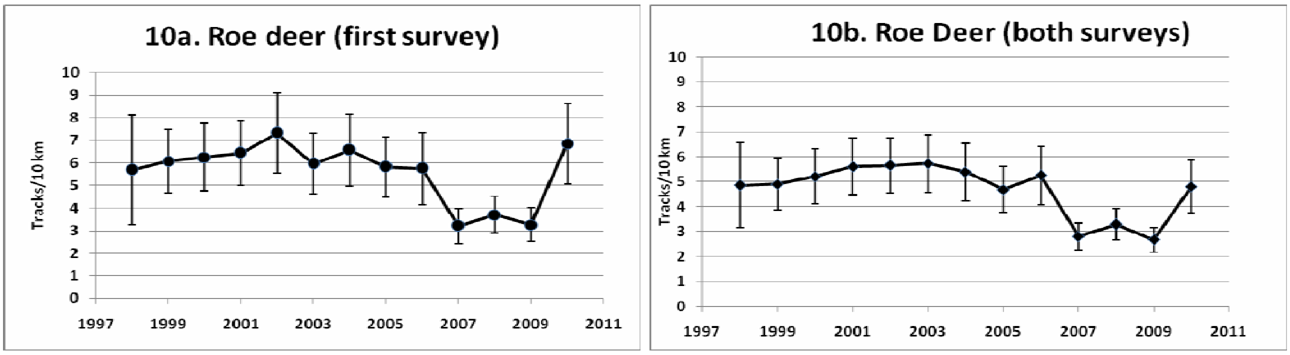


Figure 10. Estimates of track abundance (tracks/10 km) and 95% confidence intervals for roe deer when a. only the first survey of each winter is used; and b. when the average of both surveys in each winter are used. Trends are very similar but actual values vary. Note small confidence intervals in 2007-2009 when surveys were conducted temporally close to each other.

Trends in Prey Numbers

As in previous years, prey numbers varied greatly among sites (Table 7). In general, those sites where sika deer occur have much higher overall track densities than sites without sika deer, suggesting that prey biomass for tigers will also be greater where sika deer are present (Table 7). Sika deer track densities reach levels that are not reported for other species. Since tiger densities tend to be greater in zapovedniks, it would be expected that ungulate densities are also greater. In general, this is the case: 4 of the 6 monitoring units with the highest overall track densities are zapovedniks (Table 7).

Table 7. Mean track densities (fresh tracks/10 km) and 95% confidence intervals of primary ungulate prey species for tigers on monitoring units of the Amur Tiger Monitoring Program, for 2010.

Monitoring Unit		Tracks/10 km							
		Red deer		Roe deer		Wild boar		Sika deer	
	n	mean	95% CI	mean	95% CI	mean	95% CI	mean	95% CI
Lazovski Zapovednik	12	5,43	4,94	0,53	0,52	2,19	2,83	108,25	25,02
Lazovski Raion	11	0,00		0,36	0,45	0,53	0,50	66,90	46,83
Ussurisk Zapovednik	11	8,39	5,78	8,52	4,71	13,21	9,05	17,56	12,23
Iman	12	4,58	2,27	4,35	3,61	2,28	2,80	0,00	
Bikin	16	3,83	1,63	6,53	2,58	3,02	1,04	0,06	0,11
Borisovskoe Plateau	14	0,00		2,65	1,93	2,35	1,81	33,28	16,43
Sandagoy	16	10,21	3,22	5,98	3,09	1,46	1,18	3,05	1,16
Khor	19	5,03	2,08	1,88	1,44	2,71	0,89	0,00	
Botchinski Zapovednik	14	11,44	4,26	3,34	1,66	0,00		0,00	
Bolshekhekhtsirki Zapovednik	7	22,43	9,98	4,43	6,94	2,50	3,98	0,00	
Tigrini Dom	14	1,73	0,48	1,00	0,49	0,35	0,21	0,00	
Mataiski Zakaznik	24	3,01	1,19	0,74	0,31	1,63	0,92	0,00	
Ussuriski Raion	12	4,25	3,59	7,71	4,06	3,52	2,11	1,42	1,28
Sikhote Alin Zapovednik	25	16,29	6,41	18,83	6,47	1,80	1,64	12,32	16,52
Sineya	15	0,40	0,32	0,97	0,69	0,39	0,36	0,00	
Terney Hunting Lease	24	1,46	0,77	2,78	1,12	0,31	0,29	0,75	0,71

Red deer

As in past years, red deer track densities varied greatly among monitoring sites, from 22 tracks/10 km in Bolshekhekhtsirski Zapovednik to 0 in Borisovskoe Plateau (where red deer have not been reported for many years) and Lazovski Raion (Table 8). In the 2010 winter the average red deer track density was 5.9 $\pm$ 1.3 tracks/10 km of survey route (Table 8). This estimate represents an increase from the previous 3 years (Figure 11). Nonetheless, trend analyses continue to indicate that there has been a longer term decrease in red deer numbers (Figure 12), beginning in 2001, and despite the increase over the past 3 years, there is still a significant declining trend (r^2 = 0.61, p = 0.007).

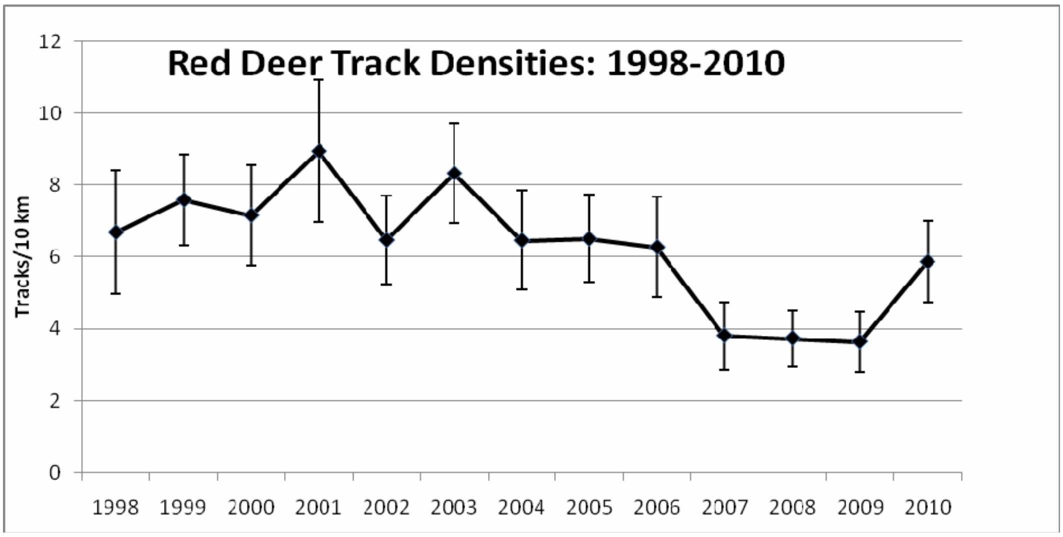


Figure 11. Average red deer track density and standard errors across 14 sites for all thirteen years of the Amur Tiger Monitoring Program, 1998 though 2010. Two sites were not included because red deer are rare or completely absent (Borisovskoe Plateau and Lazovski Raion).

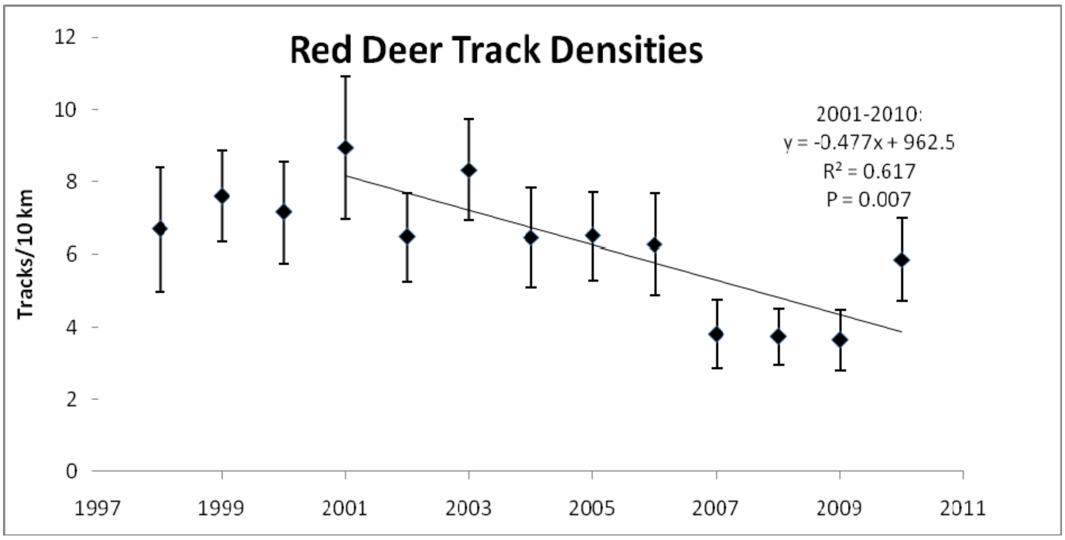


Figure 12. Trend analyses for red deer track densities averaged across all sites suggest that despite an increase from 2009 to 2010, there is still a significant downward trend since 2001.

Table 8. Red deer track densities (tracks/10 km) on routes surveyed on 16 sites for the Amur Tiger Monitoring Program 1998-2010.

	Fresh tracks/10 km													
Monitoring Unit	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Lazovski Zapovednik	1,36	1,49	6,62	9,16	3,92	1,14	5,53	4,30	4,67	3,71	2,28	1,10	5,43	3,90
Lazovski Raion	0,83	0,25	1,18	0,18	0,14	0,36	0,18	0,00	0,08	0,04	0,00	0,00	0,00	0,25
Ussurisk Zapovednik	5,87	7,03	7,06	5,11	3,43	4,79	3,64	5,13	3,08	7,21	7,05	7,05	8,39	5,76
Iman	1,83	6,33	5,33	5,56	8,10	5,29	4,61	6,66	4,57	3,04	3,35	3,20	4,58	4,80
Bikin	1,47	11,24	7,14	9,53	5,32	10,37	4,52	6,91	4,13	6,85	2,86	3,96	3,83	6,01
Borisovskoe Plateau	0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Sandagoy	1,74	3,84	9,90	7,41	9,87	6,87	5,07	4,67	4,08	2,30	6,41	2,78	10,21	5,78
Khor	5,35	6,82	3,98	3,66	4,19	11,72	5,64	7,82	7,73	3,30	4,89	2,59	5,03	5,59
Botchinski Zapovednik	1,82	6,87	4,33	2,84	4,73	5,40	11,61	4,72	5,44	0,79	1,11	6,47	11,44	5,20
Bolshekhekhtsirki Zapovednik	11,01	16,29	13,63	40,57	29,00	34,79	35,93	24,50	41,66	26,07	17,21	25,43	22,43	26,04
Tigrini Dom	3,00	5,06	1,38	1,38	2,29	2,38	1,58	0,72	1,73	1,41	1,34	0,83	1,73	1,91
Mataiski Zakaznik	1,74	4,85	3,76	2,23	4,67	9,54	3,43	5,34	3,05	1,98	2,64	1,82	3,01	3,70
Ussuriski Raion	2,28	2,02	4,30	1,85	1,43	2,78	1,50	2,84	0,94	3,48	3,54	4,45	4,25	2,74
Sikhote Alin Zapovednik	32,55	23,98	23,98	32,82	19,41	21,29	20,35	21,74	20,48	8,35	8,86	8,20	16,29	19,87
Sineya	1,67	4,00	2,77	3,49	1,55	2,31	1,79	1,62	0,57	0,67	0,59	0,41	0,40	1,68
Terney Hunting Lease	13,69	10,11	9,27	13,94	6,16	9,87	3,96	4,26	5,15	1,94	1,77	0,88	1,46	6,34
Average	6,69	7,60	7,17	8,95	6,47	8,34	6,47	6,51	6,28	3,81	3,74	3,64	5,87	6,27

Wild boar

Wild boar populations are known to fluctuate more dramatically than most deer populations due to disease and other factors. This natural tendency for greater fluctuations, along with the fact that they are commonly found in large groups, makes accurate estimating wild boar population numbers and trends more problematic than other ungulate species, except perhaps sika deer.

Since 2005, overall wild boar numbers appeared to drop over the next three years, and stay relatively low through 2010 (Figure 13). There are significant difference among years in average track density ($F = 6.54$, $df = 12, 3183$, $P < 0.0001$). Despite the fact that there is a significant downward trend in wild boar numbers since 2005 (Figure 14), this relationship appears to be driven nearly entirely by the high value in 2005. When this value is removed from the analysis, there does not appear to be any clear trends across all years (Figure 14).

Table 9. Wild boar track densities (tracks/10 km) on routes surveyed on 16 sites for the Amur Tiger Monitoring Program 1998-2010.

	Fresh tracks/10 km													
Monitoring Unit	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Lazovski Zapovednik	1,51	2,52	5,49	5,08	8,04	7,82	11,18	5,96	2,57	6,17	3,04	17,87	2,19	6,11
Lazovski Raion	3,38	0,30	0,35	0,27	1,87	1,99	3,48	0,75	1,00	0,94	2,16	1,18	0,53	1,40
Ussurisk Zapovednik	13,60	29,56	4,24	25,63	5,33	0,99	4,13	7,79	8,90	3,27	2,26	7,86	13,21	9,75
Iman	4,17	1,55	0,22	0,66	2,51	1,14	5,32	3,97	1,68	1,03	1,72	1,14	2,28	2,11
Bikin	1,45	4,00	0,29	3,97	1,69	3,20	5,09	8,46	3,96	7,31	7,21	4,47	3,02	4,16
Borisovskoe Plateau	5,27	0,26	5,53	7,47	1,38	6,65	5,42	16,90	11,16	1,35	1,32	0,37	2,35	5,03
Sandagoy	0,42	2,76	2,68	0,54	1,04	2,42	5,40	1,83	1,74	0,66	1,41	0,28	1,46	1,74
Khor	1,17	0,66	0,37	2,27	1,71	2,13	1,68	6,34	2,93	4,57	2,92	3,73	2,71	2,55
Botchinski Zapovednik	0,03	0	0	0	0	0	0	0	0	0	0	0	0	0
Bolshekhekhtsirki Zapovednik	1,36	3,16	0,61	3,36	2,29	26,43	4,57	2,14	4,46	2,07	4,00	3,21	2,50	4,63
Tigrini Dom	0,54	0,94	1,00	0,46	0,08	0,15	0,35	0,30	0,18	0,17	0,90	0,20	0,35	0,43
Mataiski Zakaznik	0,63	1,11	2,05	1,95	0,48	5,56	1,00	4,20	1,54	0,48	2,21	2,28	1,63	1,93
Ussuriski Raion	3,30	2,19	2,22	1,84	2,74	1,25	1,61	2,26	2,83	4,44	1,46	4,42	3,52	2,62
Sikhote Alin Zapovednik	4,47	4,21	2,69	3,64	1,91	1,91	2,61	11,31	5,63	1,62	2,46	1,98	1,80	3,56
Sineya	1,53	1,23	0,61	0,56	1,26	0,88	0,53	0,61	0,61	0,51	0,94	0,37	0,39	0,77
Terney Hunting Lease	4,76	0,75	1,22	0,20	0,18	0,72	1,37	1,57	1,75	0,38	0,76	0,23	0,31	1,09
Average	2,85	2,97	1,83	3,16	1,76	3,16	3,02	4,93	3,09	2,05	2,13	2,74	2,13	2,76

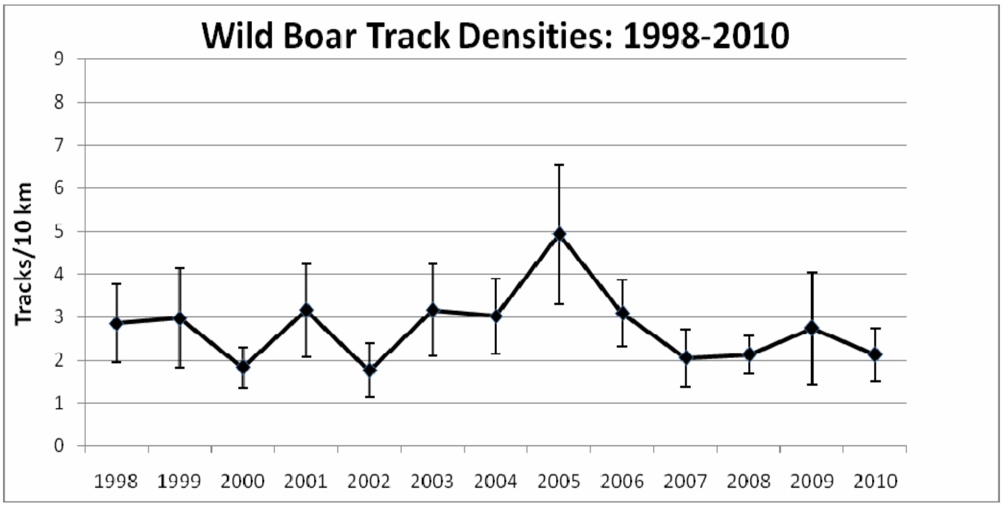


Figure 13. Average wild boar track density and 95% confidence intervals for all sites, for each of the thirteen years of the Amur Tiger Monitoring Program, 1998 though 2010.

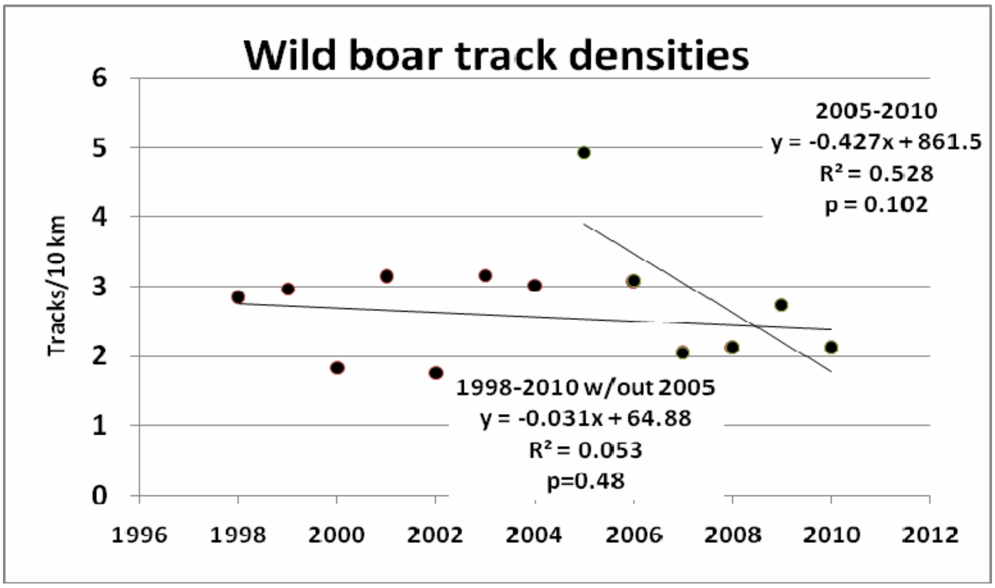


Figure 14. Average wild boar track density and 95% confidence intervals for all sites, 1998 though 2010. Although there is a negative trend in wild boar numbers, it is marginally significant ($p = 0.10$) and largely driven by a single high value in 2005.

Roe deer

Roe deer are the only ungulate species that is found on all 16 monitoring sites. In the 2010 winter the average roe deer track index was 4.80 $\pm$ 1.1 tracks/10 km of survey route (Table 10), very similar to the 13-year average (4.17 $\pm$ 0.80) and much higher than the previous three years (Figure 15). The reason for the increase over the past few years is not clear, but it is not related to timing of surveys, as the increase is evident even when data from only the first survey is included (Figure 9a). Despite this increase, the trend analysis for data since 2002 indicates that there is a significant ($p < 0.04$) downward trend.

Trends in roe deer track counts vary greatly among individual survey units. Seven of 16 survey units show negative population trends for all 13 years or a subset of these, while three units show positive trends.

Table 10. Roe deer track densities (tracks/10 km) counted along survey routes within all 16 monitoring sites of the Amur Tiger Monitoring Program, 1998-2010.

	Fresh tracks/10 km													
Monitoring Unit	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Lazovski Zapovednik	4,49	2,40	4,35	2,73	4,07	0,62	0,97	2,47	1,29	0,67	2,80	1,28	0,53	2,34
Lazovski Raion	4,18	1,01	1,04	0,11	1,40	0,10	0,97	0,35	0,41	0,09	3,12	4,37	0,36	1,43
Ussurisk Zapovednik	13,08	8,61	10,53	6,62	6,31	2,19	1,60	2,03	2,44	1,81	3,04	3,90	8,52	5,18
Iman	3,83	2,68	3,16	4,45	4,29	5,50	3,50	5,04	4,18	3,46	3,39	2,70	4,35	3,85
Bikin	1,61	4,96	1,39	2,88	4,49	3,41	4,73	5,43	3,95	5,35	5,60	5,87	6,53	4,14
Borisovskoe Plateau	3,38	8,48	4,58	6,22	11,27	2,69	4,36	3,78	2,26	5,00	2,97	2,42	2,65	4,78
Sandagoy	2,37	2,44	6,70	8,98	11,94	6,39	3,26	3,94	4,39	2,55	4,09	2,44	5,98	4,96
Khor	2,42	7,60	2,73	2,85	5,25	4,05	5,62	6,45	5,48	1,80	1,23	0,62	1,88	3,84
Botchinski Zapovednik	0,43	2,99	2,69	4,59	3,91	6,55	7,51	2,44	1,82	0,60	0,81	6,02	3,34	3,36
Bolshekhekhtsirki Zapovednik	0,64	1,27	0,16	1,36	4,86	0,64	4,36	1,57	3,34	4,86	1,00	2,00	4,43	2,17
Tigrini Dom	0,65	1,04	0,36	0,28	0,59	0,08	0,45	0,15	1,88	0,13	0,06	0,37	1,00	0,51
Mataiski Zakaznik	1,46	2,62	2,10	1,49	1,39	4,02	1,46	1,45	1,27	1,03	0,89	0,73	0,74	1,66
Ussuriski Raion	7,79	7,92	11,73	7,93	4,68	2,03	2,55	2,58	4,53	4,84	4,34	5,46	7,71	5,53
Sikhote Alin Zapovednik	16,24	11,50	17,53	16,94	13,69	19,17	21,45	15,64	22,50	7,06	11,02	4,33	18,83	14,76
Sineya	2,39	2,59	2,37	3,77	3,01	5,55	2,12	4,27	1,73	1,04	1,75	0,74	0,97	2,61
Terney Hunting Lease	6,61	4,58	4,67	8,33	4,63	10,87	7,25	6,02	7,48	2,95	2,29	1,47	2,78	5,60
Average	4,47	4,54	4,76	4,97	5,36	4,61	4,51	3,98	4,31	2,70	3,03	2,80	4,81	4,17

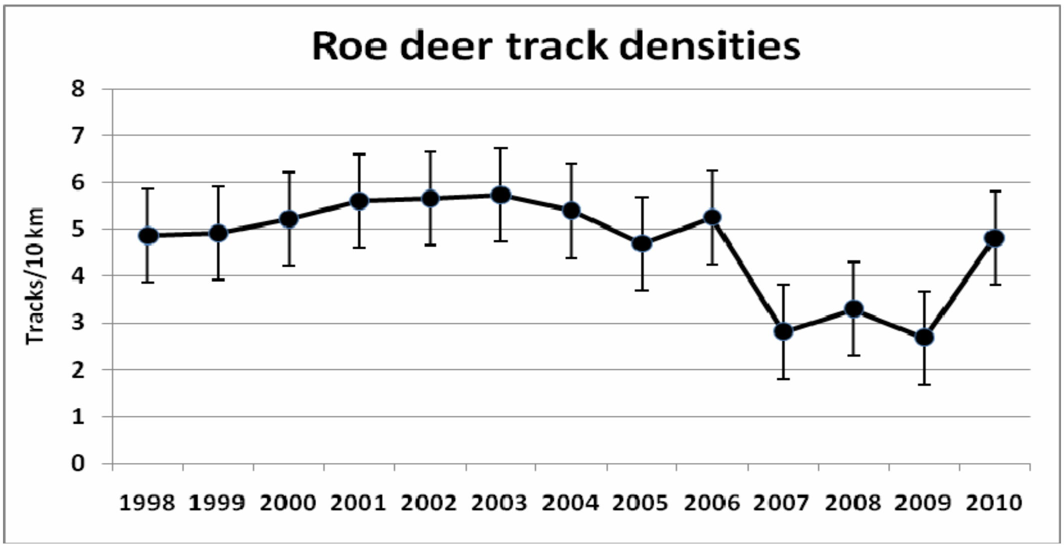


Figure 15. Roe deer track density averaged across all study sites, for thirteen years of the Amur Tiger Monitoring Program, 1998 though 2010.

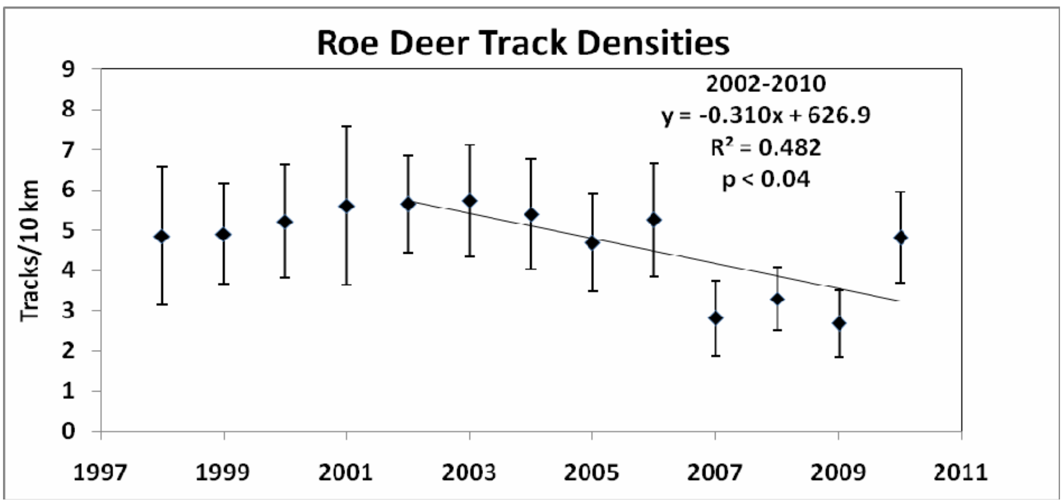


Figure 16. Trend analyses for roe deer track densities averaged across all sites suggest that despite an increase from 2009 to 2010, there is still a significant downward trend ($p < 0.04$) since 2002.

Sika deer

Sika deer are found regularly in only eight of the monitoring units, including all 6 in the south, and 2 of the central monitoring sites (Table 11). However, in the two central units where they occur (Sikhote-Alin Zapovednik and Terney Hunting Lease) they exist in localized pockets, and are not uniformly distributed throughout the monitoring units. Sika deer appear to be increasing in the coastal areas of Terney Raion, and appear to be extending their range to the north, as more reports of sika deer are coming in from Khabarovsk and northern Terney Raion.

Track densities (and hence presumably animal densities) are generally much higher for sika deer than other ungulate species, consistently reaching their highest levels in Lazovski Zapovednik (Table 11). Track densities average 24.7 $\pm$ 1.0 /10 km across all 8 sites for all years (Table 11), with the large confidence interval a reflection of the great variability in sika deer densities across sites, ranging from less than 1 track/10 km in Terney Hunting Lease to over 100/10 km in Lazovski Zapovednik.

There are no trends that appear consistent across all 8 southern sites combined for the 13 years of monitoring (Figure 17), but there are important and opposing trends for some of the individual sites (Figure 18). In Lazovski Zapovednik and Lazovski raion sika deer appear to be increasing over time (Figure 18), whereas in Borisovskoe Plateau and Terney Hunting lease trends appear to be negative. Results from 2010 provide indications that sika deer populations in Sandagoy and Sikhote-Alin Zapovednik may be recovering from downward trends of the previous six to eight years.

Table 11. Sika deer track densities (fresh tracks/10 km) on routes surveyed on 8 sites of the Amur Tiger Monitoring Program 1998-2010.

	Tracks/10 km													
Monitoring Unit	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Lazovski Zapovednik	47,4	43,9	107,0	123,4	92,5	42,7	83,7	183,8	120,4	67,9	211,0	99,1	108,3	102,4
Lazovski Raion	9,7	11,4	51,3	51,6	47,8	28,8	30,3	37,4	36,3	56,8	39,0	36,6	66,9	38,8
Ussurisk Zapovednik	21,2	16,1	31,2	27,6	24,7	12,0	22,7	18,0	19,9	14,8	26,4	24,2	17,6	21,3
Borisovskoe Plateau	28,1	42,9	65,7	20,8	34,1	18,6	28,3	19,9	20,7	24,5	20,7	21,7	33,3	29,2
Sandagoy	0,8	2,5	4,1	7,9	4,3	2,9	1,3	1,3	1,4	1,7	2,4	1,3	3,1	2,7
Ussuriski Raion	0,6	0,3	2,7	2,0	1,2	1,1	0,6	1,3	2,5	1,0	1,0	1,5	1,4	1,3
Sikhote Alin Zapovednik	9,9	5,2	3,7	8,4	9,7	11,8	14,7	6,6	9,1	7,2	7,7	3,7	12,3	8,5
Terney Hunting Lease	6,6	1,6	2,0	0,5	1,3	3,4	1,4	0,5	1,4	0,1	1,0	0,4	0,8	1,6
Average	13,8	13,1	26,8	24,1	21,9	13,3	19,3	26,5	21,3	17,3	30,5	18,4	24,7	20,8

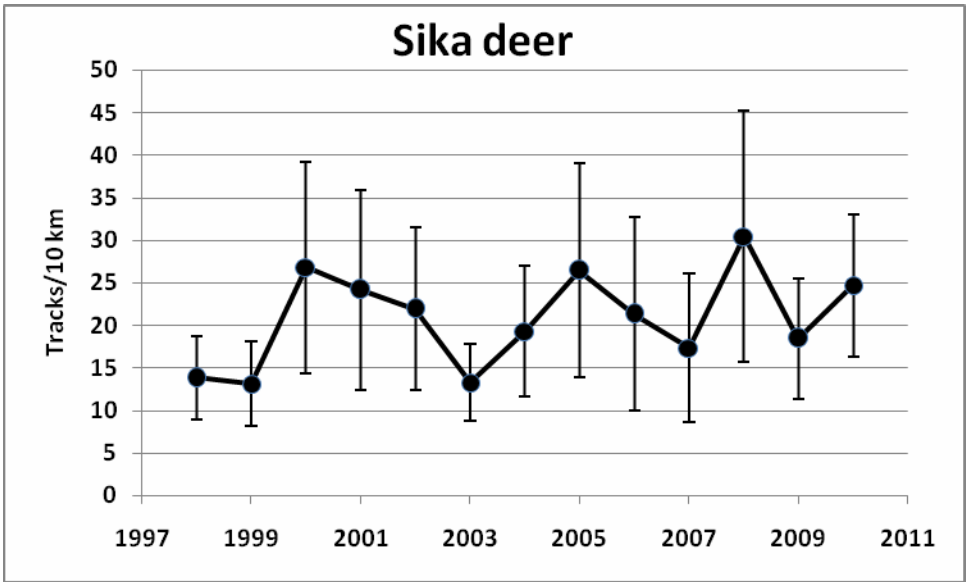


Figure 17. Average sika deer track density and 95% confidence intervals averaged across eight sites where sika regularly occur, for thirteen years of the Amur Tiger Monitoring Program, 1998 though 2010.

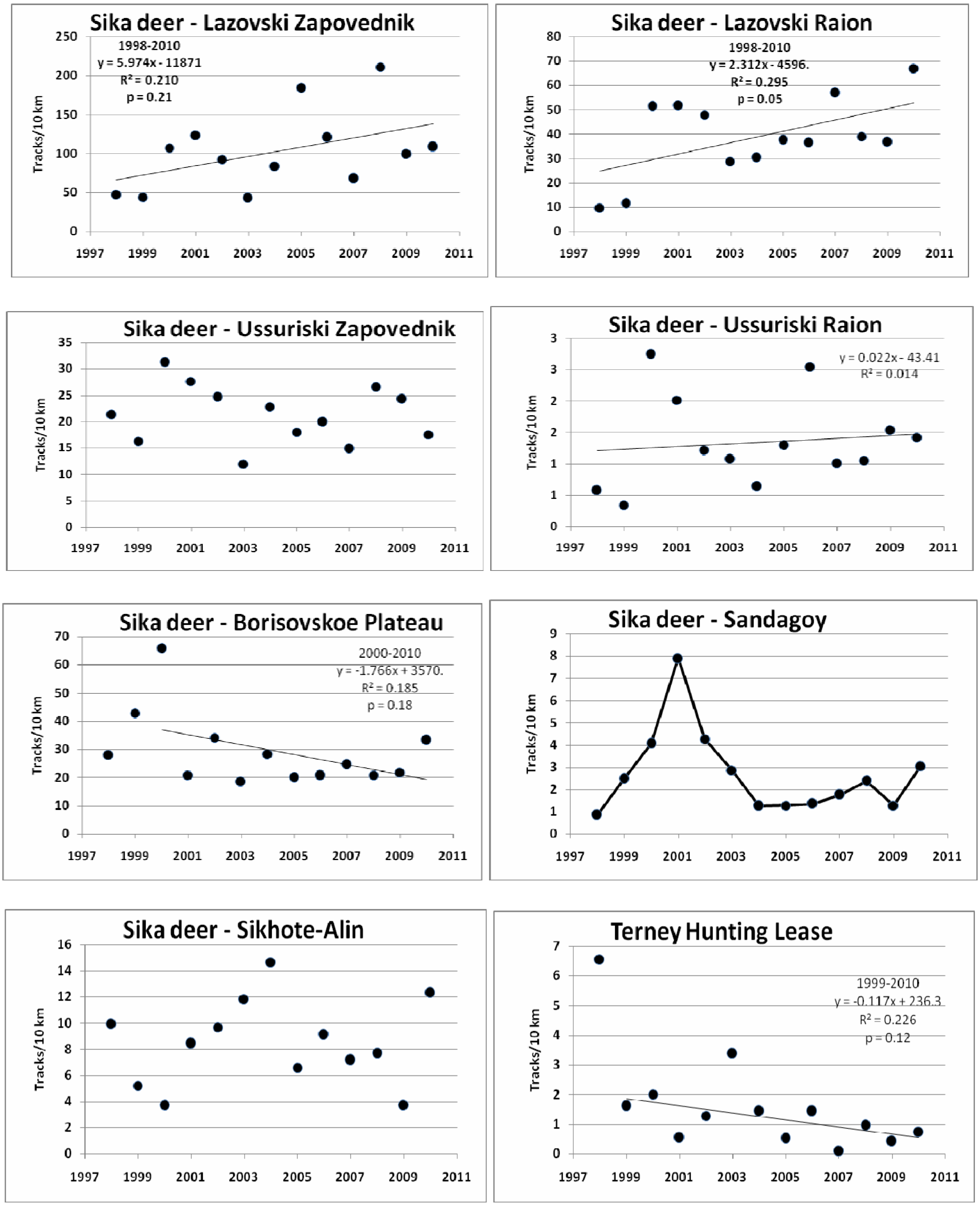


Figure 18. Changes in sika deer densities, as measured by tracks/10 km along routes in all 8 monitoring sites where this species occurs in the Amur Tiger Monitoring Program, 1998 through 2010.

Despite this apparent trend of range extension, the data across all 8 sites where sika deer normally occur does not suggest that, overall, sika deer numbers are increasing at those sites (Figure 18), but rather, suggests a variety of dynamics in different regions. In the Lazo area (Lazovski Zapovednik and Lazo Raion) there are marginally significant upward trends in population indices (Figure 18) suggesting that the population there may be increasing (though low R^2 values and large p-values make this conclusion tentative). Dramatic differences in the track counts between those adjacent units reflect the importance of protected areas in protecting even populations on the Russian Red Data Book – track densities in the zapovednik are 2-4 times higher than adjacent hunted lands. Nonetheless, the general pattern in the Lazo region appears to be upward or stable.

Track count indices in Borisovskoe Plateau and Terney Hunting lease suggest sika deer numbers have been decreasing during the entire period of monitoring (Figure 18). Sika deer are legally hunted only in Nezhinskoe Military Hunting lease (part of the Borisovskoe Plateau monitoring site, but the downward trends in both sites may reflects the low level of protection provided by these two hunting leases.

STATUS OF AMUR TIGERS IN THE RUSSIAN FAR EAST

Numbers of tigers increased in 2010 in comparison to 2009, when the lowest number of tigers was reported over all 13 years of the monitoring program. This rebound was largely expected for several reasons: 1) record snows in northeast Primorye in 2009 dramatically reduced counts of both tigers and prey, and movement by both was nearly impossible due to the exceedingly deep snows; 2) other sites reported unusually few tigers, purely by chance. Therefore, the increase in absolute numbers of tigers on monitoring sites, in comparison to 2009, was wholly expected. Despite this slight "recovery", the overall trends are still not favorable for tigers. Significant negative trends are still evident for tiger numbers, using either track indices or expert assessments of tiger numbers. Therefore, the concerns raised last year, are still valid.

Increases in ungulate numbers - primarily red deer and roe deer – are difficult to explain. Analyses suggest that such increases are not the result of changing timing when surveys are conducted, as the relative change in which month surveys are conducted is much smaller than the change in track densities. Further studies, and data collected in future years, may shed light on these patterns.

There is still a need to address methodology. In this report we argue that conducting each of the two surveys temporally close to each will reduce error in ungulate counts, and ensure closure in assessing numbers of tigers, thereby decreasing overall error in estimates. Some coordinators of the Amur Tiger Program disagree with this approach, but it is important to reach consensus and standardize methodologies to allow meaningful comparisons between years and sites.

Overall, the status of tigers should still be considered in decline, and recommendations made to reverse these trends are still urgently needed.

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