# Amur Tigers and Far Eastern Leopards in Russia:

## Research, Training, and Capacity Building

## in the Russian Far East

**FINAL REPORT**

TO

**21ST CENTURY TIGER**

FROM THE

**WILDLIFE CONSERVATION SOCIETY (WCS)**

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## PROJECT SUMMARY

Although showing some signs of recovery thanks to the multi-year commitment of the Wildlife Conservation Society (WCS) and others, the Amur, or Siberian, tiger (*Panthera tigris altaica*) remains severely threatened. Recent declines, as demonstrated by the Amur Tiger Monitoring Program managed by WCS, demonstrate the tentative existence of this population. As a classic landscape species inhabiting a variety of human-influenced terrains, tigers compete with man for critical habitat and resources. Amur tiger populations remain perilously low, and international efforts in the Russian Far East to save them from extinction have continued for more than 16 years.

WCS's Siberian Tiger Project (STP) began in the Sikhote-Alin Biosphere Zapovednik (SABZ) in 1992, when the Siberian tiger's ecology and status were little known outside the Soviet Union. STP objectives were straightforward: apply good science to Siberian tiger conservation to supply the best possible information on the ecology and dynamics of the species, creating the necessary database for conservation planning to allow Siberian tigers to recover.

Sympatric with Amur tigers at the very southern tip of their range in Russia is the Amur, or Far Eastern, leopard. There are only about 30 individuals of this subspecies left in the wild, making it one of the most endangered of all cats. Tigers in this area exist in a very small, isolated or semi-isolated subpopulation in Southwest Primorsky Krai, along the border with China and North Korea. This subpopulation is the primary source of wild tigers in China, and is critical as a source population for tiger recovery in the country. In autumn of 2006, WCS began a new research project to collect biomedical and ecological data on Amur leopards, along with their bigger cousins, Amur tigers, in Southwest Primorye.

WCS has also established an intensive training and capacity-building program in an attempt to produce the next generation of conservation biologists in the Russian Far East. When we began the Siberian Tiger Project in 1992, there was a cadre of excellent biologists working for tiger conservation within the zapovednik (protected area) system and at the Russian Academy of Sciences. However, many of these biologists have left the field or retired, and there remain few young biologists to take their place because salaries are too low. Recognizing this, WCS has begun a program to identify, attract, support, and nurture promising young students and graduate students in conservation-related fields. Our research programs are the primary vehicle for training such students.

This report describes STP field research in SABZ, field research on Far Eastern leopards and Amur tigers in Southwest Primorsky Krai, and training and capacity-building efforts for the period from July 1, 2008 to June 30, 2009. We believe we have made significant gains in our efforts to better understand the ecology of tigers in SABZ, and of leopards in Southwest Primorye. During the grant period we also provided training for 13 graduate students and interns, including seven Russian and six foreign nationals. We believe we are providing a unique opportunity for these students, and exposing Russian students to the international conservation community.

## PROJECT OBJECTIVES

### RESEARCH PROGRAM:

- Collect the best data for use in conservation plans for Amur tigers and Far Eastern leopards. This includes conducting scientific field research on Amur tigers, both in the central part of their range in SABZ and at the southern edge of tiger habitat in Southwest Primorsky Krai, and conducting research on Far Eastern leopards in Southwest Primorsky Krai.
- Continue biomedical evaluations of tigers and leopards to identify potential inbreeding and disease-related problems in Southwest Primorsky Krai.
- Continue capture and snow-tracking activities both in SABZ and in Southwest Primorsky Krai.

### TRAINING AND CAPACITY BUILDING:

- Continue training current students; bring on at least two new students.
- Continue training Russian project coordinators in fundraising, project administration, and management.

## RESULTS

### THE SIBERIAN TIGER PROJECT: LONG-TERM RESEARCH IN SABZ

***Background and update on radio-collared tigers***. We monitored two adult female tigers (Pt55 and Pt56), one adult male (Pt85), and two juvenile males (Pt88 and Pt89, cubs of Pt56) during the study period (Table 1). Pt88 and Pt89 were captured in the spring of 2008 and began dispersal movements in the summer. Pt88 left his natal home range and moved north, and we continued to track him for several months by plane, until we lost contact with him. Pt89 slipped his collar in August 2008. In July, we found the body of Pt85, an adult male residing in the northern part of the reserve; he appears to have died a natural death.

Pt55 gave birth to cubs in spring of 2008. We were unable to capture these cubs, as much of Pt55's home range is not easily accessible on foot, and we could not find her den site. We ascertained from tracks in the snow that Pt55 had two cubs as of November, and since then we have been closely tracking the family, which is mostly keeping to more remote, higher elevations away from the road and SABZ cabins.

Although Pt56's cubs dispersed in the summer, she has not yet given birth to another litter. It is possible that it has been difficult for her to find a mate.

## Capture Efforts

In 2008-2009 capture activities were divided into two parts and were conducted in four different areas.

In the fall of 2008 capture activities were conducted in the Blagodatnoye area from October 4 – November 19 and in Golubichnaya and Dolgii Stream river basins from October 12 – October 31. Both areas are situated on the coast of Sea of Japan not far from each other. They were selected due to the following reasons:

1. This area is traditionally main place for STP to monitor tigers with radiocollars. For a long time we were trying to fit all resident tigers in this area with radiocollars and monitor their lives and the process of home range occupation after resident tiger replacement.
2. This area is the home range of Pt56 (Galya, an adult radiocollared female). Batteries in her radiocollar are expiring and we need to replace it.
3. We assumed that this area is the home range of resident male tiger and subadult female (Galya's daughter). We planned to capture and radiocollar these tigers.

During fall capture season we attempted to capture these individuals, without result. Although Pt56 visited this area she was very cautious. Signs of other tigers were not detected.

In spring 2009 capture activities were conducted in two areas: Zabolochennaya river basin and the upper reaches of Kuruma river. Both places are relatively remote and hard to reach in comparison with coastal areas of the reserve. They were selected because we have received the permit to use GPS-collars for tigers. Successful GPS radiocollaring provides us the opportunity to monitor tigers in areas, where radiotracking activities from the ground (without monitoring from the air) are impossible. These areas were also selected due to the presence of different forest types: Korean pine–broadleaved, fir-spruce, oak, birch and birch-larch forests. Thus we could determine the importance of different habitat types for tigers.

Kuruma river basin was promising area for capture activities because based on data obtained from camera-traps there was a non-collared resident female in the upper reaches of this river. It was important to capture this female because her home range adjoins the home range of radiocollared female Pt55 in the same river basin. It was interesting to know how two females share one territory. Moreover, based on data obtained from camera-traps there was a non-collared resident male in Kuruma river basin. This was an important individual for radio-tracking because based on preliminary data his home range included home ranges of two radiocollared females (Pt 55, Pt 56).

We assumed Zabolochennaya river basin to be the most promising area for capture activities. Based on the results of winter transect counts, camera-trapping and preliminary search for tiger signs we proposed high tiger density in this area. Despite the absence of radiocollared tigers in this area in recent years, there were successful capture and radio-tracking activities in this river basin earlier.

One capture group worked in the Kuruma area from May 22 – June 11, another group worked in Zabolochennaya river basin from May 7 – June 18.

On June 4 adult resident female (about five years old) was captures in Kuruma area. It was that resident female, which we planned to capture. The tigress (Pt94, was named Sveta) was in good physical condition, capture and handling were conducted without incident, and she became the first tiger in STP fitted with a GPS-radiocollar.
Thus one tiger was radiocollared during the year.

***Radiotracking***

We tracked five radio-collared tigers in 2008-2009 (Table 1).

Table 1. Summary of radio-tracking data collected from tigers on the Sikhote-Alin Biosphere Zapovednik, 1 July 2008 – 20 June 2009.

| Tiger No. | Sex | Age (yrs) | Dates tracked | | Number of locations | | Notes |
|---|---|---|---|---|---|---|---|
| | | | from | to | total | during report period | |
| 55 | ♀ | 7 | 10.24.2002 | 06.20.2009 | 435 | 59 | Gave birth to cubs |
| 56 | ♀ | 7 | 10.24.2002 | 06.20.2009 | 649 | 104 | Family break-up (cubs leave female) |
| 88 | ♂ | 2 | 05.03.2008 | 11.28.2008 | 31 | 5 | Left study area |
| 89 | ♂ | 2 | 05.23.2008 | 08.04.2008 | 46 | 25 | Lost radiocollar |
| 94 | ♀ | 5 | 06.04.2008 | 06.20.2009 | 1 | 1 | Captured |

We obtained 194 location records from five tigers during report period (Table 1). Only two adult females (Pt 55 and Pt56) were monitored the entire year. Two subadult males, offspring of Pt56, were radiotracked for short-time period until their dispersal. One of them (Pt 89) lost his collar, and another (Pt 88) left our study area to the north, beyond our present capacity to monitoring animals. Flights have become prohibitively expensive – nearly $1000/hour – which is one of the reasons we are moving to GPS collars. We just have started monitoring our fifth tiger Sveta (Pt 94), which was captured at the end of report period.

Using radio-telemetry data we were able to determine that the home ranges for two radiocollared females (Galya and Vera) were the same as in previous years. Galya (Pt56) occupies the area along the coast of the Sea of Japan from the Dzhigit Bay to Malennyi Pass. Vera (Pt55) occupies Khanova, Zhadonok and Chaschevityi Streams, and the middle reaches of the Kuruma River. We know from camera trapping data that Sveta (Pt94) resides "above" Vera, on the upper reaches of the Kuruma River

***Reproduction***

Vera (Pt55) gave birth to her most recent litter in July-August 2008. This is the second known litter for Vera. Her first litter was born in 2004. We were not able to find the natal den and determine the initial litter size. After the family left the natal den Vera was accompanied by two cubs, and we were concerned that record snow falls in the region (six feet in one January snowfall) might provide fatal for the cubs. Despite our concerns, both cubs which managed to survive. In fact, it appeared that, for this past winter at least, the deep snows may have actually made hunting easier for tigers for a spell. The deep snow made travel by ungulates nearly impossible, so once tigers came

upon an ungulate trail it appeared they had a relatively easy time simply walking down the ungulates.

In the fall and winter of 2008- 2009 we recorded an increase in Pt56 activities. Galia was moving throughout her home range without long-term stay at any site, visiting the edges of her home range and was heavily scentmarking trees. We surmise that she was likely in estrus, and in search of a male tiger after dispersal of her cubs.

We analyzed data on time spent in natal dens, den site selection and den characteristics. The results of data analysis were presented at the International Congress of Game Biologists in Moscow, August 2009.

***Dispersal of subadult tigers***

In 2008 Galya (Pt56) was accompanied by three cubs in their second year (two males and one female). The two males were captured and radiocollared in May 2008 before dispersal. The only information we have on the female cub is that in February 2008 she was 18 months old and accompanied her mother and siblings. At the time of capture of the two males these cubs were 21 months old; they often accompanied their mother but also traveled independently from time to time. One of these males, Ivan (Pt88), traveled alone more often than the other male. Both male cubs were observed together with their mother for the last time on June 14, 2008 at the age of 22.5 months. Ivan (Pt88) was 23 months old when he left his mother's home range. In July he was observed in Beya area, in August – in Russkaya Bay, and in September – in Kema river area (75 km north of his natal home range). The second male tiger (Clay, Pt89), 24 months old, lost his radiocollar at the beginning of August 2008 near Terney village, not far from the northern boundary of his mother's home range. Most likely that he was starting to disperse at this time.

***Mortality***

In 2008 an adult ten-year old radiocollared male tiger (Pt85) died. He died in the first half of 2008 but we found his carcass only in the second half of the year, and therefore we did not include this information in previous year report.

Tiger remains were found in Elovy creek valley (7 km from creek mouth, Serebryanka river basin) in the forest in small depression in the ground. An examination of the carcass indicated that the tiger died lying on its side with legs tucked under the body. The body was totally decomposed, except for the skeleton. The skeleton was unbroken, all bones aligned in the same position as at the moment of death, except the skull and one shoulder-blade, which were found 1.5 m from the skeleton. Skull and shoulder-blade were probably moved by animals much later after tiger death because there were no hair and putrefaction signs under these bones and there was newly-grown grass. The radiocollar was lying in the neck-bone area. All bones were unbroken, without any damage, so we concluded that large predators did not feed upon tiger carcass. Soft tissues were utilized by bacterium and necrophage insects, of which numerous chrysalices were found under the carcass.

The area examined showed no signs of a struggle with other animals: all bushes and ground were untouched. The radiocollar was clearly not a contributing factor: it was clean, without adhered hair or clotted blood, and the collar girth was 5 cm larger than tiger neck girth when attached.

The cause of death remains unknown, but in all probability to was a natural death, uninfluenced by humans (one of the few we have documented). It is not inconceivable that the tiger had fatal gunshot wound earlier or was wounded during the fight with another predator, but it is just as likely that this animal died of disease (reports of tigers with canine distemper were confirmed this year).

***Predator-prey relations***

During the report period we located and described 14 tiger kills, seven of which were killed by Vera (Pt55) and six by Galya (Pt56). These kills included six wild boars, five red deer, and three roe deer. An additional 13 kills (ungulates) of other predators (tiger competitors) were described – eight animals killed by lynx, four by bear and one by sable.

Winter (2008-2009) and first half of spring were a great challenge for ungulates in Sikhote-Alin Reserve. Their movements were substantially limited by deep snow. For the first time in the course of this study (17 years), we observed a large winter-spring die-off. In this situation tigers, which travel through loose snow easier than ungulates, were able to kill weak ungulates without any difficulties. However we assume that significant decrease of ungulate numbers will have a negative influence on tiger population in the future.

We registered wildlife sighting data to determine some population characteristics of tiger prey species. A total of 140 sighting events were recorded during report period. Wildlife sighting form includes the following information: animal species, number of individuals, sex and age, distance to animals, time and location of observation.

***Use of GPS Collars***

A significant portion of what we planned to accomplish within the confines of this grant were predicated on the fact that permission for use of GPS collars was imminent. Despite all our efforts, however, final permission for GPS collars was not granted until spring 2009, allowing us to begin capture and deployment of GPS collars only a few months ago. Since this spring trapping season resulted in only one capture, we were only able to deploy one GPS collar. However, in fall 2009 (not covered in this grant period) we were able to deploy two more GPS collars. Therefore, although our success has come about after the grant period, support from 21$^{st}$ Century was critical to finally making this happen. See below (impact of tigers on prey populations) for more information on this component of our program.

**Photo 1.** Siberian Tiger Project field technician Vladimir Melnikov listens for radio-collared tigress Pt56. Photo Cheryl Hojnowski © WCS.

We were successful in capturing two of Pt56's juvenile cubs (Pt88 and Pt89, both males) in the spring of 2008, and followed them as they began dispersal movements in the summer. However, we lost contact with Pt88 when he moved far north of his natal home range, and it became possible to track him only by plane (which, due to expenses and logistics, is possible only one or two times per month). The last time we were able to pinpoint his location was in late September, after which we were unable to locate him again by air. Pt89 slipped his collar before completely leaving his natal home range in the summer. We were unsuccessful in capturing Pt56's daughter, with whom we suspected Pt56 may divide her home range. However, at this point, Pt56 seems to be using the entire territory of her home range, and her daughter's fate is unknown to us.

***Impact of tigers on prey populations***.

Because acquisition of food is a fundamental component of every predators' daily existence, knowledge of food selection is critical to understanding life history strategies and developing sound conservation recommendations (Miquelle et al. 1996). For the past 17 years, the Siberian Tiger Project (STP) has used intensive radio telemetry monitoring and snow tracking to locate kill sites. These techniques are valuable for locating large prey because tigers usually spend several days at each kill site. However, accurate estimates of kill rates during summer have proven nearly impossible to obtain. Kills are hard to detect because direct tracking is difficult during summer in forested ecosystems, and fewer scavenger birds at this time of year. Moreover, we suspect that tigers actually prey on large ungulates to a lesser degree in summer, and instead concentrate on smaller prey items such as badgers (*Meles meles*) and raccoon dogs (*Nyctereutes procyonoides*).

Detection of these predation events is unlikely because these items can be consumed in a short period of time not noticeable by traditional tracking using VHF collars. This decrease in time spent at kill sites could lead to fewer small prey species kill sites being located and in turn lead to an over estimate in the importance of large prey to the tigers spring, summer and fall food habits. It may also mistakenly lead to a conclusion that overall kill rates of all prey are much lower than what actually occurs

In the recent decade, wildlife conservation has undergone a revolution through the application of GPS collar technology to improve our understanding the ecology and conservation of large carnivores and other endangered species. An important application to large carnivores is the use of GPS collars to improve methods to estimate kill rates and food habits. Recent studies have confirmed the utility of GPS collars to accurately estimate kill-rates of difficult to study carnivores and to understand annual and summer kill-rates – something that has been difficult to do in the past. Despite advances in these methods, few studies have applied this new technology to conservation of large cats besides mountain lions in North America.

A debate continues in the Russian Far East about the impact of tigers on prey populations. The accepted dogma among hunters is that there are "too many tigers" and that they are responsible for the depletion of ungulate populations. Year-round predation rates are generally calculated in Russia by extrapolating data collecting only in winter. If predation rates on large ungulates are actually less in the non-snow months (which we hypothesize) than the overall impact on ungulate populations is in fact less than what is commonly assumed (in both the popular and scientific literature). A similar controversy has plagued wolf conservation throughout northern ecosystems where the extrapolation of winter kill-rates to summer tended to overpredict impacts of wolves on prey. Recent studies of summer wolf kill-rates harnessed the power of GPS technology to show that summer wolf kill-rates were very different than in winter. In the Russian Far East, because there are over 60,000 registered hunters in tiger habitat of the Russian Far East, accurate data on kill rates is an important component of the debate over the influence of tigers on prey numbers. Rigorous information on whether annual kill-rates are overinflated because of lower summer kill-rates will provide the basis for a more rational discussion of tiger impact on prey populations.

Implementation of this activity has been delayed due to delays in successful deployment of GPS collars. However, with three GPS collars now deployed, we are planning on collecting new and more realistic data on kill rates of tigers in winter and summer. We have a new graduate student, Clay Miller at the University of Montana, who will be conducting this work for his M.Sc. We are looking forward to seeing this projection come to fruition.

***Comparison of techniques for estimating tiger densities***.

This component of our field work has been led by graduate students Svetlana Soutyrina and Meghan Riley (who worked on the project from June 2007 to May 2008). The objective was to systematically rank six candidate methods (winter track surveys, camera trapping, DNA analyses from scat and hair, use of scent dogs to identify individual tigers, and using morphometric measurements to distinguish individuals through track

identification) for abundance estimation based on three broad criteria of performance: logistics, statistics, and cost. Because of the logistical difficulties inherent in the region, it is especially important to consider not just the precision of each method, but its feasibility under the biological, environmental, and social constraints of the Russian Far East. Results of this assessment indicated that the traditional Russian track survey was the most promising in terms of logistics and cost, although it was one of the poorer methods in terms of statistical properties. In contrast, camera trapping was deemed the most promising method statistically, although it performed poorly under logistical and cost concerns. In light of the these results, it was recommended that double sampling be employed to monitor population trends of Amur tigers, with broad implementation of track surveys and more focused implementation of camera trapping in areas of critical importance to tiger conservation.

**Photo 2.** A camera-trap photo of Pt55. ©WCS.

Camera-trapping in the northern part of SABZ represented the final phase of this density-estimation project, which has encompassed the entire territory of SABZ (4,000 square kilometers) and has been conducted over a period of two-and-a-half years (since May 2006). Field work in northern SABZ was completed in early December 2008. In the course of this project, more than 400 photographs of tigers were taken, and a total of 26 different tigers were identified (ten females, eleven males, and five undetermined). These camera-trapping results are similar to estimates of SABZ tiger densities made both on the basis of STP radio-tracking research, and on the basis of winter track counts conducted annually by zapovednik staff.

Table 2. Estimates of tiger numbers (using two different models for capture-recapture estimates) in three regions of Sikhote-Alin Biosphere Zapovednik (SABZ) derived from camera-trapping studies partially supported by 21st Century Tiger

| **Region of SABZ** | **Time of survey** | Model $M_o$ | | Model $M_h$ | |
|---|---|---|---|---|---|
| | | **N ± S** | **95% Cl** | **N ± S** | **95% Cl** |
| Southern | 2006 | 8 ± 2.7 | 7-20 | 6 ± 2.27 | 6-20 |
| Southern | 2007 | 9 ± 0.8 | 9-9 | 11 ± 2.3 | 10-21 |
| Southern | 2008 | 5 ± 0.89 | 5-5 | 6 ± 1.36 | 6-12 |
| Central | 2006 | 10 ± 0.8 | 10-10 | 12 ± 2.04 | 11-20 |
| Central | 2007 | 7 ± 0.18 | 7-7 | 7 ± 0.22 | 7-7 |
| Northern | Spring 2008 | 4 ± 0.24 | 4-4 | 5 ± 1.38 | 5-11 |
| Northern | fall 2008 | 3 ± 0.1 | 3-3 | 3 ± 0.6 | 3-3 |

Table 3. Average density estimates from each of the three regions of Sikhote-Alin Biosphere Zapovendnik (SABZ), 2006-2008, derived with support from 21st Century Tiger.

| **Region of SABZ** | Tiger density (animals/100 $km^2$) | |
|---|---|---|
| | Model $M_{(0)}$ | Model $M_{(h)}$ |
| Southern | 0.7 ± 0.13 | 0.7 ± 0.27 |
| Central | 0.5 ± 0.2 | 0.6 ± 0.24 |
| Northern | 0.4 ±0.4 | 0.8 ± 0.04 |

This project represents the first attempt to use camera-trapping to survey Amur tiger populations, and has demonstrated that camera-trapping can be used on tigers, even when they exist at low densities.

## ECOLOGY OF AMUR TIGERS AND FAR EASTERN LEOPARDS IN SOUTHWEST PRIMORYE

Field research for this project takes place in the Neshinskoe Hunting Lease and part of Borisovskoye Plateau Regional Zakaznik, or wildlife refuge (see Figure 1), which represents some of the best remaining habitat for tigers and leopards in Southwest Primorsky Krai, Russia.

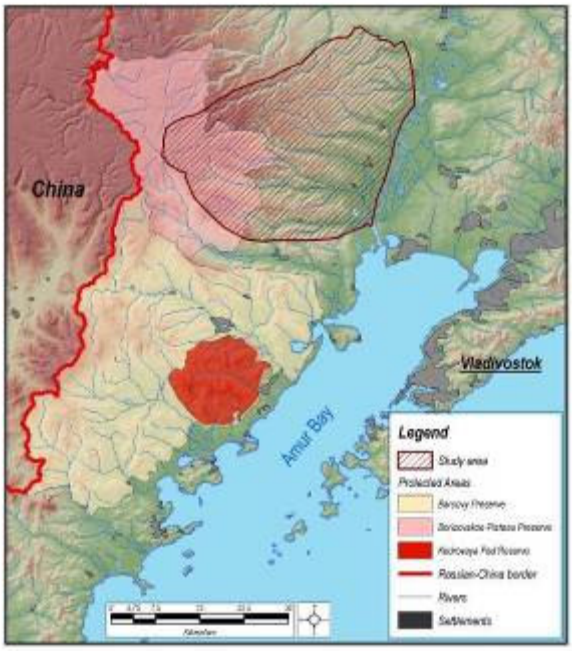


**Figure 1**. Southwestern Primorsky Krai, including location of protected areas and study area (Nezhinskoe Hunting Lease is shaded in red).

***Capture activities***.

We conducted captures for Amur tigers and Far Eastern leopards from September 28, 2008 through November 17, 2008, along the Bolshaya Elduga River Valley on the territory of Borisovskoye Plateau Regional Zakaznik, where we established a tent-camp as a base. Snares were set along two trap lines, one on a ridge top at the northern edge of the valley, and the other along an old road at the valley bottom. The capture team consisted of John Goodrich, Ph.D. (WCS), Alexander Rybin (WCS), John Lewis, Ph.D. (Wildlife Vets International), Clay Miller (WCS), Viktor Starozhuk (WCS), and Alyona Salmanova (WCS, graduate student). We monitored snares 24 hours a day, and visually checked snares at least once every morning. When an animal was captured, a radio-transmitter attached to the snare would emit a signal (with a specific frequency for each snare). When a signal was received, day or night, we immediately checked the snare and anesthetized the captured animal.

Two leopards were caught during the fall 2008 capture season (Table 4), bringing our total number of study animals to four leopards. The male leopard Pp02 was captured for the third time (he had been captured in fall of 2006 and 2007). Pp04 is the second female we have captured under this project.

Table 4. Notes on animals captured in Southwest Primorski Krai, Russia, fall 2008.

| Date | ID No. | Sex | Estimated age (yrs) | Weight (kgs) | Notes |
|---|---|---|---|---|---|
| 10/08/2008 | Pp02 | M | 9-10 | 61 | Leopard; re-captured, collar changed |
| 10/18/2008 | Pp04 | F | 8-9 | 39 | Leopard |

Both leopards were in excellent physical condition. Dr. Lewis, with assistance from WCS staff, collected biological material (blood, tissue, sperm) necessary to identify problems associated with disease and inbreeding, and conducted a full biomedical examination of all captured individuals. We also used ultrasound technology to listen to the animals' heart muscles and to take EKGs. Heart murmurs were possible in both individuals, but we are still waiting for a cardiologist to conduct a thorough analysis of data collected using the ultrasound and EKG, in order to make a final conclusion on their health status.

Clinical laboratory findings conducted in the field demonstrated that both cats had good red blood cell counts (neither was anemic), both were negative for feline leukemia virus and feline immunodeficiency virus, and both were negative for heartworms. Serum will be tested to look at the overall health of Pp02 (serum chemistry panels), and he will be screened for exposure to disease agents known to be pathogenic to non-domestic felids. We hope to be able to export all biological material to the U.S. for full analysis in 2009.

Both leopards were fitted with traditional VHF collars to collect data on a variety of ecological and biomedical parameters, e.g., identify movement corridors between subpopulations and countries; sources of conflict between human activities, and tiger and leopard conservation; and areas of conflict and compatibility between tiger and leopard conservation.

We were unsuccessful in capturing tigers in the area during the fall of 2008. One male tiger walked by our snares in the valley, but we were unable to capture him. In the past, we have tracked a total of three tigers under this field research project, but all were poached within a relatively short period of time in 2006-07. We hope to have more success capturing tigers during our spring 2009 capture season.

**Photo 3.** John Lewis of Wildlife Vets International (right) examines Pp04, with assistance from Clay Miller (WCS), October 2008. Photo by Andrew Harrington.

***Kills and Hunting Behavior of Leopards.***

Over the course of snow and ground tracking these four leopards we have encountered 20 kills (Table 4). The majority of kills (60%) have been sika deer. Surprisingly, roe deer, a smaller deer that would presumably be easier for leopards to handle, comprises only 10% of the kill total. Relatively high densities of sika deer compared to roe deer may explain the preponderance of sika deer in their diet, but this situation likely puts them more directly in competition with tigers, who no doubt rely on the two largest prey species in this region, sika deer and wild boar.

Table 7. Kills made by study leopards

| Species | Number | Percentage |
|---|---|---|
| fox | 1 | 5% |
| hare | 2 | 10% |
| raccoon dog | 1 | 5% |
| roe deer | 2 | 10% |
| sika deer | 12 | 60% |
| wild boar | 1 | 5% |
| yellow-throated marten | 1 | 5% |
| Total | 20 | 1 |

While snow tracking leopards we have been able to document 11 hunting attempts, of which 4 were successful (ended in killing the prey). Of seven attempts on sika deer, only two were successful (28%).

Table 8. Hunting attempts by leopards based on snow-tracking

| Leopard sex | Prey species | Prey sex | Hunting success |
|---|---|---|---|
| M | sika deer | unknown | no |
| M | sika deer | unknown | no |
| F | hazel grouse | unknown | no |
| M | wild boar | unknown | yes |
| F | raptor | unknown | no |
| F | sika deer | unknown | no |
| F | sika deer | F | yes |
| F | yellow-throated marten | unknown | yes |
| M | sika deer | unknown | no |
| | sika deer | unknown | yes |
| | sika deer | unknown | no |

***Far Eastern Leopard Camera Trapping Monitoring***

For the seventh consecutive year we conducted camera trapping in the Neshinshoe study area to estimate the numbers of tigers and leopards in this region. In 2009 we photographed 9 leopards and 5 tigers. Although numbers are fluctuating, the adult population appears to be relatively stable.

Table 9. Number of photographs, "captures" and total number of individual leopards photographed from 2003-2009.

| Year | # photographs of leopards | # "captures" | Number of leopards photographed |
|---|---|---|---|
| 2003 | 65 | 30 | 9 |
| 2004 | 69 | 34 | 13 |
| 2005 | 113 | 67 | 14 |
| 2006 | 63 | 28 | 9 |
| 2007 | 65 | 33 | 14 |
| 2008 | 56 | 29 | 8 |

| | | | |
|---|---|---|---|
| 2009 | 106 | 34 | 9 |

Table 10. Numbers of Far Eastern leopards in the Neshinoe Study area

| Year | Closure test | | Model | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $M_0$ | | | | $M_h$ | | | |
| | $z$ | $P^b$ | $\overline{N}$ | $S$ | 95% $CI^c$ | $p^d$ | $\overline{N}$ | $S$ | 95% $CI^c$ | $\hat{p}^e$ |
| 2003 | -0,373 | 0,355 | 10 | 0,7 | 10-10 | 0,223 | 11 | 2,8 | 11-27 | 0,203 |
| 2004 | 0,182 | 0,572 | 14 | 1,2 | 14-20 | 0,158 | 16 | 3,6 | 14-31 | 0,133 |
| 2005 | 0,624 | 0,734 | 14 | 0,4 | 14-14 | 0,252 | 15 | 2,8 | 15-32 | 0,236 |
| 2006 | -0,353 | 0,324 | 9 | 0,8 | 9-14 | 0,2209 | 10 | 3 | 10-28 | 0,2 |
| 2007 | 6,000 | 1,00 | 16 | 1,8 | 15-23 | 0,187 | 19 | 4,2 | 16-35 | 0,153 |
| 2008 | 0,246 | 0,6 | 8 | 0,4 | 8-8 | 0,2589 | 11 | 2,5 | 9-20 | 0,242 |
| 2009 | 6,000 | 1,00 | 9 | 0,3 | 9-9 | 0,2593 | 11 | 2 | 10-19 | 0,212 |

**TRAINING AND CAPACITY BUILDING**

In the summer of 2008 we finished the interior of the Sikhote-Alin Research Center, our office and housing facility in Terney, which included completing staircases and third-floor and installing carpeting throughout the building. This facility provides housing for graduate students, computer and internet access, and office space for graduate students and field technicians to access data forms, maps, etc. We still need to have telephones installed in the building, and purchase various items of furniture.

During the reporting period, we supported the following 14 graduate students and internships (seven Russians, six foreigners) at the Sikhote-Alin Research Center in Terney (working in SABZ), and with our Amur tiger and Far Eastern leopard research project in Southwest Primorye:

- Svetlana Soutyrina (Candidate of Science student, University of Irkutsk) completed the field work component of her dissertation research on camera-trapping the Amur tiger and comparing tiger density estimation techniques in SABZ (see Siberian Tiger Project research activities, above). Sveta began processing data for her dissertation and working on two scientific publications on her work in late 2008. We expect that she will defend her dissertation at the end

of 2009 when we hope that a monograph with her results (along with Meghan Riley's) will be published. (A Candidate of Science degree is equivalent to a level between a Master's and a PhD in the United States.)

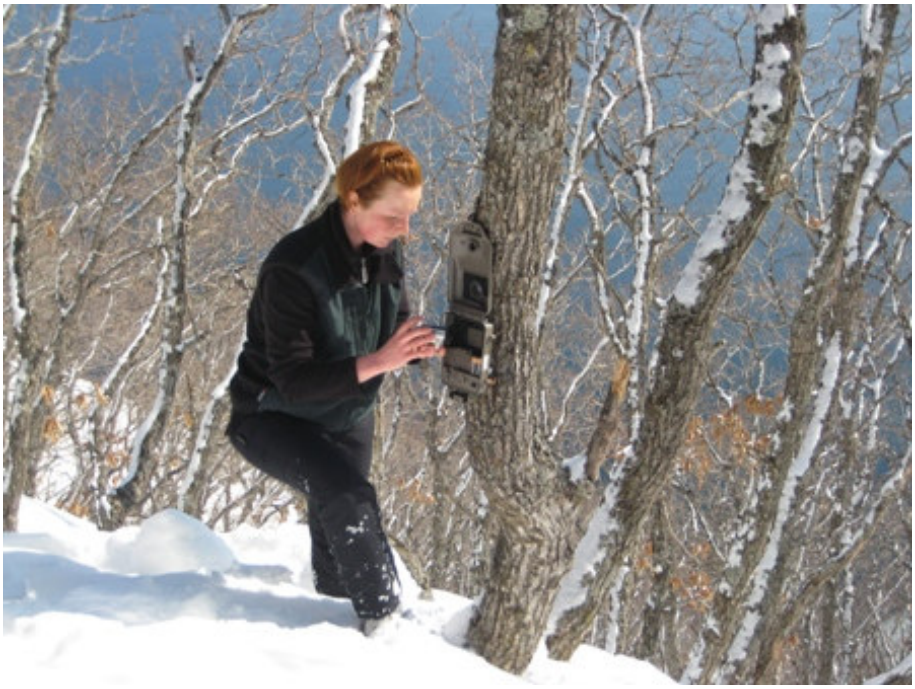

**Photo 4.** Graduate student Svetlana Soutryina checks a camera trap set in tigress Pt56's home range on the coast of SABZ. Photo by Cheryl Hojnowski © WCS.

- Sergei Pizyuk (Candidate of Science student, Institute of Biology and Soils, Russian Academy of Sciences Far Eastern Branch) is completing his dissertation research on Asiatic black bear behavior, and has been working as a field assistant for STP since the fall of 2007. In the summer of 2008, Sergei worked with Erin Latham (previously of Parks Canada, now a Master's degree student) to implement non-invasive hair-snagging methodology to survey bear populations in SABZ. This three-month study represented the first attempt to use hair-snagging to survey bear populations in the Russian Far East. In the fall of 2008, Sergei participated in capture, radio- and snow-tracking activities under STP.

- After finishing her undergraduate degree at Moscow State University, Lika Sagatelova (Candidate of Science student, Moscow State University) spent the summer of 2008 working as a field assistant for STP and assessing options for her dissertation research. Lika—a new student for us—has decided to conduct field work for her dissertation on rehabilitating orphaned Asiatic black bears; and when not engaged directly in her dissertation research (i.e. from late fall to early spring), she is continuing to work as an assistant for STP.

- Anya Mukachova is presently posted at the Siberian Tiger Project's base in Terney where she assists in all phases of field work and data logging. Anya is

working towards her Candidate of Science degree, which is tentatively focused on ecology of tigers in Southwest Primorye.

- Alexander Rybin, a long-term field technician for STP, completed his Master's degree thesis on camera-trapping of Far Eastern leopards in June 2008 (with Dale Miquelle as one of his advisors), and will begin research for his Candidate of Science degree in the spring of 2009. Alexander also works full time as the field crew leader for our leopard research project in Southwest Primorsky Krai.

- Alyona Salmanova completed her undergraduate thesis on the use of telemetry to study the Amur tiger, and WCS is now supporting her field work for a Master's degree thesis on Far Eastern leopard habitat use. Since the fall of 2007, Alyona has continuously worked as a field assistant for our Amur tiger and Far Eastern leopard research project, where she has gained experience in radio-tracking, snow-tracking and camera-trapping of tigers and leopards. In addition, in the summer of 2008, Alyona spent a month in Terney learning hair-snagging techniques for surveying brown and Asiatic black bears (together with Sergei Pizyuk and Erin Latham). Last fall, she returned to Southwest Primorye, where she participated in her first capture season and now continues tracking our study animals. Alyona is scheduled to complete her Master's degree in 2009.

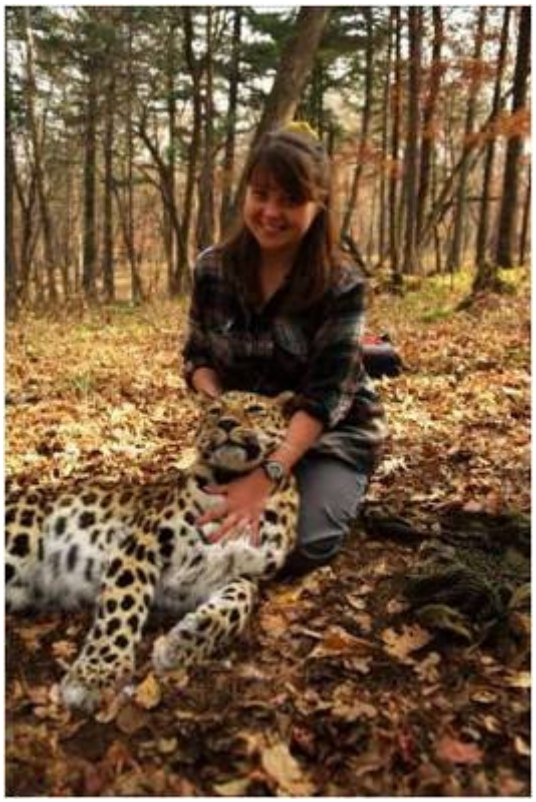

**Photo 5.** Alyona Salmanova with female leopard Pp04, captured in Southwest Primorye in October 2008. Photo ©WCS.

- Deanna Matyushkina is a M.S. student at Primorski Krai State University, and is working with staff of our project on Far Eastern Leopards and Amur tigers in Southwest Primorye. Deanna plans to assess the effect of logging activities on tiger and leopard habitat.

- Samantha Earle, a British citizen, is in her second season with the Far Eastern leopard Project as an intern, and is applying for graduate school admissions in England, but hopes to conduct her fieldwork on Far Eastern leopards in association with Russian students (see above) working on that project).

- Louisa McNutt, a New Zealander, interned at both the Siberian Tiger Project and the Far eastern Leopard Project this fall, and is considering applying for graduate school in the US or Canada, with a field project focused on tigers.

- Lizza Protas is a Master's student at Columbia University in New York, but she was born a Russian before her family emigrated to New York. Lizza spent a summer internship with the Siberian Tiger Project, and is planning on returning for the winter of 2010 to collect data on scent-marking by tigers for her Master's degree.

- Clay Miller, a US citizen, spent a year and a half working on both our projects before being accepted to the University of Montana's graduate school. Clay will be using GPS collars on tigers to better estimate kill rates of as a means to assess tiger impact on prey populations.

- Tamatha Patterson is a Master's student at the University of Michigan School of Natural Resources and Environment. She is a Certified Veterinary Technician and is working as an intern with our capture teams to provide veterinarian assistance.

- Karolyn Upham, a Master's student at the University of Exeter, spent two months with our Siberian Tiger Project in winter 2009 to assess the feasibility of using a non-invasive, cost effective and sustainable methods of population monitoring by using footprint analysis. Her Master's degree published the results of this work.

- Jon Slaght is a Ph D candidate at University of Minnesota where he is studying the ecology of Blakiston's fish owls. Jon works with biologists at the Institute of Biology and Soils in Vladivostok in a cooperative program to better understand this endemic, elusive species.

## CONCLUSION

We sincerely appreciate 21st Century Tiger's role as a key partner in our ongoing efforts to protect the remaining Siberian tigers in the Russian Far East. Our training activities continue apace, enhanced by our new research office in Terney, and our field research

programs in both SABZ and Southwest Primorye are providing important data needed for conserving Amur tigers and understanding interactions between tiger and Far Eastern leopard populations. We are grateful to 21st Century Tiger for its long-term partnership in our conservation programs.

## RECENT PUBLICATIONS


Goodrich, J. M., L. L. Kerley, E. N. Smirnov, D. G. Miquelle, L. McDonald, H. B. Quigley, M. G. Hornocker, and T. McDonald. 2008. Survival Rates and Causes of Mortality of Amur Tigers on and near the Sikhote-Alin Biosphere Zapovednik. Journal of Zoology 276 (2008) 323-329.

Chapron, G., D. Miquelle, A. Lambert, J. Goodrich, S. Legendre, and J. Clobert. 2008. The impact of poaching versus prey depletion on tigers and other large solitary felids. Journal of Applied Ecology 45:1667-1674.

Goodrich, J. M. and D. G. Miquelle. *In press.* Tiger telemetry. In Tigers of the World, 2nd Edition: the science, politics, and conservation of *Panthera tigris* (R. Tilson and P. Nyhus, eds.). William Andrew Publishing, New York.

Goodrich, J. M., L. L. Kerley, D. G. Miquelle, E. N. Smirnov, H. B. Quigley, and M. G. Hornocker. In press. Social Structure of Amur (Siberian) Tigers (*Panthera tigris altaica*) on Sikhote-Alin Biosphere Zapovednik, Russia. Journal of Mammalogy.

Miquelle, D. G., Goodrich, J. M., Kerley, L. L., Dunishenko, Y. M., Aramiliev, V. V., Smirnov, E. N., Nikolaev, I. G., Salkina, G. P., Zhang, E., Seryodkin, I. V., Carrol, C., Gapanov, V. V., Fomenko, P. V., Kostyria, A. V., Murzin, A. A., Quigley, H. B., and Hornocker, M. G. (in press b) Science-Based Conservation of Amur Tigers in Russian Far East and Northeast China. IN Tilson, R. & Nyhus, P. (Eds.) Tigers of the World. Noyes Press.

Miquelle, D. G., Goodrich, J. M., Smirnov, E. N., Stephens, P. A., Zaumyslova, O., Yu., G., Chapron, L., Kerley, A. A., Murzin, A. A., Hornocker, M. G., and Quigley, H. B. (in press a) The Amur Tiger: a case study of living on the edge. IN MacDonald, D. W. & Loveridge, A. (Eds.) Biology and Conservation of Wild Felids. Oxford, UK., Oxford University Press.