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Abstract: The Far Eastern leopard *Panthera pardus orientalis* is recognized as a critically endangered subspecies. During an international conference held in Vladivostok in 1996, a group of specialists discussed the status of the Far Eastern leopard and devised a comprehensive conservation plan to ensure the survival of the Far Eastern leopard in the wild. This plan is the foundation upon which a national strategy for leopard conservation was developed by the State Committee of the Russian Federation for the Protection of the Environment. The plan includes a detailed status report with an analysis of threats. Goals and objectives for the survival of a self-sustaining leopard population in its natural habitat are formulated. Seven key components of leopard protection are identified: 1) Research Priorities 2) Land use planning and protected area management 3) Legislation and leopard protection 4) Captive breeding 5) Reintroduction 6) Environmental education and public awareness 7) Genetic analysis of wild and captive populations. Conservation plans for each component are presented in the report, including goals/objectives, recovery steps, timetables, responsible organizations, and budget.

Notes: This plan is the base of the national strategy for leopard conservation developed by the State Committee of the Russian Federation for the Protection of the Environment, RefID:2291 (see also: RefID's:2288, 4605)

A RECOVERY PLAN FOR CONSERVATION OF THE FAR EASTERN LEOPARD

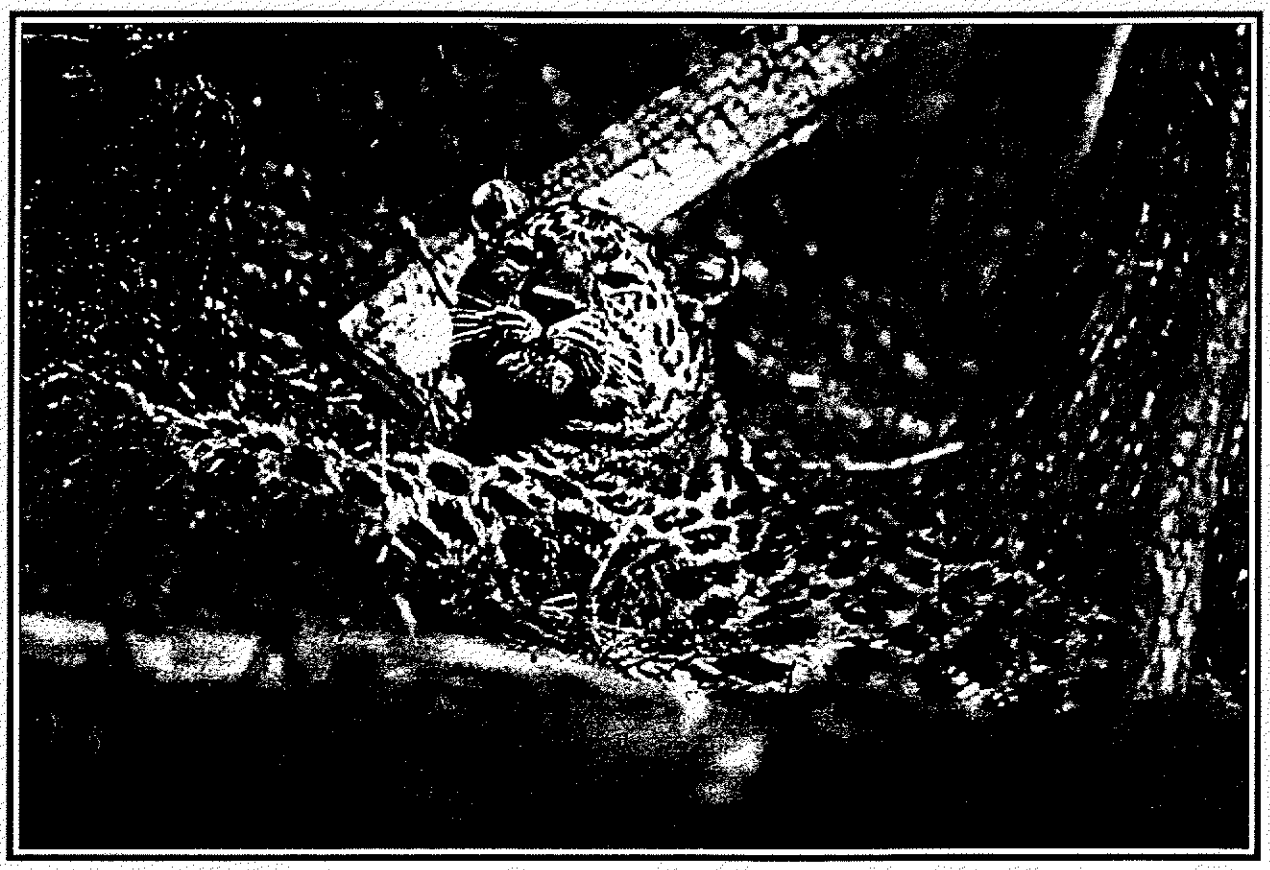

Photo by D.Pikunov

RESULTS OF AN INTERNATIONAL CONFERENCE HELD IN VLADIVOSTOK, PRIMORSKI KRAI, RUSSIA

October 28 - November 1, 1996

WWF

USAID
EPT PROJECT

A Recovery Plan for Conservation of the Far Eastern Leopard: Results of an International Conference Held in Vladivostok, Russia.

Edited by Dale G. Miquelle, Tatyana D. Arzhanova, and Vasily A. Solkin.

Final Report to the USAID Russian Far East Environmental Policy and Technology Project, 1996

Support for this conference was provided by the USAID Russian Far East Environmental Policy and Technology Project

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Preface

Purpose of Workshop and Recovery Plan

The Far Eastern leopard is recognized at the international, federal, and regional level as a critically endangered subspecies.

At the international level it is classified as "critically endangered" in the IUCN Red List of Threatened Animals (1996), and international trade is regulated by CITES (Convention on International Trade of Endangered Species), where it is listed as an Appendix I species, the highest level of protection possible.

At the federal level it is listed as Category I in the Russian Red Data Book.

Primorski Krai's response to Chernomyrdin's decree (Order No. 795) for the development of a national strategy for tiger conservation, cited an absence and a real need for such a program for the Far Eastern leopard.

Anyone familiar with the situation recognizes that this subspecies is critically endangered and in immediate threat of extinction in the wild. And in captivity, the situation is also serious, as interbreeding with animals of unknown heritage has affected a large percentage of the captive breeding pool.

With these concerns in mind, we felt it urgent to bring together the most competent biologists, geneticists, conservationists, zoo specialists, educators, and representatives of the Russian federal and regional government to address the serious problem of conservation of the Far Eastern leopard.

From Oct. 28 to Nov. 2, an international group of over 50 people convened in the Russian Far East city of Vladivostok to discuss the status of the Far Eastern leopard, and to devise a conservation plan for its survival. The objective was to bring together key specialists from around the world who would be of assistance in devising a comprehensive plan to insure the survival of the Far Eastern leopard in the wild.

Prior to the meeting, an organizing committee developed the agenda and identified 6 key components that would be needed to develop the plan. Later the importance of genetic analyses dictated that it be formed as a seventh group. The 7 groups are:

1. Research priorities for developing a conservation plan;
2. Land use planning and protected areas management;
3. Legislation and leopard protection;
4. Captive breeding;
5. Reintroduction;
6. Environmental education and public awareness;
7. Genetic analyses of wild and captive populations.

Coordinators were assigned to lead each group: it was their task to develop initial plans that would act as a basis for discussion of a program, and to lead the process in developing a conservation plan for each section.

The workshop started with 2 days of formal reports, in which specialists in each field provided background information on Far Eastern leopards (summarized in Part II), and made recommendations for components of each session. At the end of the first two days, working groups were formed, and initial plans were made as to how each group would function. On the morning of the third day, all groups gathered and agreed on the goals and objectives of the conservation plan (described in Part I). At the end of the fourth day, groups regathered to debate and discuss key points. On the morning of Day 5, formal presentations of the 7

components of the Recovery Plan were given to an open audience. Editing and discussion of final points continued until the end of Day 6, at which point a draft recovery plan had been developed (Part III). Most importantly, a resolution was agreed upon to continue the work developed during this weeklong session (Appendix 1). A working group was formed, and specific instructions in the resolution called for completion of the recovery plan and implementation of key initial conservation steps (Appendix 3).

Intended Audience: How to Use this Document

This plan is intended for anyone interested in conservation of large cats, but in particular those interested in the ecology and conservation of the Far Eastern leopard. We hope that this document will be useful for regional and federal administrations, departments, and ministries that have responsibility for nature conservation and/or management of lands that include suitable leopard habitat. This plan will be the foundation upon which a national strategy for leopard conservation will be developed by the State Committee of the Russian Federation for the Protection of the Environment. It is also intended as a guide for any non-government conservation organizations seeking concrete recommendations for needed conservation actions. Because the region inhabited by leopards in southwest Primorye represents some of the most biologically rich lands found throughout Russia, leopard conservation can act as an umbrella for biodiversity conservation in the Russian Far East. Finally, this recovery plan is intended for potential funders. It is often difficult for parties potentially interested in funding conservation activities in foreign countries to obtain the necessary background information, to develop understand those actions needed to achieve concrete results, and to know which agencies/institutions/individuals can most effectively implement management activities. We have tried to develop a very concrete set of actions with estimated costs and a list of those agencies (both government and non-government) that either have the responsibility or the interest in seeing actions carried through to completion.

The specific goals and objectives that guided development of the recovery steps are delineated in Part I. We asked each working group to use these criteria while developing a set of recommendations for conservation actions. For those individuals interested in background information on Far Eastern leopard ecology, natural history, genetics, status in the wild and in captivity, and existing threats to their survival, Part II provides a synopsis of existing information. The set of recommended conservation actions is detailed in the 7 sections of Part III, the Recovery Plan. Appendices provide supporting documentation, including the Resolution of the Workshop (Appendix 1), List of Participants (Appendix 2), and responsibilities of the working group (Appendix 3). Protocols were developed for specific situations, including handling leopards in the wild (Appendix 4), and processing injured leopards (Appendix 5), and a protocol for captive breeding programs (Appendix 6). Appendix 7 provides relevant information on the distribution of leopards in Jilan Province in China, adjacent to Khasanski Raion (where most Russian leopards are located), and provides an indication of where cooperative management between the two countries could be most effective. In Appendix 8 John Seidensticker provides a thoughtful assessment of priorities as we move forward with conservation efforts. Finally, Appendix 9 is a summary, in table form, of each recommended action step, with specific estimates of necessary funding over a 4-year period (where such was possible), possible sources of funding, and agencies/institutions responsible for implementation. Included at the end of Appendix 9 is a listing of abbreviations for all organizations referenced in the text. This summary should be especially useful as a brief overview of the recommended recovery steps needed, in the opinion of experts, for survival of the Far Eastern leopard. This summary is daunting, not only in consideration of the financing

necessary, but also in view of the logistical, administrative, legal, scientific, and conservation efforts needed for implementation.

However, as demonstrated by the number of people who participated in the workshop, and by the coverage it received in the local press, the interest exists to take on this task. Although the necessary steps are many, there is a large force of people and agencies willing to initiate specific components. It is our hope that potential funders will also support for those specific components of the program that meet their interests. We intentionally created a program with components as "building blocks": each can stand separately, and can each be implemented largely independently of other components, but as the parts come together, the cumulative effect will be much larger than simply the sum of these parts.

We plan for the working group to continue to act as a guiding force for activities and funding as leopard conservation actions commence. We urge all interested individuals and organizations to contact any member of the working group.

The following recovery program and resolution are the results of our efforts, and the beginning of this process. We hope that this document will be the first step towards insuring the survival of the Far Eastern leopard in the wild.

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List of abbreviations and terms used in text

BPZ	Borisovkoe Plateau Zakaznik (wildlife refuge)
BZ	Barsovy Zakaznik (wildlife refuge)
DTO	Far East Customs, Russian Federation
DVORAN	Far Eastern Branch of the Russian Academy of Sciences
EEP	European Captive Breeding Program
EPT	Environmental Policy and Technology Project, Russian Far East
FOEJ	Friends of the Earth-Japan
GIS	Geographic Information System
GKOC	Primorski Krai State Committee for Environmental Protection (regional)
HWI	Hornocker Wildlife Institute (USA)
IBS	Institute of Biology and Soils
ISNU	Institute of Sustainable Nature Use (Vladivostok Russia)
IUCN	International Union for the Conservation of Nature
IUDZG	International Union of Directors of Zoological Gardens
JWCA	Jilin Wildlife Conservation Association (China)
KKPR	Krai Committee for Natural Resources, Primorski Krai Administration
KPZ	Kedrovya Pad Zapovednik
NGO	Non-governmental organization
NIH	National Institute of Health, USA
OOK	Hunting Management Department, Primorski Krai
OOTOF	Pacific Fleet Hunting Society
PA	Protected areas
PKA	Primorski Krai Administration
PP	Environmental Protection Attorney's Office
PRF	The Government of the Russian Federation
RFGKOC	Russian Federation State Committee for Environmental Protection (federal)
SWP	Southwest Primorye
TIG	Pacific Institute of Geography
USAID	United States Agency for International Development
WCS	Wildlife Conservation Society (New York, USA)
WWF	World Wide Fund for Nature
Zakaznik	Wildlife refuge
Zapovednik	Reserve

Part I.
Goals and Objectives of the Recovery Plan

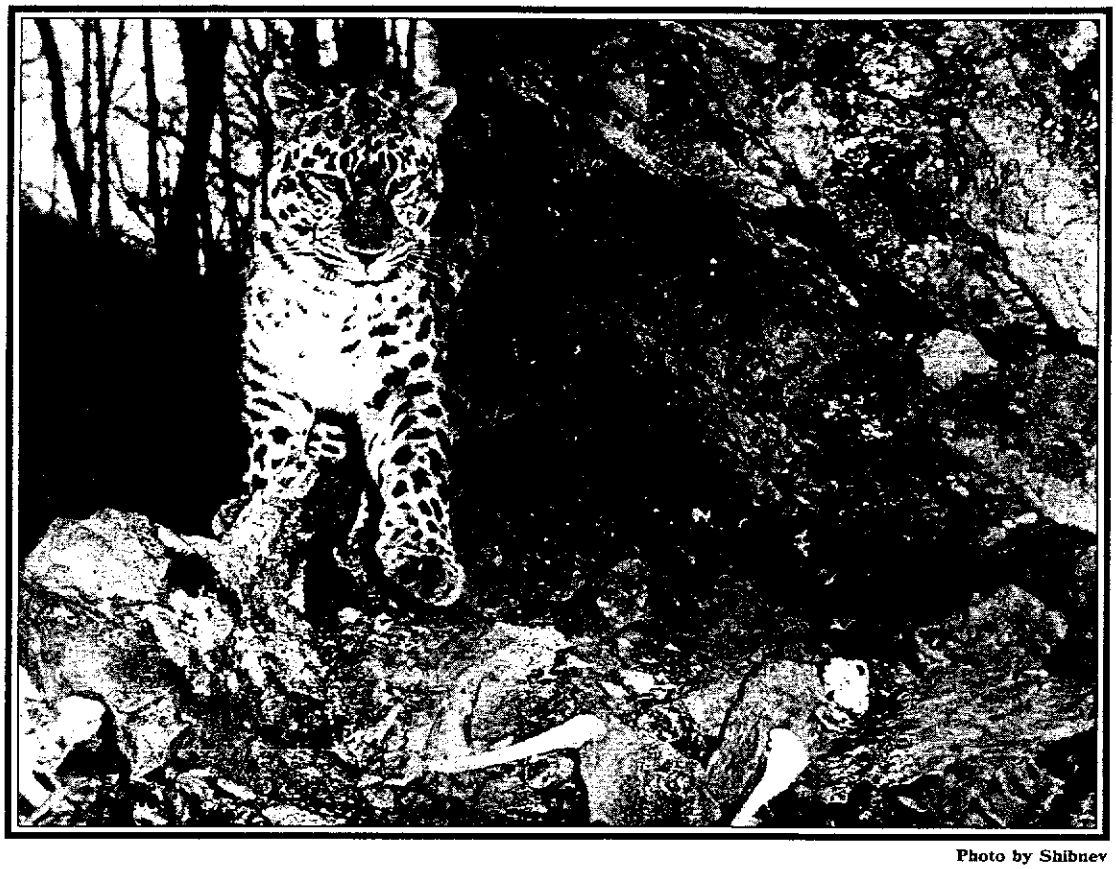


Photo by Shibnev

PART I.

GOALS AND OBJECTIVES OF THE RECOVERY PLAN

Introduction

This section defines the goals of the recovery plan. Definition of goals and objectives for the recovery program is critical, because these will provide the criteria to measure the success of management actions. Each section of the recovery plan is designed with these goals and objectives in mind.

GOALS AND OBJECTIVES OF RECOVERY PLAN

The Far Eastern, or Amur leopard (*Panthera pardus orientalis*) is one of the most endangered subspecies of large cats in the world. Reduced to a fraction of its original population, there are known, fragmented populations in Jilan and Heilongjiang Provinces of northeast China and southwest Primorski Krai of the Russian Far East. There are likely wild Far Eastern leopards in North Korea, but their status is unknown. Recognized as a genetically discrete population (Miththapala et al. 1996), this subspecies deserves protection as a unique genetic contribution to the species and to the region. Just as importantly, as a carnivore at the top of the trophic chain, the Far Eastern leopard acts as an indicator of ecosystem health and integrity. The leopard's importance, therefore, extends well beyond its status as one of many species threatened in a region with a unique and dwindling forest ecosystem.

There are two goals for this conservation plan:

1) The primary goal of this conservation plan for the Far Eastern Leopard is to insure the survival of a self-sustaining, wild population of Far Eastern leopards in their natural habitat. To achieve this goal, there are three recovery objectives.

- At the international level, the existing wild Far Eastern leopards in Russia, China, and North Korea must be managed as a single population.

At the national level, within Russia the objectives are to:

- ensure that the existing population in southwest Primorski Krai includes at least 50 adult, breeding individuals;
- to establish a second population within the former range of the species. Establishment of a second population will require an extensive set of actions and substantial investment, and is therefore of secondary priority.

2) To be successful, this plan must have the support of regional and federal agencies responsible for leopard conservation. Therefore, **the second goal is the acceptance of the recovery plan by the Federal government as a national strategy, and by the local governments (Krai and Raions) as a regional plan for leopard conservation in all range countries.** To be successful, this program will require political, administrative, and financial support from both the federal and regional governments.

This program is primarily focused on recovery steps in the Russian Far East and northeast China, where the status of the Far Eastern leopard is best known. However, it is

recognized that for the overall objective of the program to be achieved, it will be necessary to develop an active and vigorous international conservation program that will require cooperative efforts between Russia, China, and North Korea. It is hoped that the initial steps developed in this program will be a catalyst for international cooperation for the survival of the Far Eastern Leopard.

Part II.
Biology and Ecology of the Far Eastern Leopard in the Wild and in Captivity

Photo by Shibnev

PART II.

BIOLOGY AND ECOLOGY OF THE FAR EASTERN LEOPARD IN THE WILD AND IN CAPTIVITY

Introduction

Delineation of a plan should begin with a clear understanding of what is known about the leopard. Therefore, this section provides background information that acts as a basis for recovery steps delineated in Part III.

DESCRIPTION AND TAXONOMY

The leopard, *Panthera pardus*, has the broadest distribution of any felid species in the world, and is one of the most widely ranging carnivores of any terrestrial mammal species, rivaled only by the wolf (*Canis lupus*), puma, (*Puma concolor*), and lynx (*Lynx lynx*). Initially named by Carl Linneaus in 1758 on the basis of a skin thought to originate from Egypt, the leopard has been divided into many subspecies based on different geographical regions and differences in color, size, and markings. The Far Eastern, or Amur leopard, *Panthera pardus orientialis*, was described by Schlegel in 1858 based on a skin now housed in the British Museum of Natural History. The official description from Heptner and Sludski (1972) is:

> Size, not large. Coat fairly soft, with long (on back, 30 to 50 mm, and on the abdomen, 70 mm) and dense hair. Main general color type bright and lustrous. Winter coat varies from fairly light yellow to dense yellowish-red with a golden tinge or rusty-reddish-yellow. Color on flanks and outer sides of legs lighter. Spots pure black color; light-colored centers of circle of spots ("rosettes") somewhat darker than main background color of skin. Spots numerous, i.e., spottiness prominent. Summer pelage shorter and brighter with more vivid coloration pattern. Skull small, with narrow intraorbital region (on average, width about 20% of condylobasal length; post-orbital constriction distinct, short, and in the form of an isthmus; nasal pointed at posterior ends and zygomatic arches relatively massive. Measurement of male (six): body length 107 to 136 cm; tail length 82 to 90 cm; length of hind foot 24 to 27 cm; and height at shoulders 64 to 78 cm. Maximum length of skull 204 to 232 mm; condylobasal length 186 to 200; zygomatic width 129-144 mm; interorbital width 34.3 to 39.9 mm; postorbital width 36.8 to 45.0 mm; and length of upper tooth row 67.8 to 68.7 mm. Weight of males of moderate size--32 kg, and of large ones--48 kg. This weight may even reach 60 to 74 kg.

The differences between Far Eastern and North Chinese leopards (*P. p. japonensis*) are complex and not fully understood (see section on genetics). As mentioned above, the range of color variability in Far Eastern leopards is quite broad and differences in color intensity and brightness of extreme forms is fairly sharp. Differences in vividness of coloration between winter and summer coats are also distinct. This sometimes creates the impression of the existence in the Russian Far East of two forms (subspecies) of leopard differing in color. The presence of bright-colored specimens has provided some authors a basis for suggesting the occasional or even regular occurrence of North Chinese leopards in the southern Ussuri region.

Far Eastern leopards typically have an extremely thick, long-haired winter coat, an adaptation for survival in the cold climate of the Russian Far East, northeastern China and Korea, and are famous for their extremely large, thick-rimmed black rosettes or complete circular markings that cover their body. Leopards from Korea were originally described as a separate subspecies, *Panthera pardus villosa*, but later were synopsized under the subspecies *orientalis*.

DISTRIBUTION

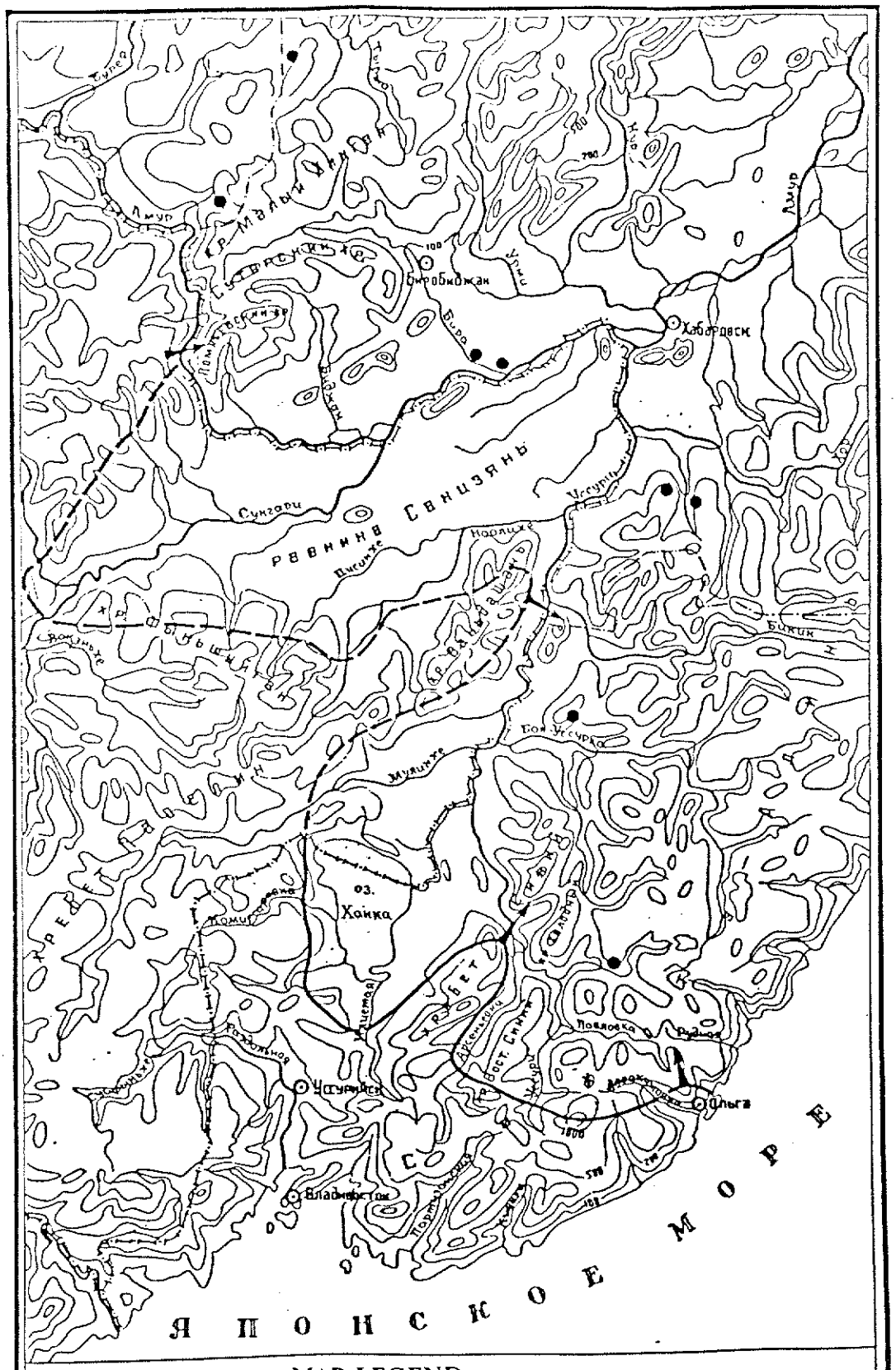
The Far Eastern leopard is the northernmost of all leopard subspecies. In China, its southern boundary is marked by the merger point with the North Chinese subspecies *P. p. japonensis*. The exact location differentiating the two races is debatable, and due to habitat loss, will probably never be known precisely, although it has been suggested that *P. p. orientalis* may have ranged as far south as Beijing (Heptner and Sludski 1972). Its original range in China extended throughout northeastern ("Manchurian") China, including Jilan and Heilongjiang Provinces (Figure 1), and was originally distributed throughout the Korean Peninsula.

In Russia, information from the previous century is scarce. At the turn of this century the leopard was found throughout much of southern Primorski Krai (Figure 1), although always at lower densities than the Amur tiger (*Panthera tigris altaica*). Heptner and Slukski (1972) report occasional intrusions of leopards far north of this region in northern Primorye (e.g. Bikin River Basin), southern Khabarovsk (e.g. Khor River Basin) and even in the southeastern TransBaikal Region. However, most of these reports probably represent dispersal of individuals from China, and do not represent permanent establishment of a breeding population. Some of these movements may have been related to long distance migrations of roe deer (*Capreolus capreolus*), a key prey species for the Far Eastern leopard. The permanent range of a leopard population in Primorski Krai at the turn of the century can be delineated as the region south of a line running from Olga Bay west, including the upper reaches of the Ussuri Basin (southern Chugueveski Raion), extending north of the Spassk-Dalneya region, and west to the Chinese border, but not including the region immediately surrounding Lake Khanka (Arseniev 1914, Heptner and Sludski 1972, Pikunov and Korkishko 1992) (Figure 1).

The range of the Far Eastern leopard has collapsed dramatically in this century. There have been no reports of leopards in either the Small or Large Hingan Mountains in northern Heilongjiang (near the border of Amur Oblast, Russia along the Amur River) for the last 70-80 years. There are an estimated 15 animals scattered throughout Jilan Province, with probably the biggest population concentrated around Changbaishan Reserve on the Korean border (see Xingjia Yang and Jinsong Jiang, Appendix 8). Heilongjiang Province is still the northern boundary of leopards in China, but most are now found in the southern region near the Russian border. In South Korea, the leopard was probably extinct by the 1950's (although some recent, unconfirmed reports suggest that a few leopards may remain in some protected areas). In North Korea, there are likely still leopards in the wild, especially in the rugged northern region near the Chinese border, but reliable information is lacking.

The distribution and numbers of leopards in the Russian Far East has decreased throughout this century, due primarily to habitat loss and hunting. For instance, between 1934

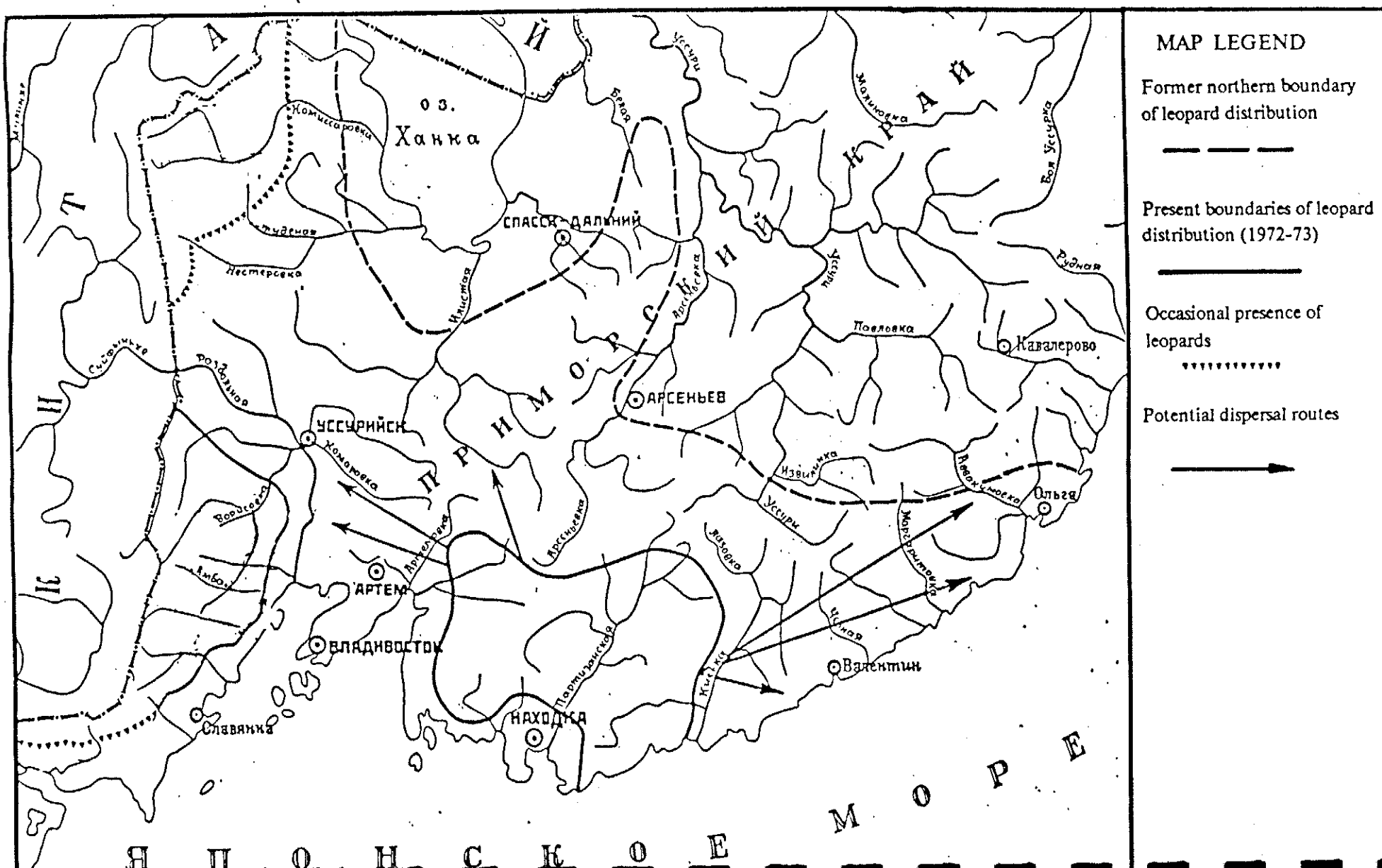
Fig. 1. Former distribution of Far Eastern leopard
(from Pikunov, unpubl. data)



MAP LEGEND

- Former northern boundary of leopard distribution in Primorski krai
- Possible northern boundary of leopard distribution in Manchuria
- Former dispersal routes
- Confirmed locations of leopards beyond normal of distribution

Fig. 2. Distribution of Far Eastern leopard in winter 1972-73
(Pikunov and Korkishko 1992)



and 1965, 39 skins were officially registered, the actual number of animals killed obviously being significantly more than that.

The first reliable estimate of leopard numbers in Russia was conducted by Abramov and Pikunov (1974) in the 1972-1973 winter. By this time, the population in Primorye had contracted from one contiguous to three isolated populations (Figure 2): 1) in the southern Sikhote-Alin Mountains leopards were most common along the coastal regions, but there were only an estimated 8-10 animals remaining; 2) in the western section of Pogranichny Raion (west of Lake Khanka), primarily within Komissarovka Basin there were 5-6 animals that moved back and forth across the Chinese boundary; and, 3) in southwestern Primorye, including nearly all of Khasanski Raion, and the western sections of Ussuriski and Nedeshdenski Raions, there were an estimated 25-30 animals (Abramov and Pikunov 1974, Heptner and Sludski 1972). Therefore, by 1973, there were an estimated 38-46 Far Eastern leopards remaining in Russia, many of which were dependent on habitat on both sides of the Russian-Chinese border.

A census in 1985 by Pikunov and Korkishko (1985) suggested that leopards had disappeared from the western section of Pogranichny Raion. Furthermore, they were not able to confirm the presence of leopards in southern Sikhote-Alin. The population in southwestern Primorye remained approximately the same as the 1972 survey: 25-30 animals (Pikunov and Korkishko 1985). A more recent count in the 1990-1991 winter revealed the population size in southwest Primorye to be stable, with 30-36 animals counted, if migrants to and from China were included (Korkishko and Pikunov 1994). In southern Sikhote-Alin there have been occasional reports of leopards and leopard tracks during the past 5-10 years (Mezentsev 1966, Gaponov, pers. comm.), but as yet there are no confirmed reports of leopards in this region since the 1972 survey.

NATURAL HISTORY OF THE FAR EASTERN LEOPARD

Information on natural history of the Far Eastern leopard is based primarily on two sources of information. Extensive studies during the winter months, when snow is on the ground, have provided information through traditional snow-tracking techniques (Abramov and Pikunov 1974, Korkishko 1981, 1983, Pikunov and Korkishko 1992). Recently, some information has been gained from radio-tracking studies initiated on the Far Eastern leopard by the Hornocker Wildlife Institute and Kedrovya Pad Zapovednik.

Habitat. In southwest Primorye the Far Eastern leopard inhabits mountainous, forested regions where there are sufficient numbers of roe deer, sika deer (*Cervus nippon*), badger (*Meles meles*), Manchurian hare (*Caprolagus brachyurus*), and raccoon dog (*Nyctereutes procyonoides*). Leopards prefer broken topography with the dominant forest type being closed Korean pine (*Pinus koraiensis*)-black fir (*Abies holophylla*)-broad-leaved forests. This forest formation is found in the middle and upper basins stretching along the Russian-Chinese border, especially in the Borisovkoe Plateau. Less preferred habitat used by leopards includes secondary growth broad-leaved forests of Mongolian and toothed oak (*Quercus mongolia* and *Q. denthalis*). Leopards seldom occur in woodland savannas except to visit deer farms. In winter the most commonly used habitat types include ridgetops and slopes with steep southern exposures where snow quickly melts. Preferred habitat is between 300-600 m above sea level; leopards rarely occur above 700-800 m.

One key factor limiting distribution of leopards is snow depth: leopards do not appear well adapted to deep snow. In winter leopards select the warmest habitats with the least snow cover, where the average long-term snow cover is 10-15 cm.

Food Habits. The list of animals included in the diet of the Far Eastern leopard is extensive, including representatives of nearly all classes of vertebrates found within its habitat. The relative abundance of prey in the diet of southwest Primorye leopards has varied with different periods of observation, different regions, and with season. From 1961-1976 the diet of leopards was reported as: 66% roe deer, 9% musk deer, 8% wild boar, 6% sika deer, 4% hare, 3% badger, 3% raccoon dog, and 1% Manchurian elk (*Cervus elaphus*) (Abramov and Pikunov 1974), while from 1970 to 1985 Korkishko (1986) reported the diet of leopards in Kedrovya Pad Zapovednik to be: 54% roe deer, 12% sika deer, 12% raccoon dog, 5% badger, 7% Manchurian hare, and small amounts (2.5%) of wild boar, musk deer, and pheasant. The ghoral (*Nemorhaedus caudatus*) formerly may have been an important prey species of leopards, and in the People's Republic of China, where the habitat of leopards and ghoral coincide, it may still form a component of the diet of leopards.

Data collected from radio-collared animals suggests that badger and raccoon dog may be important components of the diet during the summer months, especially for young animals and females with kittens. Presently, the low and unstable density of key prey species (sika deer, roe deer, and badger) have forced many leopards to rely on captive sika deer from deer farms to supplement their diet.

Single adult leopards usually remain at kills of adult ungulates (roe and sika deer) for 5-7 days. Leopards are able to survive extended periods without food: there are recorded cases in Russia where the interval between kills was 10-12 days. Results of both snow tracking and radio-tracking suggest that on average an adult leopard requires one adult ungulate every 12-15 days. Under poor hunting conditions, or low densities of ungulates, the interval between kills of large prey can reach 20-25 days.

Presently, the number of ungulates in southwestern Primorye is low and unstable, and cannot provide a sustainable prey base for leopards, especially where there is intensive hunting of ungulates (which occurs over much of the region where leopards presently occur). This fact likely explains the apparent dependence of many leopards on deer farms.

Social Organization. Development of a scientifically-based conservation plan requires an understanding of the spatial structure of a population. Minimum area requirements for individual animals and land tenure systems of various sex and age classes are key determinants for defining land area requirements for a viable population. Such parameters will guide planners during sighting of reserves, selection of ecological corridors, and other land-use decisions.

Based on snow tracking, Pikunov and Korkishko (1992) documented female leopards using areas between 40-100 km^2 and a male leopard that used 300 km^2. Year-round home range sizes estimated with radio telemetry data (100% minimum convex polygon estimator) are 33 and 62 km^2 for two adult females, and at least 280 km^2 for one adult male. Both sources of information suggest that male leopards use 4-6 times the area required by females.

Information available on the land tenure system of leopards indicates that both females and males are sex-specific territorial. That is, adult resident females maintain an area exclusive of other adult females for herself and young. Resident males will visit for breeding purposes, and are tolerated on the female territory, but other adult females are excluded. Males, as described above, have much larger home ranges, and are also apparently territorial, in that they exclude other adult males. Male territories will include one or more adult females. Radio tracking information shows that one collared male ranges over an area that includes 3 resident

females. Telemetry data show this male has had breeding liaisons with both of the radio-collared females and that he likely breeds with the an uncollared female as well.

The conclusion that Far Eastern leopards maintain exclusive territories differs from results obtained from study of several African populations of leopards (Bailey 1993, Stander et al. 1996), and should be evaluated when more data is available.

Reproduction. The peak of breeding season for the Far Eastern leopard is in the second half of the winter, but there is great variation in time of breeding. One to four kittens can be born, but usually, by the post-lactation period, a female is accompanied by no more than 1-2 kittens. Dens are often located in small caves with narrow openings, or occasionally in tree trunks. Kittens remain with the female for up to two years, and females therefore breed once every two to three years. However, there are recent accounts of one adult female with subadult cubs (approximately 15 months) and with a young kitten (2-4 months).

Results of survey data suggest that survival of cubs has decreased over time: the number of subadults per adult female decreased from the 1972-73 estimate of 1.9 to 1.7 in 1983-84 to 1.0 in 1990-91.

GENETIC STATUS OF THE FAR EASTERN LEOPARD

There has been an ongoing concern about the potential impact of inbreeding depression on small and declining wild populations of large mammals. For instance, O'Brien (1994) states that "in addition to ecological and demographic perils, it has become clear that small populations that narrowly survive demographic contraction may undergo close inbreeding, genetic drift, and loss of overall genomic variation due to allelic loss or reduction to homozygosity." Alternatively, the small population may be inbred and fit and can be at risk if exposed to out-breeding (Chepko-Slade and Halpin 1987).

Molecular genetics has recently been extensively used to address conservation questions at multiple levels of evolutionary divergence. For example, the use of these procedures is influencing our definitions of species and subspecies. Molecular biologists have also recently been engaged in tracking the exposures of a number of pathogens in cats. Nowell and Jackson (1996:217) have published a survey of this effort in the *Wild Cat Status Survey and Conservation Action Plan.* Dr. O'Brien and his associates have made major contributions to this effort.

A recent and rather extensive study of the extent and character of genetic variation in leopards across their range was conducted by the Sri Lankan scientist Dr. Sriyanie Miththapala (Miththapala 1992, Miththapala et al. 1996), and in two supporting publications that concern Sri Lankan leopards (Miththapala et al. 1991, 1993). All the genetic analyses were conducted in Dr. O'Brien's lab, under his supervision. The morphological information is available in Miththapala's dissertation, but has not yet been formally published.

Several key points are relevant to discussion of Far Eastern leopards. First, as background, this research sought to reveal the extent and character of genetic variation in the island-living Sri Lankan leopard compared to mainland leopards from across their range. Using allozyme variation, it was determined that percent polymorphism (P) and percent average heterozygosity (H) were 4% and 1.4 %, respectively, for Sri Lankan wild-born leopards, and 4% and 1.2%, respectively, for Sri Lankan zoo-born leopards. The mainland samples were 10% and 3.1 % respectively. These results placed the Sri Lankan leopard among the least genetically variable of the cats, similar to the cheetah and the Asian lion,

while variation in the mainland leopards was comparable to the African lion, the most variable of the large cats (Miththapala et al. 1991).

This was an interesting and potentially important finding in considering not only conservation genetics for wild and captive Sri Lankan leopards, but for all zoo leopard breeding programs. But Dr. Miththapala's doctoral dissertation (1992) placed these finding about the Sri Lankan subspecies in context through a more detailed study of the extent and character of genetic variation within this very widespread species. Prior to this study, there were 27 subspecies of leopard recognized, but the significance of these subspecies was unknown from a genetic context. Briefly, the results indicated that:

1. Samples from the named subspecies revealed appreciable genetic diversity using three molecular methods: allozymes, mitochondrial DNA restricted sites, and feline-specific restricted minisatellites.

2. Continental populations and subspecies from Africa and Asia possessed the highest amount of molecular variation, whereas relatively lower amounts of diversity were present in island populations.

3. Molecular data were analyzed using three phylogenetic methods to resolve genetic differences below the species level.

4. The combined results, together with supporting morphological data, revealed phylogenetic distinction between six geographically isolated groups of leopards with the following subspecies designations:

a. Africa, *P. p. pardus;*

b. central Asia, *P. p. saxicolor;*

c. India, *P. p. fusca;*

d. Sri Lanka, *P. p. kotiya;*

e. Java, *P. p. melas;* and

f. east Asian, with *P. p. orientalis* for the Amur region; *P. p. japonesis* for northern China; *P. p. delacouri* for southern China, and further south.

In most cases designated subspecies conform to historic geological barriers that would have facilitated genetic divergence.

Of particular importance here is the distinctiveness of *P. p. orientalis*, and the relationship between *P. p. orientalis* and *P. p. japonesis*. *P. p. orientalis* and *P. p. japonesis* were 4.1% and 2.8%, and 4.1% and 1.3% for P and H, respectively. In these measures, *P. p. japonesis* is similar to the Sri Lankan leopards. They are quite restricted by the standard of Asian leopard populations in our sample and very restricted by the standard of African leopard populations. *P. p. orientalis* and *P. p. japonesis* were paired consistently in phylogenetic analysis and shared mitochondrial DNA haplotypes. Nuclear minisatellite (also called NVTR or DNA fingerprints) divergence between this pair of named subspecies was low (34.9%), and comparable to intrapopulation variation in these two populations: 28% and 34%, respectively. Allozyme differences between the subspecies were also low. These data suggest a recent separation of the two subspecies, but Miththapala (1992) was able to make a distinction between these two populations based on skull morphology measurements, which included the skulls of the type specimens. The material for the genetic analysis of *P. p. orientalis* and *P. p. japonesis* was necessarily obtained from captive-bred leopards and the recommendation to retain this subspecies distinction was provisional. It was concluded that samples from wild-caught animals from both populations and from different parts of their range are required for further taxonomic resolution. Until that work is done, it was recommended to retain the named trinomials.

It is essential that samples from all Far Eastern leopards that have been captured and tissue samples from any dead Far Eastern leopards be preserved for analysis. Dr. O'Brien has made arrangement to support this analysis in his laboratory.

THE HISTORY OF FAR EASTERN LEOPARDS IN CAPTIVITY

Introduction

Far Eastern, or Amur leopards, *Panthera pardus orientalis* (Schlegel, 1857), have been maintained in captivity since at least 1961, when the Prague Zoo received a male from Primorski Krai. Thereafter, at least 32 leopards have been brought into captivity from the wild, originating from both Russia and Korea. In the case of animals originating from Russia, Zooobjedinenije (Moscow Zoo Trade Center), which historically coordinated all transfers of wild animals within the former USSR, reported leopards to have originated from both Primorski and Khabarovski Krai. At times even more precise data on the district or drainage system from which the animals were captured was supplied to owners and therefore, to the studbook keeper. No information on captures in China is available. Despite the seemingly large number of leopards taken into captivity, many never reproduced and the present captive population must be managed quite intensively if this highly endangered subspecies of leopard is to remain in captivity.

Captive History

In 1974 IUCN (International Union for Conservation of Nature) and IUDZG (International Union of Directors of Zoological Gardens) approved an international studbook for Far Eastern (Amur) leopards held in captivity. At that time, nearly all Far Eastern leopards were held by zoos in Europe, and even today, the majority remain in that region. The purpose of the studbook was to record the arrival of leopards from the wild and to maintain records of all young born in captivity, regardless of whether they survived or not. In the process, extensive husbandry information was gathered in many regions, and captive propagation is now considered routine.

As a result of the studbook, it was possible to track all individual leopards throughout their lifetime, even with changes in ownership. In recent years, access to this data base has been facilitated with the computer program, SPARKS (Single Population Animal Record Keeping System), which was developed by ISIS (International Species Information System, c/o Minnesota Zoological Park, Apple Valley, MN, USA). As a result of this data base and the extremely cooperative nature of all zoos holding this subspecies of leopard, it was determined that all leopards born in captivity derive from only 9 wild born "founders", i.e. leopards born in the wild (Table 1). Of these founders, four originated from Korea and at least four more originated from Russia. The origin of the ninth male, studbook #2, who has been problematic for the European Captive Breeding Program (or EEP), is not precisely known even though he is genetically the most well represented male within the captive population.

The status of male #2 is important because of his poorly documented origin. Originally imported as a juvenile by the Frankfurt Zoological Park, Germany in 1963, he was originally considered to be a bona fide Far Eastern leopard and listed as such in zoo and professional publications. Supplied by an animal dealer in Jabria, Netherlands (as was his mate), he also produced a number of viable offspring when paired with female #3. Later, during the 1980's,

Table 1. Effective founders of Far Eastern or Amur leopards that have entered captivity from the wild.

Stud-book #	Sex	Birth date	Year of arrival	Year of death	Origin	Zoo	Remarks
2	M	1963	1963	1982	Not known	Frankfurt	Very common founder; origin unknown; supplied by Fa. Van den Brink, Jabria, Netherlands
3	F	1962	1964	1982	Russia	Frankfurt	Very common founder; exported to Center Hill by Zooobjedinenije
14	M	1967	1968	1979	Russia	Leipzig	Nadezhdenski Raion, SW Primorski Krai
15	F	1967	1968	1978	Russia	Leipzig	Shufan River region, SW Primorye Krai
35	M	1970	1972	1989	Russia	Moscow/ Frankfurt	Rare founder, Dalnerechenski Raion, Primorski Krai
89	F	ca. 1958	1960	1979	Korea	Center Hill (via France)	Always linked with # 2/3
136	M	1980-1982	1984	living	Korea	Moscow St. Petersburg	Rare founder
142	M	6-85	1985	living	Korea	TP Berlin	Rare founder, wild born?
193	M	1988	1988	living	Korea	Moscow/ Tallinn/ Prague	Rare founder
TOTAL:		9 (6 males/3 females)					

when concern arose about his vague origin, information was sought from the supplier. However, no records had been kept. Zooobjedinenije was contacted in search of historical data on this pair but they were only able to verify that the female had come from Russia. To this day, his origin cannot be verified and he may have come from sources in Hong Kong, Korea, or Manchuria. Recently it has been suggested that he was captive-born, and derived from founders that may have originated from Tibet, Kashmir, or other locations far from the range of Far Eastern leopards. Given the high degree of variability in leopard pelage, such a supposition is risky. Regardless, the appearance of several melanistic individuals within the captive population that appear linked to this male suggest that he may not be from northeast Asia, since black leopards have never been recorded from that area. In 1979 he was transferred to the Rare Feline Breeding Center, (Center Hill, Florida, USA), where he died at the age of approximately 19 years. Female, #3, also died there at 20 years.

Table 2. Potential founders of Far Eastern leopards which are still living but have yet to produce offspring.

Studbook number	Sex	Birth date	Year of arrival	Status	Origin	Zoo	Remarks
211	M	1988	1989	living	Korea	Moscow/Prague	
212	F	1989	1989	living	Korea	Moscow	
216	M	1988	1990	living	Korea	Moscow/ Novosibirsk/ Moscow	not compatible with other leopards
294	F	1991	1992	living	Korea	Prague	Captive born?
364	M	1990	1991	living	Korea	Bogor	Captive born?
365	F	1990	1991	living	Korea	Bogor	Captive born?
376	F	1992	1993	living	Korea	Prague	
TOTAL:	7 (3 males/4 females)						

Regardless of taxonomic issues posed by founder #2, the overall number of effective founders is low and as a result, the level of inbreeding within some individuals of the current population is high. Under captive conditions, individuals with inbreeding levels (F) under 0.25 are considered slightly inbred; those with inbreeding levels over 0.25 are considered highly inbred. Animals born in the wild are considered to be not inbred (F=0.0). In today's population of approximately 196 living leopards (104 males, 91 females, 1 unknown) maintained by 60 zoos and private owners, 84 individuals are considered slightly inbred (F=0 < 0.25) and 54 leopards are considered highly inbred (F=0.25 - 0.49); one leopard has an inbreeding level over 0.50. An additional 40 captive born leopards are not inbred, as are the 10 animals born in Korea.

As has been commonly observed in captive populations of many unrelated species, the distribution of genetic representation of the nine effective founders is not even. In addition to the fact that #2 and #3 are by far the most commonly represented founders, one additional founder, #89, is only represented in concert with those two individuals and her heirs cannot be separated from #2 and 3 in future breeding schemes. Founders #14 and 15 have only one aged offspring surviving which has no offspring unlinked to #2 and #3. Other effective founders, #35, #136, #142, and #193, are only genetically present in concert with #2 and #3. In the future, #193 may be genetically separated from #2 and #3 if he is able to breed at his present location at the Prague Zoo.

The origin of leopards originating via the Pyongyang Zoological Park, Democratic People's Republic of Korea, is not well documented. Although all are considered to be solely derived from leopards native to that country, several owners have felt that animals sent to them by the Pyongyang Zoo were born in captivity (Table 2). These animals were not only young at the time of their arrival in Europe, their behavior suggests that they may have been born in captivity and could therefore be related to some of the other leopards supplied by the Pyongyang Zoo. At least one pair of leopards, #364 and #365, are not maintained in a breeding situation because it is believed that they may be littermates that would, if successfully mated, produce highly inbred offspring (F=0.25). As of October, 1996, there exists only a single pair of Korean-born leopards together. A female in Moscow, #212, remains unpaired.

Table 3. Far Eastern leopards maintained in captivity without reproducing.

Stud-book #	Sex	Birth Date	Year of arrival	Year of death	Origin	Zoo	Remarks
1	M	1960	1961	1976	Russia	Prague	Primorski Krai
8	M	1965	1967	1983	Russia	Rostov	Khabarovsk
23	M	1968	1970	1983	Russia	Novosibirsk	Ugadoi Nadezhdenski
24	M	1968	1970	1978	Russia	Novosibirsk	Ugadoi Nadezhdenski
33	M	1971	1971	dead	Korea	Beijing	
34	F	1971	1971	1979	Korea	Beijing/Jin Jang	
60	M	1962	1962	1979	Russia	Erevan/ Tallinn/ Kaunas	Slavyanski region, Primorski Krai
61	M	1962	1962	1972	Russia	Erevan/ Tallinn	Khabarovsk
62	M	1961	?	1977	Russia	Kaunas/ Tallinn	Primorski Krai
63	F	1970	1972	1979	Russia	Tallinn/ Moscow	Hutor River, Ussuri District, Primorski
70	M	1959	1963	dead	Russia	Kazan	
74	M	1966	1967	1981	Russia	Asahiyawa	No record Zooobjed.
90	F	ca. 1958	1960	1965	Korea	Center Hill (via France)	
184	F	1987	1987	1987	Korea	Moscow	
	M	?	?	?	Russia	Alma-Ata	Reported living 1975
	M	?	?	?	Russia	Odessa	Reported living 1975
	M	?	?	?	Russia	Kaliningrad	Reported living 1975
TOTAL:		16 (13 males/ 3 females)					

In addition to the 9 effective founders discussed above, 7 additional Far Eastern leopards are housed in European zoos (Table 2). All originate from Korea and were supplied by the Pyongyang Zoo. Some of these leopards were born in the wild, but others may not have been. Regardless, several are probably 10 years old and should breed soon or their genetic potential will be lost. Because compatibility problems have surfaced, techniques involving assisted reproduction should be considered. Although no felids other than perhaps the cheetah, *Acinonyx jubatus*, can be described as easily bred through artificial insemination, progress is being made in embryo transfer and other related technologies. The single successes at breeding lion (*Panthera leo*), tiger (*P. tigris*), Persian leopard (*P. p. saxicolor*), puma (*Puma concolor*), and clouded leopard (*Neofelis nebulosa*), are now targeted for further investigation so that this technology can be used for other species in various situations and in different regions. In the summer of 1996 similar techniques were used successfully in Brazil for ocelot (*Leopardus pardalis*), and tiger cat (*L. tigrinus*), and some aspects of this technology may be transferable to leopards.

Perhaps the most unfortunate aspect of the Far Eastern leopard, at least from a historical perspective, is the large number of wild born leopards that never bred and never contributed to today's gene pool (Table 3). Few females were collected and only one, #63, ever reproduced; unfortunately she did not rear any offspring. Most animals were maintained as single specimens and, because technology involving artificial reproduction was not available at the time, semen was not collected for future use. It should be noted that several of these

Table 4. Location, by region and country, of captive and wild born Far Eastern leopards potentially available for breeding programs.

Region	Country	Zoo	Number of leopards (males:females)
EUROPE	Bulgaria	Sophia	1.2
	Czech Republic	Prague	3.2
	England	Burford	1.1
		Chard	3.2
	Estonia	Tallin	2.2
	Finland	Helsinki	3.2
	France	Amiens	1.0
		Lyons	3.3
		Monde Sauvage	4.1
		Montpellier	2.1
		Mulhouse	1.0
	Germany	Augsburg	5.2
		Berlin	1.1
		Berlin TP	3.3
		Dortmund	1.2
		Frankfurt	2.2
		Leipzig	2.3
	Hungary	Szeged	1.1
	Italy	Novara	3.2
		Pastrengo	1.1
		Pescara	1.2
	Lithuania	Kaunas	2.2
	Netherlands	Rotterdam	2.2
		Rhenen	1.1
	Russia	Kazan	1.0
		Moscow	2.2
		Nalchik	1.0
		Nikolaev	3.1
		Novosibirsk	2.3
		Rostov	1.0
		St. Petersburg	1.1
		Seversk	2.0
		Tomsk	1.0
	Switzerland	Zurich	1.2
	Yugoslavia	Zagreb	0.1
ASIA	Indonesia	Tamen Safari, Bogor	1.1
	Japan	Asahikawa	1.1
		Kobe	1.1

Table 4. continued.

Region	Country	Zoo	Number of leopards (males:females)
NORTH AMERICA (AZA)		Brookfield	1.0
		Colorado Springs	2.1
		Columbus	1.2
		Denver	1.1
		Granby	1.0
		Minnesota	1.3
		New Orleans	1.1
		Oakhill, OK	2.3
		Pittsburgh	2.0
		St. Louis	1.1
		Santa Barbara	1.1
		Tyler	1.1
		Wichita	3.1
		Winnipeg	1.1
NORTH AMERICA (non-AZA)		Ashby Wildlife Park, FL	3.4
		Center Hill, FL	6.4
		Dennis Hill, IN	1.1
		Exotic Cats, Gibsonton, FL	2.3
		Naples, FL	1.0
		Rosamond	4.6
		Vernon Yates, St. Petersburg, FL	1.2

single males originated from Khabarovski Krai, perhaps because they emigrated from their natal range into what may have been suboptimal habitat. The last three males in Table 3 were not issued stud numbers because the only information available concerned their existence in 1975. No records were available to provide information about their age at the time of capture, the date of arrival or death, and their owners did not respond to queries.

THREATS TO SURVIVAL OF THE FAR EASTERN LEOPARD IN THE WILD

Introduction

In developing a conservation plan for an endangered population of wild animals, it is important to understand what are the key factors limiting the population, and what are the most significant threats to their survival. A brief review of the most important threats to the survival of the Far Eastern leopard is therefore a key prelude to conservation planning.

Direct human-caused mortality. One of the main threats to the survival of the Far Eastern leopard is human-caused mortality, most commonly by shooting and snaring. Poaching of leopards results from one or some combination of 3 factors: 1) the potential profit derived from leopard skins and body parts; 2) the perceived competition for food (i.e. wild game meat) by hunters; 3) the conflict that arises from leopard depredations of domestic and semi-domestic animals (see below). Of the three, poaching for profit is likely the most common motive. As with tigers, there is strong incentive to sell leopard parts to the Asian medicinal market, where profits are high. Poaching can be opportunistic, when hunters happen upon a leopard (with snow providing a relatively easy means of tracking down an individual), or when hunting dogs "tree" a leopard, providing an easy mark for a hunter. At least some poachers are directly targeting leopards as their prey with the use of dogs or snares. Although snares do catch leopards unintentionally (when set for badgers or other furbearers), they are often set especially on trails or at leopard crossover points along fences of deer farms.

Loss of prey base. Although exact information is lacking in many instances, there is much evidence to suggest that the density of ungulates has decreased dramatically in the recent past in southwest Primorye and in China. This decline may be due to overhunting (and habitat loss in China), and due to the changing economic structures in Russia, causing a temporary halt in enforcing of hunting regulations in many hunting units. The decrease in prey densities may force leopards out of some potentially suitable habitat, and no doubt forces them to rely more on captive deer, thereby increasing the chances of human-caused mortality.

Conflict in deer farms. In southwest Primorye, conflicts between leopards and man appear to be most obviously centered around "deer farms", which are large, fenced tracts of land on which sika deer are raised primarily to harvest antlers in velvet for the traditional Asian medicinal market. Although dogs and other domestic animals (calves, goats, chickens) are occasionally killed by leopards, reaction to these relatively rare events is minor compared to the threat perceived by owners of sika deer farms. Dried antlers in velvet can be sold for $600/kilogram (1995 price), and the average male deer will provide approximately 300 grams per year. Therefore, death of individual males that can produce antlers for 5 to 8 years can represent significant loss to deer farm owners. Deer farm ventures are often marginally profitable, and loss of their breeding stock due to leopard predation could potentially substantially impact income. Even when losses are minor, leopard depredation is resented by deer farms owners, as carnivore depredation is resented by livestock owners throughout the world. A common response is to shoot or trap offending leopards. Fencelines that are poorly patrolled are a convenient and accessible spot for poaching activities.

Not only do these deer farms usurp large tracts of land that is often quality leopard habitat, but they contain high densities of natural leopard prey. Since sika deer are a native species, leopards are incapable of differentiating between captive and wild populations.

Leopards appear to have few problems finding ways over or through fences, which then allows them access to readily caught prey.

If the leopard population were more secure, selective removal of depredating leopards may be a legitimate management tool. The population that survived this selective culling regime would theoretically be that percentage of the leopard population that learned to avoid deer farms. However, given the precarious status of the Far Eastern leopard, every death has severe implications to survival of this subspecies. In fact, although it is an unnatural situation, deer farms provide a valuable and reliable source of food for leopards. Given the fact that intensive poaching has substantially reduced densities of prey elsewhere, it could be argued that deer farms may presently be critical leopard habitat in the Russian Far East.

Habitat loss due to encroachment, logging, and fires. Loss of habitat in southwest Primorye is due to a number of inter-related factors. Humans have cleared much of the land for agricultural purposes over the past hundred years, converting former leopard habitat into farmlands. Logging continues at a low level in this region, although there is interest still in the softwoods (pine and fir), for instance, on the Borisovskoe Plateau. More insidious are the annual fires in southwest Primorye, which are nearly entirely human-caused. Most fires are the result of uncontrolled burning of hayfields (to stimulate spring grass growth), although sparks from coal-fired stoves on railroad cars also ignite ground fires along the railway. Ground fires (leaf litter and grass) burn up to 40% of Khasanski Raion annually in late winter and spring. Mixed species forests have been largely replaced by pure oak stands (the most fire-resistant species). Repeated fires kill shrubs and saplings, preventing replacement of overstory trees. With these frequent fires, eventually oak forests are converted to woodland savannas, and finally, to grasslands. In southern Khasan, there are huge tracts of land that are treeless due to repeated grass fires over extensive periods of time. These fires continue to destroy forest lands.

Isolation of populations. The reduction in numbers of the Far Eastern leopard in Russia and North China (see section on "Distribution" and Appendix 8) is following a "classic" extinction pattern (e.g., Shafer 1990). Range contraction, often resulting from habitat loss, leads to fragmentation of the habitat. Fragmentation has been clearly documented in both Primorski Krai and Jilan Province. Small populations remaining in small fragments of habitat are subject to localized extinctions due to a variety of potential causes. This is especially true of carnivores such as leopards, which have relatively large land area requirements, are the subject of intense poaching in Russian Far East and China, and are dependent on intact forest ecosystems that contain relatively high densities of ungulate species. The single, contiguous population of leopards in Primorye was fragmented into three isolated populations in this century, and as of 1970 two of these three populations have apparently disappeared. In Jilan Province of China, a number of isolated, small populations of leopards have decreased over time, with many of these fragmented populations going extinct (see Table 1 of Appendix 7). Fragmentation and isolation of these populations, therefore, poses a serious threat to chances of survival.

Genetic impoverishment. As is noted above (see section on "Genetic Status"), small populations risk genetic impoverishment. Small populations are likely to incur inbreeding depression, be exposed to genetic drift, and to an overall loss of genetic variation due to allelic loss or reduction in heterozygosity.

There are three good examples of the impact of genetic impoverishment on wild felid populations. The remnant population of approximately 30 adult Florida panthers was found to have a series of genetic problems, including very high counts of sperm abnormality (over 90%), high incidence of crooked tails, and congenital heart defects (Jordan 1994, Seal et al. 1992). Low heterozygosity levels indicated that the Florida panther was inbred and had lost

approximately half of its genetic diversity (Roelke 1990). Lions in the isolated Ngorongoro Crater population, all derived from 15 founders in 1962, presently show a lack of genetic diversity, have high levels of abnormal sperm, and appear to be suffering from declining reproductive success. African cheetahs (*Acinonyx jubatus*) have a very high level of homogeneity in the wild, which may make them highly susceptible to disease or other potential perturbations (O'Brien et al. 1983, O'Brien and Evermann 1988).

The largest Far Eastern leopard population contains approximately 30 individuals in southwest Primorye, approximately the same size as the Florida panther population, and has been isolated from other populations for at least 20 years, and more likely for 40-50 years. Therefore, this subspecies should be considered at high risk for genetic impoverishment.

Potential diseases. Small populations, especially those that may have lost genetic variability, are at risk of being eliminated due to disease epidemics. Recently, canine distemper eliminated at least 45% of the 3,000 lions in the Serengeti ecosystem (Jackson 1995). Little is know of disease risk to the Far Eastern leopard population, but it is potentially susceptible to any number of diseases carried by domestic cats, dogs, or its prey species. Though little is known about potential disease threats to Far Eastern leopards, its significance should not be overlooked in conservation planning.

Part III.
Recovery Plan

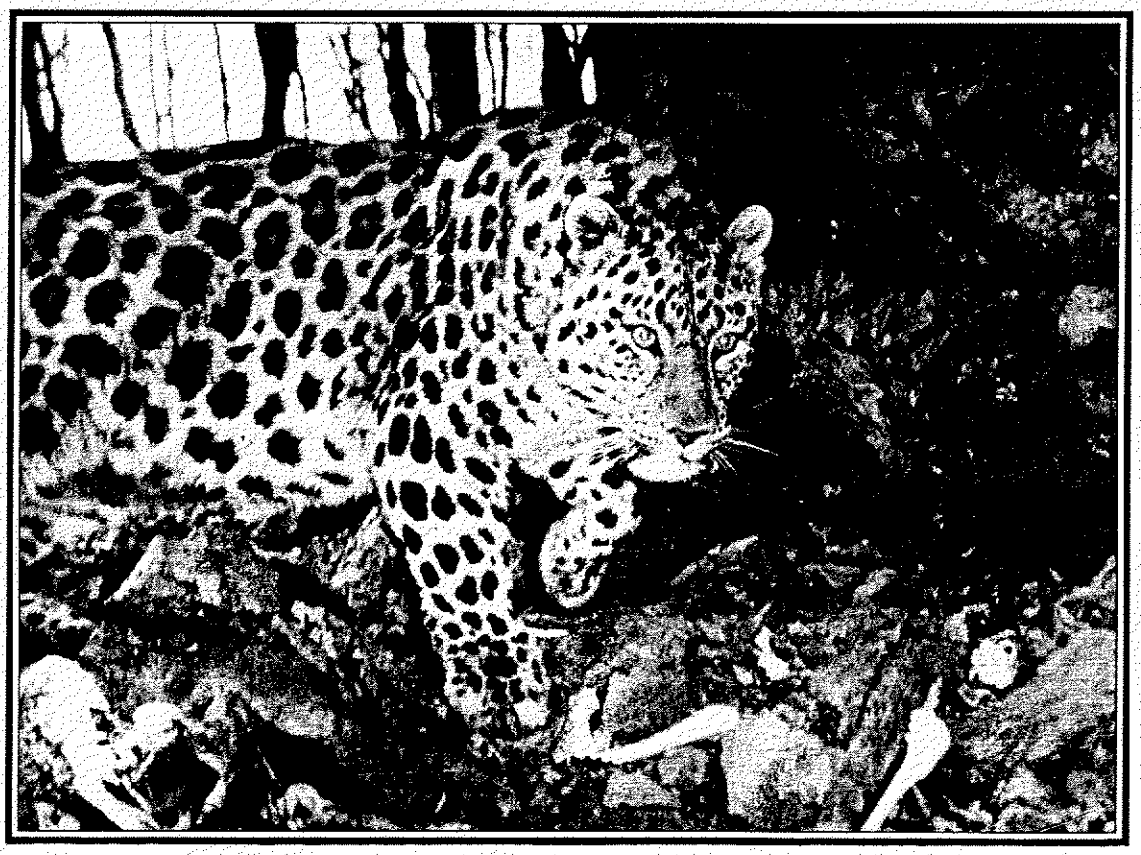


Photo by Shibnev

PART III.

RECOVERY PLAN

1. RESEARCH PRIORITIES FOR THE FAR EASTERN LEOPARD

Introduction

Research can be defined as the process by which credible information and evidence are obtained. The design and methods of research are determined by the scientific method and the ability to apply certain tools to the particular problem at hand. In the case of the Far Eastern leopard, all research activities must be focused on the fact that extinction is imminent for the subspecies if management actions are not taken. Since the activities undertaken to secure a future for the Far Eastern leopard must be efficient and effective, research must concentrate on the most critical information. Although there are many ecological and zoological questions of interest about the Far Eastern leopard, research must focus on supplying key information for development of a conservation plan.

Research priorities for any species will be dictated by several factors. The following information provides some background and a framework to define research priorities:

- approximately 25-30 leopards exist on the Russian side of the border;
- in Jilan Province, China, the most recent survey in 1991-92 indicated there were 15 leopards (Appendix 8); in Heilongjiang Province, China, and North Korea, we have no recent information;
- there is little doubt that the present number of leopards in the wild is less that 100;
- leopards currently occupy a small region which straddles the tri-national border area of North Korea, China, and Russia;
- the area currently occupied by Far Eastern leopards is under consideration for several types of economic development (e.g., the Tumen River Project).

Statement of Problem/ Issues

Extinction is the most pressing problem in preserving global biodiversity; maintenance of species and their subpopulations is a strategy to maintain intraspecific diversity and ecological integrity. The Far Eastern leopard occupies the northernmost area in leopard range, is an important component of the species' overall diversity, and it plays the role of a top carnivore in the tri-national region in which it lives.

The following eleven activities are defined as research activities which will provide information necessary for the conservation and recovery of the Far Eastern leopard in the wild. They are formulated and prioritized under the premise that the goal is to secure three subpopulations of leopards in the wild, with a target population of 50 in the presently occupied range in Russia, an undetermined number in China, and an undefined number in a third, reintroduced population on the Russian side (see "Goals and Objectives of the Recovery Plan"). In addition to the following descriptions of research activities, protocols are proposed for related issues: Appendix 4 - "Protocol for Capture and Handling Far Eastern Leopards", and Appendix 5 - "Protocol for Processing Injured Far Eastern Leopards". In order of priority, the following research activities should be undertaken:

Recovery Steps

1.1 Census Techniques

This activity involves the refinement and standardization of field census techniques for the Far Eastern leopard and its prey.

Introduction. Two of the most important activities in the recovery and conservation of the Far Eastern leopard will be the accurate description of the animal's present status and monitoring of that status over time. In conjunction with this, the health of prey populations will be very important in assessing viability of leopard populations.

Statement of Problems/Issues. One of the most important issues concerning the conservation of endangered species is the estimation of their numbers over time. Estimates of population size allow for the assessment of population status, the effectiveness of management activities and the need for additional actions. However, census activities are normally carried out over large geographic areas and large spans of time. Thus, it is imperative to maintain standardized methodology and consistency of technique, thereby providing comparability and credibility of data derived from these census activities. The proposed activities under this program will define, refine, and establish the protocols for scientifically credible conservation programs.

Objectives/Goals. The goal is to assess and refine the techniques of censusing and indexing leopards and ungulates.

Recovery Steps and Timetables. Meeting in 1997 to determine census techniques.

Responsible Organizations. Pacific Institute of Geography (TIG), Hornocker Wildlife Institute, (HWI), Institute of Biology and Soils (IBS).

Accomplishments/Expected Results. Definition of methods for a standardized census of leopards and ungulates.

Budget. $600 for conference and publication of standardized techniques.

1.2 Census of Far Eastern leopards in Russia

This research activity has two goals, requiring two different methods: 1) to produce a numerical estimate of the leopard population in southwestern Primorski Krai; and, 2) to define the status and boundaries of present leopard range in Russia through a simple "presence or absence" approach.

Introduction. One of the most important pieces of information in developing an effective conservation plan for an endangered species is simply knowing something about its status: where does it occur and how many are there? With this information, other activities can begin to focus on geographically important areas, and the population can be monitored for changes, either positive or negative.

Statement of Problems/Issues The first step in recovery of an endangered species is a definition of population and range; currently, information on these topics is inadequate for comprehensive conservation planning.

Objectives/Goals. The primary population of Far Eastern leopards in the wild is in southwest Primorski Krai; additional information will be necessary to define range limits in Russia.

Recovery Steps and Timetables. The first census is to be held in the winter months of 1996-1997. Concurrently, enlisting and training of observers will occur.

Responsible Organizations. TIG, HWI, IBS, Kedrovya Pad Zapovednik (see bottom of Appendix 9 for list of abbreviations used).

Accomplishments/Expected Results. An estimated population for the southwest Primorski Krai population and the existing range will be mapped.

Budget. $20,000 for the population censusing and range mapping in 1997, and a second census in year 2000 (also for $20,000). Total: $40,000.

1.3 Census of Far Eastern leopards in China

Introduction. One of the most important aspects of this recovery and conservation plan is the establishment and maintenance of three populations of the Far Eastern leopard. Because little is known about the present status of the leopard in China, it is necessary to assess this population.

Statement of Problems/Issues. The Chinese population is one of three critical populations for the maintenance of the Far Eastern leopard; little solid information currently exists on which to base a comprehensive conservation plan.

Objectives/Goals. The primary goals are to define range limits and numbers of leopards in Jilan and Heilongjiang Provinces in China.

Recovery Steps and Timetables. The first census will be held in the winter months of 1997-1998 and concurrently existing range will be mapped.

Responsible Organizations. Jilin Wildlife Conservation Association (JWCA), Institute of Wildlife of Heilongjiang, TIG, HWI.

Accomplishments/Expected Results. To estimate the population size in northern China and map the existing leopard distribution.

Budget. $50,000 for the population estimate and mapping the existing range.

1.4 Land-use Analysis

This activity is designed to provide the framework for land-use planning through a complete mapping of the features - biological, physical, and anthropogenic - that are present on leopard range, both occupied and unoccupied.

Introduction. Prior to any management actions, there must be a systematic evaluation of the landscape to assess needs and priorities. This analysis would use a Geographic Information System to map features in areas that are presently occupied by leopards and to identify areas which could potentially support leopards. Features that are positively associated with survival of leopards (such as core areas for reproduction and raising of young) and other parameters that are negatively associated with leopard survival (e.g. roads or other features derived from the habitat analysis in number 1.5) would be especially important to map.

This component is covered in more detail in section 2, "Land Use Planning and Protected Territories Management".

Statement of Problems/Issues. The conservation of species and biological diversity requires land-use patterns compatible with the ecological needs of the species of concern. The Far Eastern leopard occurs in a region with considerable planned economic development and little information on current and potential patterns of land use. Thus, data for mapping these patterns will provide the foundation for the planning process.

Objectives/Goals. The objective of this activity is to obtain the best possible information on current and potential land use patterns and to develop a conservation strategy which includes plans for the conservation of the leopard and economic development.

Recovery Steps and Timetables. See Section 2, "Land Use Planning and Protected Territories Management".

Responsible Organizations. HWI, WCI, TIG, IBS, Kedrovya Pad.

Accomplishments/Expected Results. The production of a comprehensive plan for the region and its development, which prioritizes conservation of the leopard.

Budget. See Section 2 "Land Use Planning and Protected Territories Management".

1.5 Habitat Preferences of Far Eastern Leopards

Introduction. This activity would provide information to determine which features of the landscape are associated with quality leopard habitat, and which types of habitat are selected by leopards. Analyses would provide the opportunity to make specific management recommendations for retaining or restoring leopard habitat, and how to minimize potential conflict with human activities.

Statement of Problems/Issues. An essential element for the land-use planning process and the production of a comprehensive conservation plan is the inclusion of scientifically collected information on the ecological requirements of the leopard. Specifically, the habitat features which leopards select for (and select against) will be required to complete this planning process.

Objectives/Goals. The objective of this activity is to produce a thorough description of the physical and biological habitat requirements of the Far Eastern leopard to develop specific management recommendations relating to leopard habitat.

Recovery Steps and Timetables. Data on leopard locations will be obtained through radio-telemetry and census data beginning in winter 1996-1997. These data will be correlated with habitat types through the use of a GIS (Geographic Information System) beginning in 1998 and continued as information is gathered over three years. In year four a habitat model will be created using information gathered by means of radio telemetry and censusing techniques.

Responsible Organizations. HWI, WWF, FOEJ (Friends of the Earth-Japan), TIG

Accomplishments/Expected Results. A thorough and definitive habitat model for the Far Eastern leopard will be produced.

Budget Subsections 1.5-1.8 can all be coordinated under a single comprehensive research program. To conduct such a program, an annual budget of $80,000 is required for 4 years to implement a radio telemetry and research program, for a total of $320,000.

1.6 Food Habits

Introduction. One of the most important features of an animal's natural history is food habits. This is especially true for carnivores. With this information, it is possible to assess the habitat quality or the potential quality of habitat for leopards, and manage to improve or protect it.

Statement of Problems/Issues. Little information on seasonal food habits of Far Eastern leopards currently exists.

Objectives/Goals. The goal of this activity is to obtain the best possible information on the diet of the Far Eastern leopards.

Recovery Steps and Timetables. Information gathering will commence in concert with the leopard 1996-1997 census and will continue through the year 2000.

Responsible Organizations. HWI, WWF, WCS, TIG, ISB.

Accomplishments/Expected Results. A thorough and definitive description of food habits will be available.

Budget. See subsection 1.5, above.

1.7 Population Dynamics

This research activity would attempt to characterize demographic parameters of leopard populations, and correlate those features to environmental factors.

Introduction. Information on population characteristics can be critical in securing a future for endangered species. This research activity would attempt to define such parameters as age at first reproduction for females, litter size, survival rates, breeding intervals, and causes of mortality. This latter feature is especially important for conservation planning.

Statement of Problems/Issues. The decision-making process is currently operating without adequate information about population dynamics of leopards.

Objectives/Goals. The objective of this activity is to obtain the best possible information on critical aspects of population characteristics of leopards.

Recovery Steps and Timetables. Intensive activities will begin in early 1997 and continue through the year 2000.

Responsible Organizations. HWI, TIG, ISB.

Accomplishments/Expected Results. A thorough and definitive description of population characteristics and dynamics of the leopard will be obtained.

Budget See subsection 1.5, above.

1.8 Social Organization

Introduction. Information on social structure is an important component of species-specific conservation planning. Documentation is needed on the spatial distribution of individuals within an area, age of dispersal, and differences between dispersal characteristics of males versus females. Development of a comprehensive conservation plan will require analysis of spatial requirements of individuals within the population, reproductive potential of the population, and potential for dispersal between protected areas.

Statement of Problems/Issues. Conservation planning for large carnivore species often entails development of land use strategies over large regions of land. The process of developing a comprehensive conservation plan for the leopard currently lacks key information for planning long-term viability of the Far Eastern leopard population. Information on social structure is needed for analyses that will guide planners for sighting of protected areas, and selection of connecting corridors.

Objectives/Goals. The objective is to collect and analyze data on the social organization of Far Eastern leopards for application to the conservation planning process.

Recovery Steps and Timetables Data collection will begin in the early parts of 1997 and continue though to year 2000.

Responsible Organizations. HWI, WWF, WCS, ISB.

Accomplishments/Expected Results. To develop a body of information characterizing the social organization of the Far Eastern leopard.

Budget. see subsection 1.5, above.

1.9 Prey Distribution and Abundance

This research activity would attempt to map distribution of leopard prey and develop a relative index of abundance among areas.

Introduction. Like any predator, leopard distributions are inextricably correlated with the abundance and distribution of their prey base. In combination with information from a leopard census, a more complete picture of the link between relative prey abundance and the presence or absence of leopards can be drawn. This information is important for the development of the recovery phase of a comprehensive leopard conservation plan.

Statement of Problems/Issues. Currently the information necessary for designating recovery areas does not exist. These sites must provide sufficient availability of prey to meet the minimum nutritional needs of leopards. This information can be gathered by correlating

the data gathered during the leopard range surveys with information obtained during the census on ungulate abundance.

Objectives/Goals

a. Ungulate Population Index: In conjunction with censusing leopards, map relative abundance of ungulates within leopard range;

b. Ungulate population dynamics: Through the use of permanent plots, the monitoring of ungulate population abundance over time.

Recovery Steps and Timetables

a. to be conducted every third year, with the leopard census;

b. to be conducted every year.

Responsible Organizations. Source Organization: WWF, EPT.
Active Organization: HWI, TIG.

Budget.

a. Ungulate Population Index $20,000 per census; $40,000 Total

b. Ungulate Population Dynamics $2,500 per year; $10,000 Total

1.10 Depredation Dynamics

This research activity will characterize interactions between leopards and sika deer farms.

Introduction Wherever carnivores and humans activities are juxtaposed there is the potential for negative interactions. One of the most common impacts is predation on domestic animals by carnivores. For the Far Eastern leopard these interactions commonly occur at the edges of settlements (where domestic animals such as dogs and cats are taken) and at deer farms that house large numbers of sika deer for harvest of antlers. Of these interactions the impact at deer farms is of greater concern due to the economic role of these farms in the region. Currently the most common response is removal of leopards from the population.

Statement of Problems/Issues. Commonly depredation results in the killing of leopards due to a lack of management options. However, a thorough description of the situation could illuminate management options. Unfortunately, only anecdotal information is available on deer farm-leopard interactions. This activity is designed to gather scientific information necessary for pragmatic solutions.

Objectives/Goals The objective is to gain information characterizing the conflict between leopards and humans.

Recovery Steps and Timetables Work on this objective will begin in the winter of 1996-1997. It will be an ongoing through the year 2000.

Responsible Organizations. WWF, RFE EPT, HWI, ISB, Russian Federation (RF)

Accomplishments/Expected Results. Through adaptive management, use information gained to develop insightful recommendations to reduce the impact and increase survivorship of leopards.

Budget $12,000/year for four years for support and logistics of radio telemetry program and complimentary compensation program. Total budget: $48,000.

1.11 Literature Review

This research activity would undertake the compilation of pertinent information known about the Far Eastern leopard, its habitats, and other species which should be included in development of a conservation plan.

Introduction. Biological research often takes on the form of generational and sequential investigations. To ensure smooth and harmonious continuation before undertaking significant research activities its is desirable to have the prior publications on the matter

reviewed. The information can then be distilled into a single or connected series of documents ready for reference by future investigators.

Statement of Problems/Issues. Researchers and conservation planners have at their disposal a monograph published by Pikunov and Korkishko (1992). Although there are a few other publications in Russian, there remains other scattered articles published in China, Korea, and in the English language that need to be brought together.

Objectives/Goals. To gather together, make the necessary translations, and synthesize the published works into a useable document on the Far Eastern leopard.

Recovery Steps and Timetables The project would begin early in 1997 and be ready for first publication by year two.

Responsible Organizations. WWF, RF, TIG

Accomplishments/Expected Results. To produce a document reviewing available literature on the Far Eastern leopard.

Budget. $10,000 for translation costs and publication fees over 2 years.

2. LAND USE PLANNING AND PROTECTED TERRITORIES MANAGEMENT

Introduction

The primary territory for land use planning and development of a protected territories system is an area between the Tumen River and Lake Khanka along the Russian-Chinese border. This territory includes parts of six administrative regions of Primorski Krai. Razdolnaya River (Suiphyn River) divides the area into two parts: southwest Primorye and northwest Primorye. Southwest Primorye (SWP) includes parts of four Primorski Krai administrative regions (Raions): Khasanski, Nadezhdinski (western part), Ussuriski (western part), Oktyabrski (southern part). Northwest Primorye includes lands within Pogranichny and Khankaiski Raions. Land use planning activities are proposed to be divided into two stages, the first stage covering the SWP. Reasons for prioritizing SWP are:

- the highest concentration of leopards in Primorye occurs there;
- much potential leopard habitat exists in the region;
- it is in close proximity to Chinese and Korean leopard habitat; and
- there are already proposals for creation of new protected territories in adjacent Chinese leopard habitat (Anonymous 1996).

Second stage planning (northwest Primorye) is proposed after results from the first stage have been assessed.

Land use management planning will be conducted on a 1:100,000 scale with use of a GIS that will be created specifically for this task to provide support for sustainable natural resource management decision-making in SWP as a whole and for individual regions.

Statement of Problems/Issues

The main biodiversity conservation tools (with the leopard as a priority) in the region are:

- development of a protected areas (PA) system;
- development of an economic and environmentally sustainable land and natural resources use management system;
- support for land-use decision-making that includes leopards as a key component of conservation in the region.

The way to develop sustainable land use management is to transform the existing land use system; transformations should be based on results of primary-use zoning. Primary-use zoning requires an assessment of the existing land use system, with possible future zone allocations in some areas in the interest of leopard conservation and economic development. In the future, land and natural resource management will be supported by an analytical system which includes GIS as a base component.

Recovery Steps

As stated in the introduction, the first stage of work would be done conducted in SWP.

2.1 GIS-based primary use zoning

2.1.1. Natural resource potential assessment. This work can be performed without large expenditures by utilizing and analyzing existing information. The most costly stage of this work will be development of resource maps and digitized equivalents for computer use.

2.1.2 Primary-use zoning in south-west Primorye. Existing and potential conflicts between necessities of biodiversity conservation (with the leopard as a priority) and economic development (the most important of economic projects being the Tumen River Project, development of recreational opportunities, and processing of raw materials from deer farms and other enterprises) exist in the region. Primary-use zoning of SWP (scale 1:100,000) can be used as an effective tool for reaching compromises in such conflicts. The following zones should be discussed by all parties (zones can possibly be divided into subzones):

- protected areas (PAs);
- zone of restricted (by intensity) use (e.g. deer parks);
- zone of intensive commercial use, which can be:
  - -industrial;
  - -urbanized areas;
  - -recreational (perhaps considered as a subzone of PAs);
  - -agricultural.

Some areas will be zoned at a larger scale because the size of land ownership units in those areas does not permit zoning at 1:100,000. Maximization of the following categories would be attempted during primary-use zoning:

- maintenance of habitat integrity for leopard;
- reallocation of commercial-use zones to protect leopard habitat.

As a relatively independent part of the work, an assessment to determine the feasibility of establishing ecological corridors connecting southwest Primorye leopard habitat with potential leopard habitat in the Sikhote-Alin region, northwest Primorye (Pogranichny), and China.

Responsible Organizations: Land-use Committee (Primorski Krai), TIG, Krai Committee for Natural Resources.

2.2 Analytical information system

Development of an analytical information system is required for executive decision-making that supports environmentally sustainable land use management and that considers leopard conservation. A "passive" biodiversity conservation strategy, based on eliminating anthropogenic effects on all natural processes, is not currently feasible, nor will it be in the foreseeable future due to the need to exploit natural resources. Also, in some areas the damage is so significant that ecosystem processes may return to normal only with intensive management and artificial processes. Therefore, a biodiversity conservation strategy that employs a tactical planning process is a compromise that searches for an "optimal" solution.

Statement of Problems/Issues. A compromise or an optimal resolution of resource use may be reached only in a system which includes all potentially conflicting components. Therefore, when trying to restrict natural resource use, both biological and economic processes should be considered. It is possible that biodiversity conservation will require management of ecosystem processes. Indicators of these needs should be relatively sensitive and reliable.

Modeling can play a critical role in this work because large-scale experiments on processes are either undesirable or impossible to conduct. Therefore, there must be

coordination in use of formal and informal analysis methods. A good example of an informal method is "expert assessment".

The use of an individual who can define the problem, assess possible alternatives, and make decisions, is expanding for conducting such assessments. An expert or group of experts becomes a critical component of a model because of their ability to informally use their knowledge and experience in the problem area.

Objectives/Goals. A special expert group is now required to coordinate the work of "problem experts" and their technical support. Such a group should include specialists in systems analysis, computer and data technologies, and communications hardware. This group's goal is development, management , and support of a model system.

Computer assistance will provide the potential for managing the expert group's work in an interactive regime that will speed up executive decision making processes. Given this potential, new applications for complex approaches to expert assessments will be possible, as well as an assessment of their accuracy. Expert assessment strategies and tactics are now becoming more similar to formalized experiments and models. Therefore, such systems can now be considered as expert modeling systems, and not just expert information for reference purposes.

Development of an expert model system will provide informational support for natural resource management and planning processes that seek to guarantee conservation and protection of the Far Eastern leopard.

Recovery Steps and Timetables

- Development of a GIS system that could act as a base component for development of a leopard habitat model and a management guide for decision makers (1997-1999).
- Development of conceptual plans for experts and expert model procedures (1998).
- Development of an expert model system for information support of natural resource management and planning processes (1998-1999).
- Test several resource use alternatives in different development scenarios (1999-2000).

Responsible Organizations. TIG

Accomplishments/Expected Results. The main result will be implementation of a sustainable development model in southwest Primorye, including:

- long-term viability of the Far Eastern leopard population;
- support of territorial interests for biodiversity conservation (with the leopard as a top priority) and overall socio-economic development of the region;
- information and technical support of natural resource management planning processes according to the basic requirement - viability of the leopard population; and,
- test natural resource use alternatives in the region in different development scenarios.

Budget. See Appendix 9.

2.3 Protected natural territories

Introduction. The basis for sustainable resource use is biodiversity conservation. Biodiversity conservation, of which leopard conservation is a critical component, is not possible without development and maintenance of a protected natural territories system (PA) in southwest Primorye. The potential for increase in PA's will not amount to more than 10-15% of the region's area.

Objectives/Goals. Support, development and strengthening of existing protected areas.

Recovery Steps. Development and support of a protected areas system will be implemented with the following priorities for achieving effectiveness of the system:

- inventory of existing PA's and of leopard habitat in the region (Appendix 9, 2.3.1);
- support of existing PA's (Appendix 9, 2.3.2, 2.3..3, 2.4, 2.5, and 2.7);
- development of new PA's (Appendix 9, 2.6);
- higher status to existing PA's (Appendix 9, 2.8); and,
- possible unification of PA's into a single environmental protection structure (Appendix 9, 2.9);

Responsible organizations. (see Appendix 9)

Accomplishments/Expected results. The expected result is future establishment of a unifed international protected areas system with different resource management regimes within its borders. Two special reserve nuclei must be included for establishment of such a system: Kedrovaya Pad can act as one nucleus, and the other should be identified during the zoning process.

Budget. (see Appendix 9)

3. CAPTIVE BREEDING STRATEGY FOR FAR EASTERN LEOPARDS

Introduction

Like many species of animals maintained in captivity, Far Eastern leopards have suffered from poor pair selection and unequal founder representation. As a result, many of the living leopards now range from being slightly to highly inbred, even as some of the rare founders are becoming less represented or are in danger of disappearing from the gene pool entirely. In the wild, Far Eastern leopards continue to decline even though leopards have been or may become available for use in captive or reintroduction breeding programs. The following considerations are proposed to address these problems. The EEP (European Captive Breeding Program) for managing European and Russian populations of Far Eastern leopards in captivity is now in place. The development of a breeding scheme to maintain this taxon in captivity as well as to potentially provide specimens for release programs needs to progress.

Statement of Problems/Issues

Captive Far Eastern leopards suffer from three strategic problems even though the bulk of the living population breeds without significant difficulty. Many are highly inbred even though an international studbook has been available since 1974 for sound pair selection. The gene pool for the captive-born population is small (9) although additional unrepresented animals from Korea are present in several European collections (see "History of the Far Eastern Leopard in Captivity"). Moreover, many of the captive collections only have two founders (#2 and 3) prominently placed within their pedigree, with other founders (#14, 15, and 89) being much more uncommon. All other remaining founders are rare or absent from most pedigrees. Seven potential founders from Korea are available but have yet to breed.

There is the potential for zoos to obtain additional animals from the wild under special circumstances but legal controls prevent the humane and expeditious handling of such animals. This legal barrier must be eased.

Recovery Steps

The recommendations of this group are five-fold.

3.1 Preserve a representative population of the Far Eastern leopard in captivity

Objectives/Goals. The initial goal is to preserve this subspecies of leopard in captivity through the EEP and to maintain an adequate number of suitable specimens for re-supply to near-site release or breeding programs if the wild population gains better protection.

Recovery steps and timetables. Because most captive Far Eastern leopards are in Europe and Russia, captive breeding efforts for preservation of this taxon for use in both regional and international captive breeding programs (as well as a Far Eastern breeding and reintroduction project) should initially come from this region. North America has far fewer animals; and no founders are present or likely to be available in the near future to make significant genetic contributions to breeding programs. The EEP will contact all zoos to support this conservation program. Prague Zoo will be contacted and urged to breakup their large (5) collection of Korean leopards so that too many genetically valuable animals are not housed in the same situation.

For academic purposes, issues involving taxonomy of founder #2 are not considered to be a problem and the EEP will develop a program that reduces his influence and that of any

other genetically over-represented individual in captivity. Also, all animals from Korea will be considered founders until information is provided to the contrary. Blood samples from Korean and other animals will be obtained opportunistically for analysis by the genetic subgroup, and the results transmitted back to the zoos.

Responsible organizations. Breeding efforts are presently directed through the EEP and European/national zoological park associations. A PMP (Population Management Program) will be prepared in 1997 for cats held in North America, and if successful, an SSP (Species Survival Program) may be developed thereafter.

Accomplishments/Proposed Results. To date, a computerized international studbook is available in SPARKS format for use in all regions. An EEP has been established: all zoos possessing Far Eastern leopards are part of the program, and all zoos possessing young will manage and transfer them only after consulting with the EEP head.

3.2 Streamline legal requirements for movement of Far Eastern leopards within Russia, and in the future, perhaps China and Korea

Objectives/Goals. The legal requirements covering all aspects of movement of Far Eastern leopards within Russia, and in the future, perhaps China and Korea, should be streamlined at the local, provincial and national level in order to humanely and expeditiously permit the transfer of animals from Primorski Krai to qualified zoos (see also 5.2.6).

Recovery Steps and Timetables. We urge this to be completed within one year.

3.3 Permit removal of injured animals from the wild into qualified zoos for incorporation into captive breeding program

Objectives/Goals. To provide animals for potential reintroduction into the wild that are genetically similar to the wild population, it should be permitted to remove Far Eastern leopards from the wild for placement in qualified zoos if they are injured.

If no leopards are ever to be supplied by EEP zoos for release, zoos have sufficient leopards already. If leopards are to be supplied for release, additional founders from the wild will be needed to insure genetic similarity. To do this, animals should be permitted to be removed from the wild for placement in qualified zoos if they are injured. Consideration should also be given to individuals living in an area of high risk of being killed, or to cubs if a female has two or more in a litter and is living in an area where some of them are not likely to be raised. Any specimen removed from the wild will be entered into the EEP for long term control and best use in conservation programs (see also 5.2.6).

3.4. Provide training, veterinary supplies, crates, and other logistical needs to temporary holding facilities

Objectives/Goals. Training, veterinary supplies, crates and other logistical needs will be provided to temporary holding facilities by zoos receiving animals.

Recovery Steps and Timetables. Receiving zoos expect to be able to have necessary supplies and staff in Primorski within one week (see also 5.2.6).

Responsible organizations. Receiving zoo.

3.5 A Primorski breeding or reintroduction program should be considered only if a suitable and protected site can be identified

Objectives/Goals. This group recommends consideration of a Primorski breeding or release site only if a suitable and protected site can be identified. A captive breeding program in Primorski Krai is not recommended at this time.

Recovery Steps and Timetables. For financial and logistical purposes, the selection of an island location should receive first priority. This group also urges that efforts to protect the wild population receive major emphasis or there will be little need for a breeding or release site.

If an on-site breeding or reintroduction program becomes feasible, training programs for staff should be developed, employing both experienced Russian zoos as well as zoos located outside that country.

Responsible organizations. If a reintroduction or on-site breeding plan is deemed necessary, governing authorities within the Primorski Krai and Russian Federation will be responsible for assisting in the development of such a program, and insuring protection of leopards provided for release.

Budget. (see Appendix 9). Financial needs vary, depending on the feasibility of an on-site breeding program in Primorski Krai. Costs for staff training could be minimal at the keeper, curator and veterinary level if they can be absorbed by the zoos sponsoring the training. Similarly, medical costs are low and vaccines can be secured from EEP participants as one aspect of an EEP *in-situ* conservation program.

4. REINTRODUCTION AND SUPPLEMENTATION OF FAR EASTERN LEOPARD POPULATIONS IN THE RUSSIAN FAR EAST

Introduction

At present there appears to be one population of Far Eastern leopards in the Russian Far East. When a small, isolated population is the sole representation of a species or subspecies, there exist a host of environmental, genetic, and random challenges that can lead to extinction. To increase the probability of persistence, it is preferable to maintain large populations in unfragmented landscapes. When habitat fragmentation has already occurred, and there is no chance of creating corridors, at least several populations should be maintained with numbers of breeding adults maintained at as high a level as possible.

In the past 30 years localized extinctions of 2 isolated Far Eastern leopard populations have already occurred in Primorye (see Part II, Distribution). There has likely been similar localized extinctions in China. To reduce the chances of the last remaining population going extinct in Russia, a second population needs to be re-established. Because of the fragmented landscape, colonization is unlikely to occur naturally due to the barriers to dispersal. Therefore, establishment of a second population will require a reintroduction effort.

At the same time, it may be necessary to supplement the existing population with additional animals if there are indications that inbreeding or genetic impoverishment has occurred. Because the population is small, and isolated, the probability of inbreeding depression is high (Seal et al. 1994). Therefore, a protocol for release of individuals into the population should be developed.

Reintroduction of large cats has proven difficult, and there are few examples of successful, well-organized attempts (see Nowell and Jackson 1995 for a review of reintroduction attempts). However, results of the Florida panther reintroduction program indicate that large cats can be successfully reintroduced to their former range (Belden and McCowan 1995). The IUCN Reintroduction Specialist Group has provided specific guidelines for reintroductions (1995), which were used as a guide for preparation of this action plan for reintroduction.

Statement of Problems/Issues

Reintroduction, is, as defined by the IUCN Re-introduction Specialist Group, "an attempt to establish a species, subspecies, or race in an area which was once part of its historical range, but from which it has become extinct".

Reintroduction programs of large carnivores have rarely been undertaken, and where initiated, have met limited success. Major challenges must be met if such a program is to be successful. Reintroduction of Far Eastern leopards into southern Primorye represents additional challenges because, although it is likely the best remaining habitat, this region represents the northern limits of its range, where conditions were presumably already marginal. In addition to the environmental and ecological challenges, introduction of carnivores, even into former range, usually faces strong local opposition. Therefore, prior to reintroduction some important steps need to be taken, and considerable planning will be necessary for a successful operation.

Specifically, the following problems will be key issues to be addressed for a successful reintroduction:

1) **Cost.** Reintroduction, especially if coupled with raising captive animals for release, is a very expensive project that will require major long-term investment. In the case of the Far

Eastern leopard, the high cost of a successful reintroduction program will be one of the greatest barriers to implementation of a program. Such a program cannot, at present, be supported by the Federal or regional government, and will therefore have to rely on external, non-government support. Additionally, this support must be long-term if the program has any chance of success.

2) Suitable habitat. There may not be suitable habitat for release of the leopard in former habitat due to habitat destruction alteration, or changes in conditions.

3) Adequate Protection. Human-induced mortality is likely to be a principal factor determining the viability of a reintroduced population. To reduce the extent of illegal harvest, there must be an adequate protection scheme in place when the reintroduction program begins.

4) Local opposition to reintroduction program. Support from local citizens will be a key factor to successful reintroduction. Hunters see large carnivores as competition for the same prey base (ungulates and fur-bearers such as badgers and raccoon dogs), and are likely to be opposed to a reintroduction effort. Human persecution is a major cause of mortality of large carnivores, and is likely one of the major causes of death of the existing leopard population. An assessment of local sentiment is an essential prelude to reintroduction efforts, and an active publicity campaign will be essential for long term success of the program.

5) Cause for original localized extinctions is unknown. In Primorski Krai, two populations have gone extinct in the last 30 years, one in southern Sikhote-Alin, and the second in the Pogranichny region, along the border with China. There may be a remnant individuals in both places: reports of leopard tracks in southern Sikhote-Alin are not uncommon (Mezentsev 1996, and Gaponov pers. comm.). Tracks of leopards and lynx can be easily confused, making all reports of tracks suspect, but it is nonetheless possible that individuals survive, or occasionally disperse from southwest Primorye into these other ranges. However, there are no records of a self-sustaining population that is reproducing in these regions.

The causes for demise of these populations are poorly understood. The four most likely causes for locally extinctions are: 1) habitat loss; 2) inadequate prey base; 3) overharvest and poaching; 4) competition with other large carnivores, particularly tigers. These potential causes are not mutually exclusive and can be complementary. An assessment of the relative importance of each of these factors needs to be conducted.

6) Identifying source animals for reintroduction. For any introduction effort, locating a suitable source of animals is a problem. First, source animals should have the same genetic make-up as the original population, to ensure that the subspecies in the wild is not contaminated by other subspecies. Secondly, there must be sufficient numbers of them to make the probability of success high. Identification of a source population of Far Eastern leopards is especially problematic because both the captive and wild populations are presently too small to sustain removals of sufficient numbers of animals for reintroduction, and except for a very small number of animals, the captive population is potentially contaminated by a single male of unknown origin (see section on captive breeding).

7) Livestock Depredation. Owners of livestock are also likely to be opposed for fear of losses to valuable animals. It is well documented that leopards regularly take dogs, and smaller domestic animals in existing range in southwestern Primorye (Pikunov and Korkishko

1992). Compensation programs help to alleviate the financial burden, but resentment is still a byproduct to a depredation event (Belden and McCowan 1995).

8) Suitable release protocol. Success of a reintroduction protocol will be largely dependent on the release protocol. The capacity of large cats to disperse long distances, and the relatively unfragmented landscape proposed as a reintroduction site, can result in a scattering of individuals, and no development of a well-defined population. Important decisions must be made to determine whether wild-caught, or captive-reared individuals should be used. Each type of source has advantages and disadvantages. Number of individuals released, and timing of release will be critical. Decisions must be made whether to use a "soft" release (provide food and a safe site to return to), or a "hard release" (release with no support).

9) Disease Risks. The source animals must be free of any diseases, and it should be insured that the release stock should not be exposed to vectors of disease during the release process. This is especially important for reintroduction of the Far Eastern leopard, because any feline disease could expose the majority of the Amur tiger population to an infectious disease, and threaten that species existence as well.

10) Post-Release Monitoring. It will be important to monitor the release animals, through radio-telemetry, to study the process of movement and adaptation by individuals, investigation of mortality, determination of reproduction, and assessment of needs for habitat protection. It will be especially important to define criteria for success, and criteria for when intervention will be necessary (due to threat to human lives or resources, or threat to the animals themselves).

11) Dispersal. If animals are released into large, unfragmented landscapes, there exists the possibility that animals will disperse in various directions. Wild-caught Texas panthers moved large distances when released into northern Florida (Belden and McCowan 1995). Establishment of a nucleus population will be critical to initiating population growth.

Recovery Steps

Belden and McCown (1995) suggested that a combination of wild-caught and captive-reared Florida panthers provided the best combination for a reintroduction attempt. However, the existing wild population of Far Eastern leopards probably cannot withstand removal of large numbers of individuals if it is to persist. Therefore, a reintroduction program for this subspecies will have to rely primarily on reintroduction of captive-bred individuals. We propose the following program that would hopefully lead to creation of a stable, self-sustaining population.

4.1 Feasibility Assessment.

Objectives/Goals. Assess feasibility of reintroduction of Far Eastern leopards into former range, and determine causes of extinction of leopard in former range. The assessment should identify potential locations for reintroductions (based on experience), best possible source for reintroduction, and best possible scenario for reintroduction. The feasibility assessment should identify the need for a reintroduction program, the theoretical possibilities of such a program, the necessary conditions for a successful reintroduction program compared

to the reality of the present situation, and what needs to be done to bring the reality of the present situation to the needed condition for a successful reintroduction.

Recovery Steps and Timetables. Develop an assessment paper that analyzes reasons for localized extinctions of leopards in former range in Primorski Krai, defines ideal leopard habitat in the region (based on existing information and data collected in Component 1), and delineates how reintroduced populations can be managed to minimize risks of extinction.

Timetable: assessment paper developed by May, 1997

Responsible Organization/Individuals: Pikunov, D. G., Pacific Institute of Geography (TIG), and V. V. Aramelev, Institute for Sustainable Use of Nature (ISNU), V. G. Korkishko, Kedrovya Pad Zapovednik, D. Mezentsev.

Accomplishments: none to date.

Budget: 2 months salary for 4 individuals @$400 $3200

If the feasibility study indicates that a successful reintroduction is unlikely, or a low probability of success does not warrant development of such a program, this component of the conservation plan is eliminated. If further investigations are warranted, Recovery Step 2 is initiated, and a captive breeding/rearing center is developed (under Section 3)

4.2 Selection of Reintroduction Site

Objectives/Goals. Perform an assessment of potential habitat, including fieldwork, to determine the best possible location for reintroduction based on recommendations of the assessment paper (step 1), and experience. An assessment of release sites should provide information on habitat quality, size of release site, prey base, security from exploitation, and potential for conflicts with humans

Recovery Steps and Timetable. Collation of available data, and initiation of fieldwork should be conducted to gather information to make a decision for potential release sites.

Timetable: May 1997-December 1997.

Responsible Organization/Individuals: Pikunov, D. G., Pacific Institute of Geography (TIG), V. G. Korkishko (consultants), and V. V. Aramelev, Institute for Sustainable Use of Nature (ISNU).

Accomplishments: none to date

Budget:

Salary: 2 people, 6 months @$400	$ 7,200
Vehicle for field work	$ 3,000
Field expenses	$ 4,800
Mapping (computer based)	$ 2,000
Miscellaneous	$ 500
Total	$17,100

4.3 Public Awareness Campaign

Objectives/Goals. 1) To assess local sentiment towards a reintroduction campaign, and to design and implement a program to gather public support for the reintroduction, and to keep local citizens informed about the reintroduction effort; and 2) to request a scientific review of the program by the IUCN Reintroduction Specialists Group.

Recovery Steps and Timetable.

a) survey to assess of public sentiment prior to education campaign.

Timetable: prior to education campaign.

b) distribution of information locally, on radio, television, newspaper, and hosting of local pre-release meetings.

Timetable: for 6 months prior to release.

c) assessment of local sentiment after release.

Timetable: 1 year after release.

Responsible Organization/Individuals. Vasily Solkin, Zov Taiga, Olga Green, WWF, Peter Jackson IUCN Cat Specialists Group.

Accomplishments: none to date.

Budget:

Survey of public sentiment	$ 3,000
Development of information packets, television, newspapers, radio	$ 4,000
Conducting public hearings	$ 1,000
Follow-up publicity campaigns	$ 3,000
Assessment 1-year post-release	$ 1,500
Total:	$12,000

4.4 Depredation Compensation Program

Objectives/Goals. To create a compensation program to reduce the impact of depredation on pets and livestock, and to reduce negative reactions of local owners of livestock and game farms.

Recovery Steps and Timetable. Develop and advertise a depredation compensation program (advertise in concert with the public awareness campaign) that compensates standard rates for confirmed cases of depredations (confirmations should be liberally interpreted to avoid negative public opinion).

Responsible Organization/Individuals. Land management organization responsible for region of release site (either Zapovednik or Hunting Management Department).

Accomplishments/Proposed Results: Details of this program are difficult to develop until the specific reintroduction site has been established.

Estimated 1-year Budget: **Total:** $12,500

4.5 Reintroduction of leopards to release site

Objectives/Goals. To develop a self-sustaining, viable population of leopards in an area formerly inhabited by the subspecies.

Recovery Steps and Timetable. Because there is an inadequate number of wild Far Eastern leopards, a reintroduction program must rely on captive bred animals. These animals must be reared far from human settlements, free of human contact, with opportunity to learn how to hunt native game. Ideally, the rearing facility is near the actual release site. If not, a holding pen must be constructed to allow transferred animals an opportunity to adjust to new surroundings.

a. Diseases. All animals must be examined prior to release to assess health status and to insure that they carry no transmittable diseases.

b. Release protocol. The scenario most likely to lead to establishment of a nucleus population will be the simultaneous release of 4-5 females from a temporary holding facility. When these females have settled into their new habitat, and established home ranges (1-3 months), 1-2 adult males are introduced. These animals will be largely derived from a

captive population, but if opportunities exist to capture wild individuals, adult females are more likely to remain in the region, and become part of a nuclear population.

At the release site there should be a set of pens that hold individual animals prior to release for acclimatization to the area. Live natural prey species should be provided, as well as some prepared food. After release, prepared food should continue to be made available.

It may be advantageous to replace adult males after they have bred with females to increase genetic diversity of the nucleus population. Release of animals may be most effectively done in spring, after hunting season, and close to birthing season for ungulates, insuring high availability of easily caught prey.

Timetable. not established.

Responsible Organization/Individuals. Primorski Krai State Committee for Environmental Protection (GKOC).

Accomplishments: none to date.

Budget: (see component under captive breeding for costs of rearing facility): $25,000.

4.6 Monitoring released animals

Objectives/Goals. It will be important to monitor the released animals, through radio-telemetry, to study the process of movement and adaptation by individuals, to investigate mortality, determine reproduction, and assess needs for habitat protection. It will be especially important to define criteria for success, and criteria for when intervention will be necessary (due to threat to human lives or resources, or threat to the animals themselves).

Recovery Steps and Timetable. Individuals should be radio-collared simultaneously with the veterinarian's final assessment. Individuals should be located daily for the first 3 months after release. Because some animals will likely travel long distances from the release site, availability of an airplane will be necessary for tracking. Suspected kill sites should be inspected to confirm that leopards are successfully hunting independently. A lack of evidence of successful hunting should be cause for concern, and possible intervention for individuals. Evidence of breeding and young are especially important. Young animals should be captured and radio-collared.

Timetable. From time of release, daily locations should be made for first 3 months. After that, locations should be made 3 times per week. Intensive monitoring should occur for a minimum of 2 years, after which time, if reproduction and growth of population is occurring, less frequent monitoring is possible. Accurate estimates of population size should be made every year.

Responsible Organization/Individuals. Primorski Krai State Committee for Environmental Protection (GKOC), Hornocker Wildlife Institute (HWI), Pacific Institute of Geography (TIG), Institute for Sustainable Nature Use (ISNU).

Accomplishments: none to date.

Budget: Year 1.

Field staff salaries	$ 50,000
2 vehicles	$ 30,000
Telemetry equipment	$ 25,000
Capture equipment	$ 15,000
Fuel, parts, maintenance	$ 15,000
aerial flight: 2 hr weekly @$700/hr for	$ 72,800
computer and printer	$ 7,000
field gear	$ 10,000
Total Year 1	$224,800

Year 2	
Field staff salaries	$ 50,000
Fuel, parts, maintenance	$ 15,000
aerial flight: 2 hr weekly @$700/hr for	$ 72,800
field gear	$ 10,000
Total Year 2	$147,800

4.7 Protection of Reintroduced Population

Objectives/Goals: To insure the protection of the newly established population, there must be an active anti-poaching and patrol group in the reintroduction site.

Recovery Steps/Timetable: create a patrol team that should be outfitted and fully prepared to patrol with the first releases.

Responsible Organizations: land management organization responsible at reintroduction site.

Budget:

vehicle	$14,000
salary: $400/mo for 6 people	$28,800
radio sets 3 sets	$ 2,400
uniforms	$ 900
fuel, oil	$ 2,000
First year total	$48,100

4.8 Supplementation Program to Existing Population

Objectives/Goals: to develop the protocol for release of animals into the existing population in southwest Primorye if it is decided that supplementation is necessary for genetic management of the population.

Recovery Steps and Timetable:

a) This program would only be initiated if it is decided that the existing population is inbred, or needs genetic enrichment to insure survival of the population.

b) Animals potentially available for release into the existing population must be identified. These animals are potentially available from the population in China or Korea, or if a breeding center is developed that will provide suitable candidates for release into the wild.

c) Identify a release protocol, and a release site that would provide security for the individual, and a high probability of that individual to reproduce.

Responsible Organization/Individuals: Unidentified.

Budget: unknown at present.

5. LEGISLATION AND PROTECTION OF THE FAR EASTERN LEOPARD

Introduction

The existing legislation for the protection of rare and endangered species in Russia includes many areas needing better definition. This is particularly true concerning the issues of trade in plants and animals products, parts, and derivatives. Additionally, the existing federal legislation concerning wildlife management, and laws and acts pertaining to endangered species are quite weak, due largely to the fact that a government agency properly staffed with wildlife inspectors is virtually nonexistent. Thus, many people who violate environmental and wildlife laws are not brought to justice by virtue of inadequate training and the scarcity of wildlife inspectors. It is common to find an attitude of indifference toward violation of wildlife laws, due to the relative insignificance of these laws within courts and law-enforcement bodies.

The Far Eastern leopard population is at critically low levels and suffers from a poor system of protection, especially considering its status as an endangered species. The main problems threatening this subspecies are: 1) intense poaching by both Russian and Chinese people that is a result of the high demand for leopard parts in traditional Eastern medicines; and, 2) a conflict arising between the deer farming industry and leopards due to depredation by leopards on captive deer. To resolve these two issues the following plan must be implemented.

Statement of Problems/Issues

To prevent poaching a variety of issues need to be addressed. Currently in Primorski Krai the following government agencies are responsible for protection of the Far Eastern leopard:

a. The Primorski Krai State Committee for Environmental Protection (under the Russian Federation (federal) State Committee for Environmental Protection) is responsible for endangered species in Primorski Krai. It has several operative anti-poaching teams (referred to collectively as "Amba"), including 2 groups relevant for leopard protection (based in the cities of Vladivostok and Ussurisk) that include 12 people (with administrative positions).

b. The forest inspectors of Kedrovya Pad Reserve, totaling 7 people (including the head ranger), who are responsible for patrolling the Reserve and its boundaries.

c. Conservation officers and rangers of the Hunting Management Department (responsible for regulating hunting and trapping), partially under the Administration of Primorski Krai government, employs approximately 10 people acting as managers and rangers of the wildlife refuges Barsovy Zakaznik and the recently created Borisovskoe (Shufan) Plateau Zakaznik.

d. Conservation officers and rangers of hunting districts within the present range of leopards amount to 8-10 additional people.

It should be noted that the Amba anti-poaching groups were created and rely on "soft" funding from the World Wide Fund for Nature (WWF). Wildlife inspectors who function under the auspices of Amba under the State Committee for Environmental Protection are unique within Russia in that they are probably the most well-equipped of such groups. The Amba teams, together with forest inspectors and guards from the Zapovednik and Zakazniks, should be considered the primary structures responsible for protection of endangered species. Within its range, focus should be on protection of the Far Eastern leopard. Measures that

need to be implemented to combat poaching are further subdivided into: 1) improvement of the legislative base; and, 2) improvement of anti-poaching efforts in traditional hunting areas.

Recovery Steps

5.1 The Legislative Base

5.1.1 International regulation.

Because the remaining Far Eastern leopards reside in a band of habitat stretching across 3 countries, it will be critical to coordinate conservation efforts with cross-boundary management plans. Therefore, it will be necessary to submit this conservation plan to the governments of Russia, China and North Korea for the development of and agreement on joint efforts to protect the Far Eastern leopard and its habitat. These joint efforts should include: appropriate coordination of government agencies for control of poaching and smuggling activities; a jointly planned system of protected areas; and, a joint scientific research effort. The purpose of such agreements are to increase effective protection of the leopard by halting poaching on adjacent territories of neighboring countries and to address management issues by treating the remaining leopards as part of a single population.

5.1.2 National legislation.

5.1.2.1 To rectify the present situation - the absence of national legislation to control trade of endangered species and the consequent enforcement responsibilities - it is suggested that the State Committee for Environmental Protection of the Russian Federation accelerate the development of appropriate legislation and submit it to the State Duma for ratification

5.1.2.2 To eliminate the instability associated with "soft" funding of anti-poaching groups working for the Primorski Krai State Committee of Environmental Protection, it is suggested that the Federal office (Russian Federation State Committee for Environmental Protection) should expand its staffing in Primorski Krai to include members of these anti-poaching groups as permanent federal employees.

5.1.2.3 A significant part of the Far Eastern leopard's range lies within a "nonproduction" zone on the international border between Russia and China. Wildlife inspectors are not allowed access to this zone, and consequently Russian and Chinese poachers are free from scrutiny once inside this zone. To address this issue we submit a request to the Russian Federation State Committee for Environmental Protection to petition the Federal Committee on International Borders to permit the employees of assigned state environment bodies unobstructed access to the territory of Primorski Krai located within the "nonproduction" zone.

5.1.3 Regional legislation

5.1.3.1 Currently endangered species occur in wildlife refuges (zakazniks) managed by the Hunting Department, but, because these species are not hunted, they do not fall under the jurisdiction of the refuge management. Leopards (and other endangered species) within these zakazniks would be more effectively protected if enforcement responsibility lay within the jurisdiction of State Committee for Environmental Protection. Therefore, it is recommended that documents be prepared and presented to the appropriate governmental departments to transfer responsibility for protection of the wildlife refuges Barsovy Zakaznik and Borisovskoe Plateau Zakaznik to either the Primorye Krai State Committee for Environmental Protection, or they be placed under the jurisdiction of Kedrovya Pad Zapovednik (Reserve), in case of its expansion.

5.1.3.2 To confront the growing demand for plant and animals products used in traditional Eastern medicines and the associated extensive economic connections between Primorski Krai and other southeast Asian countries, it is recommended that the regional (Krai)

government should enact legislation regulating the trade of plant and animal products, parts, and derivatives. Once accepted, similar legislation should be submitted for acceptance at the federal level.

5.1.3.3 Steel jaw traps are a danger to leopards and other rare animals (in particular the Far Eastern wild cat). To address this issue, it is recommended that the Krai enact legislation forbidding the use of traps within the present limits of leopard range.

5.1.3.4 To address the issue of the current system of leased hunting areas, it is necessary to legally define the relation of the leasor to large predatory mammals. This definition is necessary in spite of the fact that the lease contract designates responsibility to the leasor for ensuring protection of the hunting area, including protection of rare and endangered species. Control of this issue is currently poor and it requires development, coordination, and acceptance at the Krai level.

5.1.3.5 It is recommended to expand the jurisdiction of Kedrovya Pad Zapovednik (Reserve) to include within its responsible territory the wildlife refuges Barsovy and Borisovskoe (Shufan) Plateau Zakazniks (see also 2.3 Protected Natural Territories).

5.2 Improvements of anti-poaching efforts

5.2.1 For improved protection of Kedrovya Pad Zapovednik and Barsovy and Borisovskoe (Shufan) Plateau Zakazniks, it is necessary to increase material assistance to strengthen the Ussuriski brigade of the Primorski Krai State Committee for Environmental Protection "Amba" team and shift the area of focus to southwest Primorye. It is also necessary to increase material support to the wildlife refuges Barsovy and Borisovskoe (Shufan) Plateau Zakazniks (see also sections 2.4 and 2.5).

5.2.2 To increase the qualifications of wildlife inspectors, it is necessary to prepare and issue a manual detailing game and endangered species legislation and potential violations.

5.2.3 To improve the effectiveness of wildlife inspectors, it is necessary to provide training seminars that explain the laws concerning game and endangered species.

5.2.4 To improve the effectiveness of customs inspectors, wildlife inspectors should cooperatively develop and implement training programs with customs officials, and should increase cooperative work with customs inspectors.

5.2.5 To improve control of smuggling by customs inspectors, a manual detailing customs laws which pertain to plant and animal trade should be prepared and issued to customs officers.

5.2.6 To be prepared for the potential situation in which an injured leopard is captured, and those injuries are severe enough to prevent release back in to the wild, a temporary holding facility should be constructed. It is suggested to construct a suitable pen in Kedrovya Pad Zapovednik and inform all state organizations which have wildlife management responsibilities of its location (see also 3.4).

5.2.7 Due to the extremely heavy case-load in the court system, funding for retention of a lawyer should be developed. The person in this position will specialize in processing environmental legislation and prosecuting poaching cases. Such a person would provide regular advice and training for wildlife inspectors of the Primorski Krai State Committee for Environmental Protection and zapovednik and zakaznik staff.

5.2.8 To increase the proficiency and effectiveness of the wildlife inspectors of the Primorski Krai State Committee for Environmental Protection, it is recommended to draft and enact legislation granting state level status to wildlife inspectors in Primorski Krai.

5.3 Depredation program to assist deer parks in sustaining current leopard populations (see also 1.10)

Deer farming as currently practiced has important, positive contributions to the conservation of Far Eastern leopards by providing easily accessible prey, especially for females raising young. To avoid heavy financial burden on deer farms supporting leopards, it is necessary to develop a depredation program to compensate deer farms for losses due to leopard predation. One of three possible schemes can be chosen;

a. creating an insurance program for deer herds;

b. creating a compensation system dependent upon verification of each depredation;

c. creating a system of annual premiums paid to any deer farm that can demonstrate use of the farm by one or more leopards within the delineated period.

5.4 Forest fires

Wild fires are common in late winter and spring within leopard range, burning up to 40% of Khasanski Raion annually (see also Part II. Threats to the Survival of the Far Eastern Leopard in the Wild). As a result of these fires, the forage base for ungulates is destroyed, (thereby significantly reducing the density of ungulates upon which leopards depend), and forest habitat is destroyed. The previous system for fighting fires is now practically nonexistent due to insufficient funds. This has affected everything from management practices and payment for fuel, to purchase of uniforms for fire fighters. Thus it is necessary to develop and introduce an effective system of fire prevention and suppression, coordinating the work of protected natural territories and the Forest Services of southwestern Primorski Krai.

5.5 Mediate and reduce conflicts between large carnivores and man

An increase in the number of tragic conflicts between man and predators has been noted in Primorski Krai. Decreases in ungulate numbers, destructive anthropogenic processes, and loss of large carnivore habitat are collectively likely to lead to even more conflicts between man and predators. It is necessary to establish a special service that will immediately respond to situations. to assess the damage done by a carnivore, and remove, relocate, or kill dangerous animals if necessary.

Responsible Organizations: see appendix 9.

Budget: see appendix 9.

6. PUBLIC AWARENESS AND ENVIRONMENTAL EDUCATION

Introduction

Our goal is to attract the attention of the international community to the problem of Far East leopard conservation in the wild, and to foster a tolerant attitude towards the animal among the local populace within leopard habitat. We propose that a special short-term educational program for one year is critical.

Recovery Steps

Such a program should consist of the following steps.

6.1 Creation of an eco-center "Leopard" at Primorskaya rail station.
Responsible Organization/Individuals: WWF, T. Zaeva
Budget: $50,000

6.2 Production, distribution, and publicity of documentary movie "The last leopard".
Responsible Organization/Individuals: Zov Taiga, V. Solkin
Budget: $28,500

6.3 Analysis of the efficiency of different educational approaches within leopard habitat; identification and coordination of educational activists.
Responsible Organization/Individuals: WWF, O. Green
Budget: $4000

6.4 Production and distribution of educational material, based on the analysis in 6.3.
Responsible Organization/Individuals: Zov Taiga, V. Solkin
Budget: $4,000

6.5 Competition for and publication of the best manuscript for a children's book on leopards.
Responsible Organization/Individuals: Zov Taiga, V. A. Solkin
Budget: $20,000

6.6 Collection of pictures of leopards and their environment.
Responsible Organization/Individuals: Yu. Shibnev
Budget: $3,600

6.7 Creation of "Kedrovya Pad" museum.
Responsible Organization/Individuals: WWF, Kedrovya Pad Zapovednik
Budget: $37,500

6.8 Press-conference with full range of specially empowered resource and environmental protection bodies on the leopard strategy and program implementation.
Responsible Organization/Individuals: A. Lebedev, E. Smirnova
Budget: $4,000

6.9 Creation of leopard section in TV program "Zapovedano" with delivery of some TV slots to all Russian TV.
Responsible Organization/Individuals: A. Lebedev
Budget: $4,000

6.10 Press trip to leopard habitat for local, Russian and foreign media.
Responsible Organization/Individuals: A. Lebedev
Budget: $4,000

6.11 Support of leopard issues in leading Primorski papers.
Responsible Organization/Individuals: A. Lebedev, V. Troinin
Budget: $1,000

6.12 Radio news clips from regions of leopard habitat in Primorye and China.
Responsible Organization/Individuals: E. Smirnova
Budget: undetermined

6.13 Workshop for 4 leopard district journalists in leopard habitat.
Responsible Organization/Individuals: EPT, A. Lebedev
Budget: $3,000

6.14 Systematic educational campaign on leopard issues in Primorski Krai.
Responsible Organization/Individuals: V. Troinin
Budget: $3,000

6.15 Clearinghouse of publications on the Far Eastern leopard.
Responsible Organization/Individuals: J. Augustine
Budget: see Section 1.11

6.16 Environmental education for school groups
Responsible Organization/Individuals: Arseniev Museum, Zov Taiga
Budget: $4,000

7. GENETIC RESEARCH

Introduction

In conservation programs for endangered species, molecular genetics provides an underpinning for decisions that are essential for the recovery process. For example, these methods can provide a clear understanding of the taxonomy of the population that is of concern, the amount of genetic variability within the population, a measure of the change in genetic variability in the population over time, and relationships between individuals within the population.

Statement of Problem

The background informational available on genetics of the Far Eastern leopard is based on animals maintained in zoo collections (Miththapala et al. 1996). The genetic variability in this zoo population is low compared to other populations of leopards from mainland Asia and Africa. This study did not show a consistently distinct difference between the leopard subspecies *P. p. japonensis* and *P. p. orientalis* using different methods of analysis (see Part II. Genetic Status of the Far Eastern Leopard).

There are now 8 samples available from 4 wild caught Far Eastern leopards, the analysis of which will be necessary to provide a basis with which to confirm or modify the results obtained based on the zoo leopard populations.

Additional material from wild leopards will provide a means to track the genetic diversity of the population during the course of the recovery process. Material from both North Korea and China will allow an assessment of inter-population genetic distance. Material from the zoo populations will allow a comparison of the new founders in that population (especially those from North Korea) with the known wild Far Eastern leopard samples.

Recovery Steps

Objectives/Goals

To measure genetic diversity within zoo and wild populations of Far Eastern leopards, to measure the genetic distance between population units (in the wild and in zoos) of the Far Eastern leopard, and to measure paternity within the primary study population.

7.1 Analysis of the existing samples from wild Far Eastern leopards in Russia

It is expected that material for genetic analysis will be collected from:

a. the wild Far Eastern leopard population in Russia, and later from China and North Korea, including samples from animals caught during radio-tracking studies and other individuals that come into the hands of the authorities from time to time;

b. fecal samples that are expected to be collected from the leopard populations in Russia, North Korea, and China;

c. all studbook listed zoo Far Eastern leopards.

Timetable: 1997-1998

Responsible Institutions:

In Russia:

Dr. Alexei Kryukov, Laboratory of Evolutionary Zoology and Genetics, Institute of Biology and Soil Science, Far East Branch of the Russian Academy of Sciences, Vladivostok 690022, Russia

In USA:
Dr. Steven J. O'Brien, Director, National Institutes of Health Laboratory of Genomic Diversity, National Cancer Institute, Frederick Cancer Research and Development Center, Frederick MD 21701-1202 USA.

7.2 Form the Far Eastern Leopard Genetics Working Group to formulate and guide the genetics component of the Far Eastern Leopard Recovery Plan.

Timetable: within three months

Responsible Institutions/Individuals: In Russia: Dr. Alexei Kryukov. In USA: Dr. Steven J. O'Brien

7.3 The Working Group will provide the protocols to guide zoos in the collection of materials for analysis and for further collection of material from wild leopards, including indirect sampling through the collection of fecal material.

Timetable: within six months

Responsible Institutions/Individuals: In Russia: Dr. Alexei Kryukov. In USA: Dr. Steven J. O'Brien

7.4 The Working Group will plan and implement a project to collect these materials and to provide these to the institutions responsible for their analysis.

Timetable: within one year

Responsible Institutions/Individuals: In Russia: Dr. Alexei Kryukov. In USA: Dr. Steven J. O'Brien

7.5 The Working Group will plan and implement a program to analyze the leopard materials, including selection of the appropriate methodologies for analyses for results that will be provided to the Far Eastern Leopard Recovery Plan working group.

Timetable: ongoing through the project

Responsible Institutions/Individuals: In Russia: Dr. Alexei Kryukov. In USA: Dr. Steven J. O'Brien

Accomplishments/Expected Results: No accomplishments to date; this component expects to provide input to the Far Eastern Leopard Recovery Plan concerning:

i) level of relatedness and inbreeding in wild and zoo populations,

ii) degree of uniqueness of the Far Eastern leopard population or populations, for the purpose of providing the basis of recommendations for breeding plans and providing the genetic basis of assessing future risks, opportunities, options in managing the wild Far Eastern leopard population or populations.

Budget

7.1	8 samples @ US $5,000/ sample for year 1	$40,000
7.2	Costs from institutions	no cost to the Recovery Plan
7.3	Costs from institutions	no cost to the Recovery Plan
7.4	Costs per institution per year	
	IBS, yearly	$ 27,000
	USA, NIH	$ 27,000
	USA, Indirect costs	$ 15,000
	estimated yearly Total	$ 69,000
	Total cost of Program	$247,000

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Appendix 1. Resolution: *all participants*
Appendix 3. Working Group: *all participants*
Appendix 4. Protocol for Capture and Handling Far Eastern Leopards in the Wild: *Research and Captive Breeding Groups*
Appendix 5. Protocol for Processing Injured Far Eastern Leopards: *Research and Captive Breeding Groups*
Appendix 6. Protocols for Captive Breeding Programs: *A. Shoemaker*
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Appendices

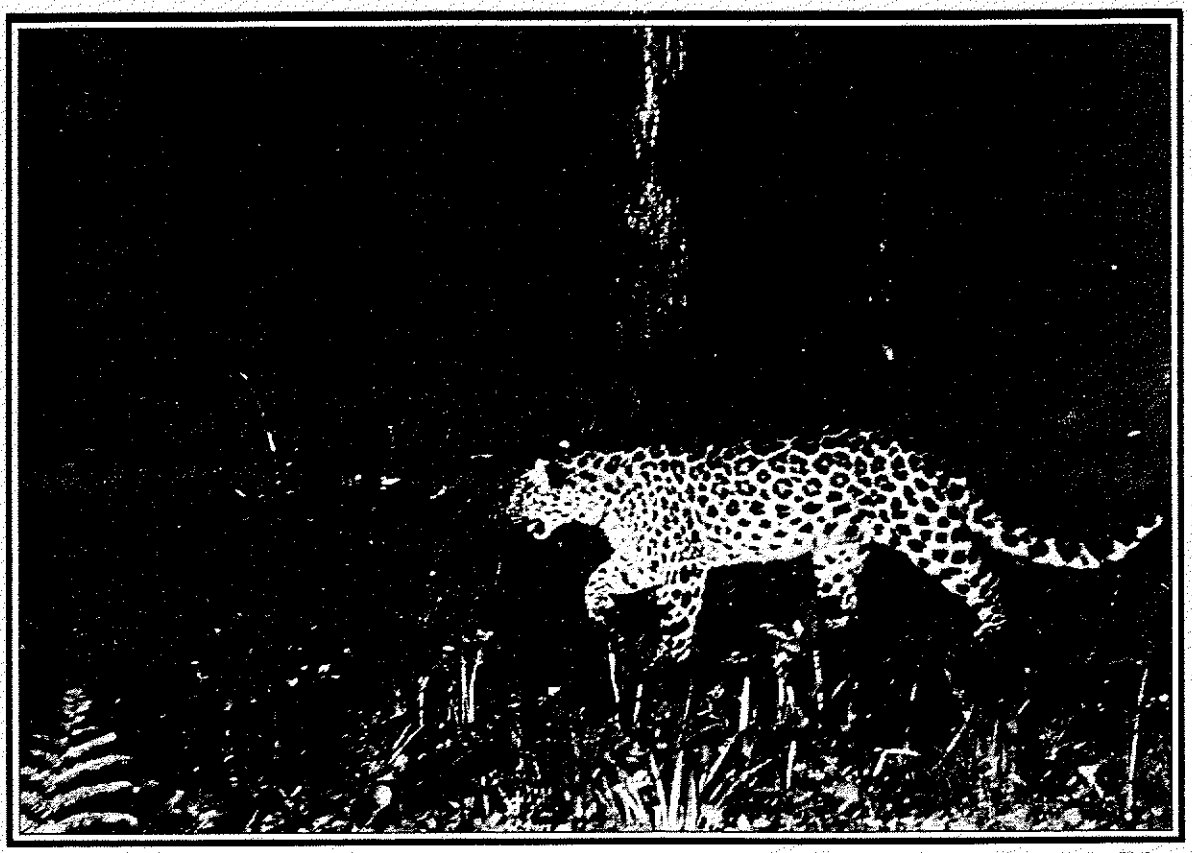

Photo by Shibnev

Appendix 1.

RESOLUTION
OF THE INTERNATIONAL WORKSHOP FOR DEVELOPMENT OF A RECOVERY PLAN FOR THE FAR EASTERN LEOPARD

October 28 - November 3, 1996
Vladivostok, Primorski Krai, Russia

Participants of the international workshop believe that:

The Far Eastern leopard is in immediate danger of extinction. With an estimated 30 individuals in the Russian Far East, 15 in northeast China (Jilan Province), and an unknown number remaining in North Korea, this subspecies must be considered one of the world's most endangered large cats. Despite the immediacy of the threat, conservation efforts in the region have been minimal to date. This workshop represents the first practical step towards development of a conservation strategy for the Far Eastern leopard, acts as an advertisement of its plight, and provides a mechanism for adopting the recovery plan as national programs supported by the respective federal governments.

Therefore, workshop participants resolve that:

1. The proposed "Recovery Plan for Conservation of the Far Eastern Leopard" is approved as the basis for further recovery activities.
2. In order to fulfill the proposals of this Resolution a Far Eastern Leopard Working Group will be created that is composed of: Dmitry G. Pikunov, Victor G. Korkishko, Pavel V. Fomenko, Igor B. Vyshin, Vladimir P. Karakin, Vasily A. Solkin, Vladimir K. Shetinin, Dale G. Miquelle, Jeff Augustine, Tatyana D. Arzhanova, Victor G. Yudin, Gennady Kolonin, and Galina N. Chelomina.
3. The working group will request the Administration of Primorski Krai for an administration representative to participate in the workgroup sessions.
4. The working group will take responsibility for finalizing the program and developing a Russian National Strategy for Recovery of the Far Eastern leopard by January 1st, 1997, and will provide the federal and regional governmental authorities with the program documents necessary for the strategy to be reviewed and approved.
5. The working group will apply to the Governments of Russia, China, and North Korea to sign a multi-government agreement for the recovery of the Far Eastern Leopard.
6. The working group will publish the international program "Conservation of the Far Eastern Leopard" and the Resolution.

The workshop participants recommend that:

1. Federal Executive Environmental Agencies should review the Russian strategy for the recovery of the Far Eastern leopard which will be submitted by the working group.
2. Federal Executive Environmental Agencies should not give out permits for removal of leopards from the wild (for transfer to zoos) before a census provides an estimate of numbers of Far Eastern leopards within Russia. To initiate the captive breeding

program prior to a census, zoos should use only those wild individuals whose life is under immediate threat.

3. The Duma and Administration of Primorski Krai should approve the proposals within the Program "Recovery Plan for Conservation of the Far Eastern Leopard".
4. Federal, regional and local environmental agencies should improve the anti-poaching activities within the range of the Far Eastern leopard as a critical measure for protection of the remaining population in Russia.
5. Projects on economic development of the southwestern Primorye, like the "Tumen River Project" will be requested to allocate money for the leopard recovery program.
6. The EPT Project, WWF, Hornocker Wildlife Institute and other possible donors seek support to implement the initial steps of the program "Recovery Plan for Conservation of the Far Eastern Leopard".
7. EEP and the American Zoo Association should immediately begin implementation of the Captive Breeding Program designed for the Far Eastern leopard.

Finally, the workshop participants thank:

WWF and the Environmental Policy and Technology (EPT) Project for their support of the workshop, which was organized with the financial assistance of the US Agency for International Development (USAID).

Appendix 2

LIST OF PARTICIPANTS

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Appendix 3.

WORKING GROUP FOR RECOVERY OF THE FAR EASTERN LEOPARD

As delineated in the Resolution of the International Workshop for development of a Recovery Plan for the Far Eastern Leopard (Appendix 1), a working group will be created that consists of:

Dmitry G. Pikunov	Victor G. Korkishko	Pavel V. Fomenko
Igor B. Vyshin	Vladimir P. Karakin	Vassily A. Solkin
Vladimir K. Shetinin	Dale G. Miquelle	Jeff Augustine
Tatiana D. Arzhanova	Victor G. Yudin	Gennady N. Kolonin
Galina N. Chelomina.		

As delineated within the Resolution, this working group is charged with the following tasks:

1. The working group will request the Administration of Primorski Krai for an administration representative to participate in the workgroup sessions.

2. The working group will take responsibility for finalizing the program and developing a Russian National Strategy for Recovery of the Far Eastern Leopard by January 1st, 1997, and will provide the federal and regional governmental authorities with the Program documents necessary for the strategy to be reviewed and approved.

3. The working group will apply to the Governments of Russia, China, and North Korea to sign a multi-government agreement for the recovery of the Far Eastern leopard.

4. The working group will publish the international program "Recovery Plan for Conservation of the Far Eastern Leopard" and the Resolution.

Secondarily, the working group should provide a mechanism to insure that the following recommendations of the Resolution are implemented:

1. Federal Executive Environmental Agencies should review the Russian strategy for the recovery of the Far Eastern leopard which will be submitted by the working group.

2. The Duma and Administration of Primorski Krai should approve the proposals within the Program "Conservation of the Far Eastern Leopard".

3. Federal, regional and local environmental agencies should improve the anti-poaching activities within the range of the Far Eastern leopard as a critical measure for protection of the remaining population in Russia.

4. Projects on economic development of southwestern Primorye, like the "Tumen River Project" will be requested to allocate money for the leopard recovery program.

5. The EPT Project, WWF, Hornocker Wildlife Institute and other possible donors seek support to implement the initial steps of the program "Conservation of the Far Eastern leopard".

6. EEP should continue implementation of the EEP Captive Breeding Program for the subspecies, and the American Zoo Association should immediately begin implementation of the Captive Breeding Program designed for the Far Eastern leopard.

Appendix 4.

PROTOCOL FOR CAPTURE AND HANDLING FAR EASTERN LEOPARDS IN THE WILD

The Far Eastern leopard is one of the most highly endangered subspecies of cats in the world. As such, every effort must be made to develop plans for the conservation of the animal in its native habitat. Such planning and actions require that the best possible information about the animal be obtained in a timely and scientifically credible manner. In many cases, this may require the capture and handling of individuals. Because capture and handling of any wild animal is a serious responsibility, scientific and ethical standards must be followed. In the case of the Far Eastern leopard, these considerations are critical. The following guidelines are meant to be general considerations in handling Far Eastern leopards.

Capture Protocol

The following recommendations are made in the light of the need for restraint of wild leopards, such as scientific research as defined by the "Recovery Plan for Conservation of the Far Eastern Leopard".

1. Capture methods for leopards shall be consistent with those methods utilized safely and effectively by similar capture and release programs elsewhere. This will include proven capture methods used on leopards and similar-sized cats elsewhere, such as the use of trailing hounds, boxtraps, or Aldrich foot-hold snares;

2. All captures will be performed and attended by personnel experienced in immobilization of large carnivores;

3. A temporary holding facility which is protected but removed from the influence of humans should be available in the case of the need to treat an injury. EEP should support the construction of the temporary holding facility in order to provide an injured animal(s) with appropriate conditions until it can be transferred to an EEP zoo in Russia or released back into the wild.

4. Because the genetic status of the Far Eastern leopard in the wild and in captivity is uncertain and of immediate concern, blood and tissue samples for genetic analyses should be collected whenever handling animals.

Appendix 5.

PROTOCOL FOR PROCESSING INJURED FAR EASTERN LEOPARDS

It is important to develop standard procedures for decision-making in the case of injured Far Eastern leopards. Injuries result from a variety of circumstances, including poaching, trapping, or research activities. In some instances, injured animals may be able to survive in the wild; if so, this is the preferred situation and the animal should be released back into the wild. In other cases, it may be determined that the animal, due to its injuries, may not be able to survive on its own in the wild; if so, it is preferable that the animal be transferred to an appropriate facility. In such a situation, the highest priority should be to introduce such an animal into the Captive Breeding Program for Far Eastern leopards (see Section 4).

The first step in such a process should be an assessment of the injuries to the leopard. This should be carried out in as thorough a manner possible, and it may require the immobilization of the injured leopard. The involvement of a veterinarian is recommended. Assessment of the ability of the animal to survive in the wild should be made by knowledgeable experts, including field biologists.

If the decision is made not to re-release the injured leopard into the wild, all possible effort must be made to expedite transfer to a permanent facility. In such a case, the Moscow and/or Novosibirsk zoos should be contacted quickly for cooperation and transportation to one of these facilities (see Section 3.3, 3.4).

Appendix 6.

PROTOCOLS FOR CAPTIVE BREEDING PROGRAMS

Husbandry

Although leopards have been maintained under a wide variety of conditions, data received from owners worldwide suggests that certain basic husbandry needs must be met in order to reduce problems. Based on successful maintenance and propagation by owners in Europe and North America, the following husbandry protocols are offered for consideration in any captive breeding program that might developed within Primorski Krai.

Diet. Being carnivores, it is tempting to suggest that leopards may be fed any form of "meat" or meat-based diet, and in the past, many zoos fed large felids only muscle meat from freshly butchered livestock. Although this source of feed is still used occasionally, young leopards and other felids raised only on whole or ground muscle meat, poultry necks and by-products, and other nutritionally deficient diets often develop metabolic bone disease that leads to lameness or death. Based on data from the international studbook, it has been shown that female leopards taken into captivity when young may develop pelvic problems because of inadequate nutrition which required cesarean operations during parturition. Males felids of all species become functionally sterile when fed diets consisting only of muscle meat. Also young felids of many species have died within their first year due to nutritionally inadequate diets. Owners should also be wary of carcasses obtained from road kills or donations because of the potential for contamination, and feed animals selected from such sources should be inspected to insure that they are free from disease.

Given the above, commercially prepared diets made from beef or horse are recommended, and are available in many regions. Moreover, these diets already have appropriate vitamins and minerals added, and in amounts that vary according to the age and status of the specimens. Similar diets may also be prepared in-house. Whole animal carcasses (rodents, rabbits or fowl) may be substituted upon occasion to vary the diet. To address problems with obesity, leopards should be fasted at least once a week. Bones, especially those from joints or knuckles, also should be given once or twice a week to maintain good oral hygiene; fast days are good opportunities.

Water. Fresh clean water for drinking should be available at all times. Watering devices may include built-in units that are structurally sound, easily cleaned, and disinfected at least weekly, if not daily. Leopards do not normally swim but pools may be welcome in summer.

Sanitation. Hard surface enclosures and food containers (if used) should be cleaned at least weekly with detergent and disinfectant. Perches and shelves where animals climb and sit should also be included within this regime. Soil substrates should be spot cleaned daily. Foot baths containing quaternary chemicals should be used prior to entering all felid enclosures, or areas containing enclosures, and their use strictly adhered to by all personnel.

Temperature. Leopards are tolerant of wide temperature extremes, at least during daylight hours. Animals housed outside should have access to shade, especially during warmer months of the year. When acclimated, most individuals without young require only minimal unheated shelter at night.

Veterinary Needs

Services of a veterinarian familiar with felids should be available for high profile breeding programs. Periodic (at least twice yearly) fecal examinations should be made to

check for parasite infestation and treated accordingly. When animals are immobilized, blood should be collected and screened for infectious diseases. Serum should also be stored for future reference. Annual vaccinations should include protection against feline panleukopenia (distemper), canine distemper, rhinoctracheitis, calicivirus, and rabies. Because leopards are susceptible to human tuberculosis, only keeper staff testing negative for this disease should be employed.

Staff Training

Given the high priority this species has for regional, national and world conservation efforts, staff selection and training will be extremely important to the success of *ex situ* conservation efforts. While leopards are generally considered easy to keep, their propagation can be difficult if stress from errors by keepers is frequent.

Ideally a nearby zoological park with experience in breeding large felids could provide staff or staff training for personnel hired to maintain Far Eastern leopards. Because the nearest successful breeding site, at least within Russia, appears to be the Novosibirsk Zoo, that zoo should be contacted for cooperative training and staff assistance. Other European zoos with past breeding successes should also be contacted for assistance, including zoos in Moscow, Tallin, Berlin, Prague, Leipzig and Munster, to name but a few. The Jersey Wildlife Preservation Trust should also be approached for staff training. That facility is internationally known for its keeper training programs and it may be able to develop special programs for this project. Funding from EEP holders of Far Eastern leopards should be sought to defray costs.

Social and Reproductive Considerations

Hundreds of leopards and other large felids have been bred in captivity, and the techniques for their captive propagation are well known. Because leopards are solitary in nature, they do best when housed alone or as pairs for breeding. Owners who have attempted larger groups have often found compatibly and successful reproduction to be lacking. Some male leopard are easily paired with other females for breeding. Others are only compatible with certain females, or only when females are in heat. Some older males become incompatible with all other leopards and are of little value in natural breeding programs.

Because pregnant leopards are more likely to raise their young when offered seclusion, a cubing den located some distance from leopards and other carnivores, humans, loud noises, etc. should be included in all facilities. To minimize behavioral problems, all captive born young should be raised by their dams unless no other options exist. In cases where young must be raised by hand, they should be raised in the presence of their littermates and efforts made to insure minimal human contact.

Recently there have been several successes in breeding large felids through techniques of assisted reproduction, including artificial insemination, *in vitro* fertilization and embryo transfer. Although such technology is far from routine, consistent (50%) reproduction can be expected when breeding cheetahs, *Acinoynx jubatus*, using this technology. Successful assisted reproduction with other species, including tigers, leopards, pumas, and clouded leopard, has been attempted many times in North America but only achieved one time for each species. Additional research is needed before such techniques can be considered routine. Because of the status of such technologies, reproduction using such technology should not be considered the primary means of breeding although semen evaluation, collection and storage should be attempted if necessary equipment and staffing can be made available.

Management Needs

Since 1974 Far Eastern leopards have been managed via an international studbook and regardless of the region, most owners have been cooperative in supplying pedigree information. Pedigree information is maintained using SPARKS software developed by ISIS, and additionally, SPARKS is used for managing leopards within the EEP program of Europe and Russia. Because of the close proximity of Russia to other holders in Europe, the continuation and expansion of the EEP program is encouraged. Although some regional management programs emphasize pairings that will produce young with low levels of inbreeding, this management approach may lose genetically important individuals because their background was not deliberately emphasized for inclusion within the breeding population. The SPARKS program, using mean kinship as a means of selecting potentially breeding pairs, ranks individuals according to their age and genetic relationship with all other living individuals, thereby insuring that rare founders are not over-looked. This approach would work well for programs using only Far Eastern leopards in a breeding program using either leopards derived only from Korea, or one that incorporates both animals from Korea with ones that contain founder #2 in their background because highly inbred individuals (usually ones with significant representation of #2 in their pedigree) would be ranked very low and not be recommended for breeding. With this approach, leopards with rare founders (e.g. #14, 15, 35) would be highly ranked for breeding purposes, thereby minimizing #2's influence. The EEP is encouraged to have all holders within the region participate, with support from IUDZG and regional zoo associations.

Few studbook-kept leopards have been housed in North America until recently, in part because spaces were not available and leopards from Korea are not directly available to zoos in that region. Also, until recently most Far Eastern leopards in North America were inbred and/or possessed by private owners and not available for conservation programs in zoos. For these reasons, primary management of this race should continue to focus on the European region.

It is important that animals from Korea be incorporated into the EEP as soon as possible. Efforts to exchange individuals with Bogor (Indonesia) should be explored and if the opportunity arises, information on the exact history of the Far Eastern leopards at the North Korean Pyongyang Zoo should be obtained. The relationship of presumably captive born specimens that have been supplied to zoos in Europe is not known but could impact EEP and Primorski breeding programs profoundly.

Appendix 7.

DISTRIBUTION, NUMBERS AND CONSERVATION OF THE NORTH CHINA LEOPARD (*Panthera pardus*) IN JILIN PROVINCE, CHINA

Xingjia Yang, Forestry Biological Control Center of Jilin, and
Jinsong Jiang, Forestry Department of Jilin

In Jilin the North China (Far Eastern) leopard is mainly distributed in the Changbai Mountains in the eastern portion of the province. There have been few published reports about this species. In order to study the current status of the leopard and other wildlife resources, 3 province-wide wildlife resource surveys were conducted from 1976 to 1977, 1981 to 1982, and 1991 to 1992 by the Forestry Department and Agriculture Division Office of Jilin Province. In accordance with the requirement of the Ministry of Forestry of the People's Republic of China to "conduct the national terrestrial wildlife resources survey", a 3-year province-wide survey organized by the Forestry Department is underway. The following is a report about the leopard's situation according to surveys completed thus far.

1. Features of the natural environment

Jilin Province is located in central northeast China near the east coast of Eurasia. It is bordered to the north by Hilongjiang Province, to the south by Lioning Province, to the west by Inner Mongolia and to the east by Russia and North Korea. The total area is 187,300 km^2 (see Figure 1).

Eastern Jilin is primarily mountainous, with the elevation averaging 800-1,000 m. Baitoushan, the highest peak in the area, has an elevation of 2,691 m. Elevation decreases from east to west, where it is typically less than 200 m. Along this gradient the vegetation changes clearly with changes in topography. The vegetation types range from conifer forests of "Dragon" spruce and fir, mixed forests gradually changing to larch and broad-leafed forests, to forested prairie and grassy prairies. This kind of vegetation provides good habitat for the North China leopard and other wildlife.

2. Methodology

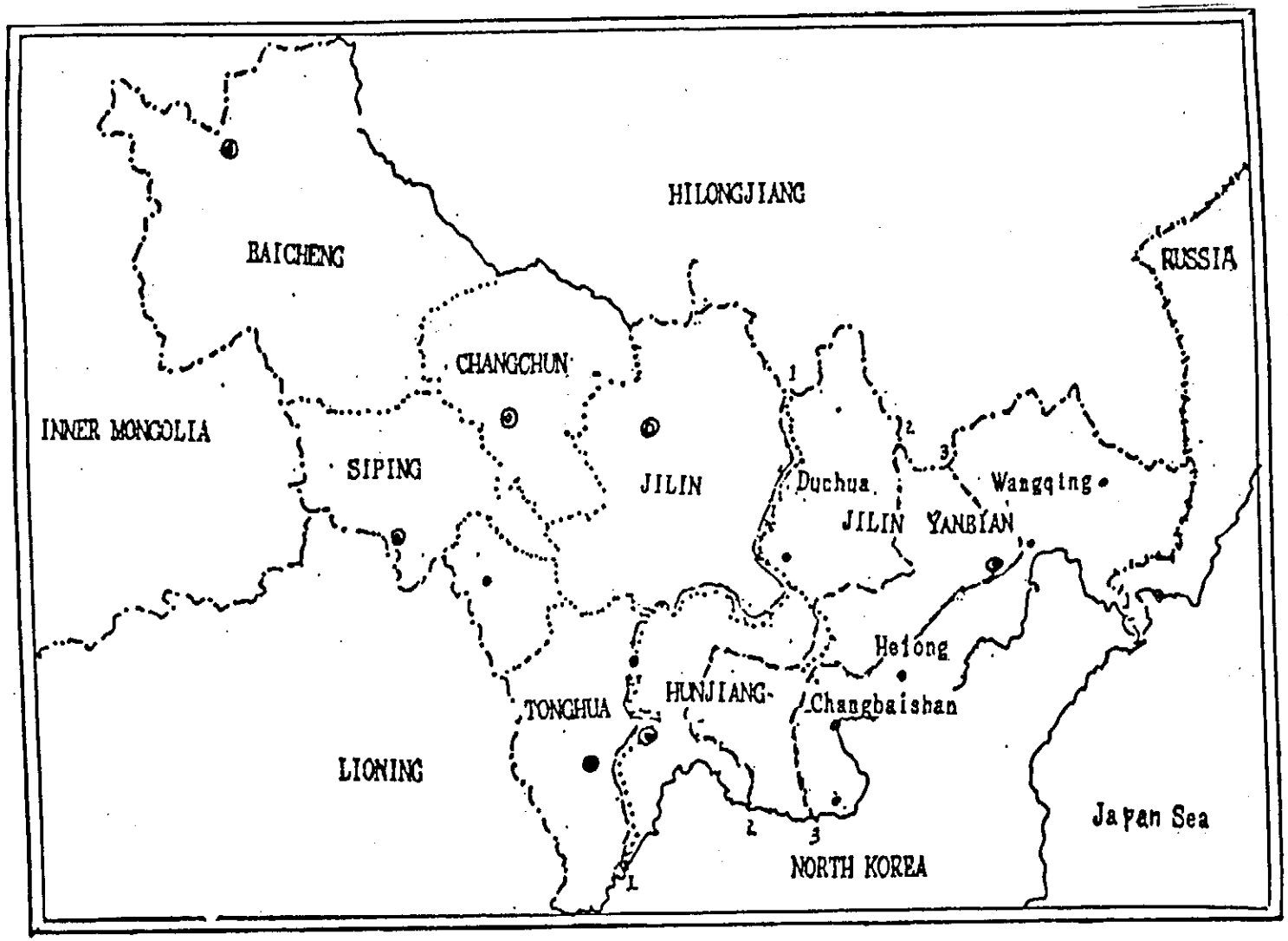
The survey method combines a specific survey of the most important habitats with a general survey. There were also some necessary social investigations made along with the field work.

2.1 The general survey. Standard sample transects with 1% sample fraction were set up within the area of leopard distribution. Each transect is 5 km in length, 100 m in width, and has an area of 0.5 km^2. Tracks or other indications of leopard activity were then recorded along each of the transects.

2.2 The specific survey. In the important regions of leopard distribution, if the sample transects did not meet the requirements, a specific survey was done. This consists mainly of fixed place observation and repeated measurements on a regular basis.

2.3 The social investigation. As a necessary component, during the course of the field survey hunters were interviewed for any information they could provide about the leopard; historical records were also examined.

Figure 1. Geographic position of Jilin Province, China.



National boundary
Provincial boundary
Prefecture boundary
City/County location

Figure 1. Geographic position of Jilin Province

3. Distribution and Numbers

3.1 Distribution. The northeast and southwest slopes of the Changbai Mountains appear to be the most important areas for the leopard population. Leopard range extends from the juncture of Wangqing, Yanbian Counties and Hilongjiang Province in the north; to the Laoling Mountains in the south, represented by the juncture of Hunjiang and Tonghua Counties. The east-west distribution begins with the Russian and North Korean border west to Yanbian and Jilin City. The total area within which the leopard is distributed is 60,100 km², 31.3% of the total area of Jilan Province (Figure 2).

Distribution of leopards has steadily declined in recent decades. In the 1976-1977 survey the leopard was distributed in Yanbian and Hunjiang, further south of the Laoling Mountains to the region of Tonghua, and west to the mountain forests in the east central region.

The 1981-1982 survey showed that the leopard was disappearing from its former range in Tonghua and the eastern mountains of Jilin. And in the 1991-1992 the distribution was even further reduced. For example, during our field investigation in the Changbaishan Natural Reserve, an area of 190,000 ha where leopards were once common. we found almost no leopard tracks. Today, although there are still some leopards distributed in Jilin, most are concentrated in remote mountain areas where human beings rarely travel, especially on the northeast slopes of the Changbai Mountains, and the border regions of Russia and North Korea.

3.2 Numbers. Surveys from the 1970's to the 1990's have demonstrated the downward trend in the population of the North China Leopard. There were approximately 45-50 individuals in Jilin in the 70's, 30-35 in the 80's, and only about 15-20 in the early 90's (Table 1).

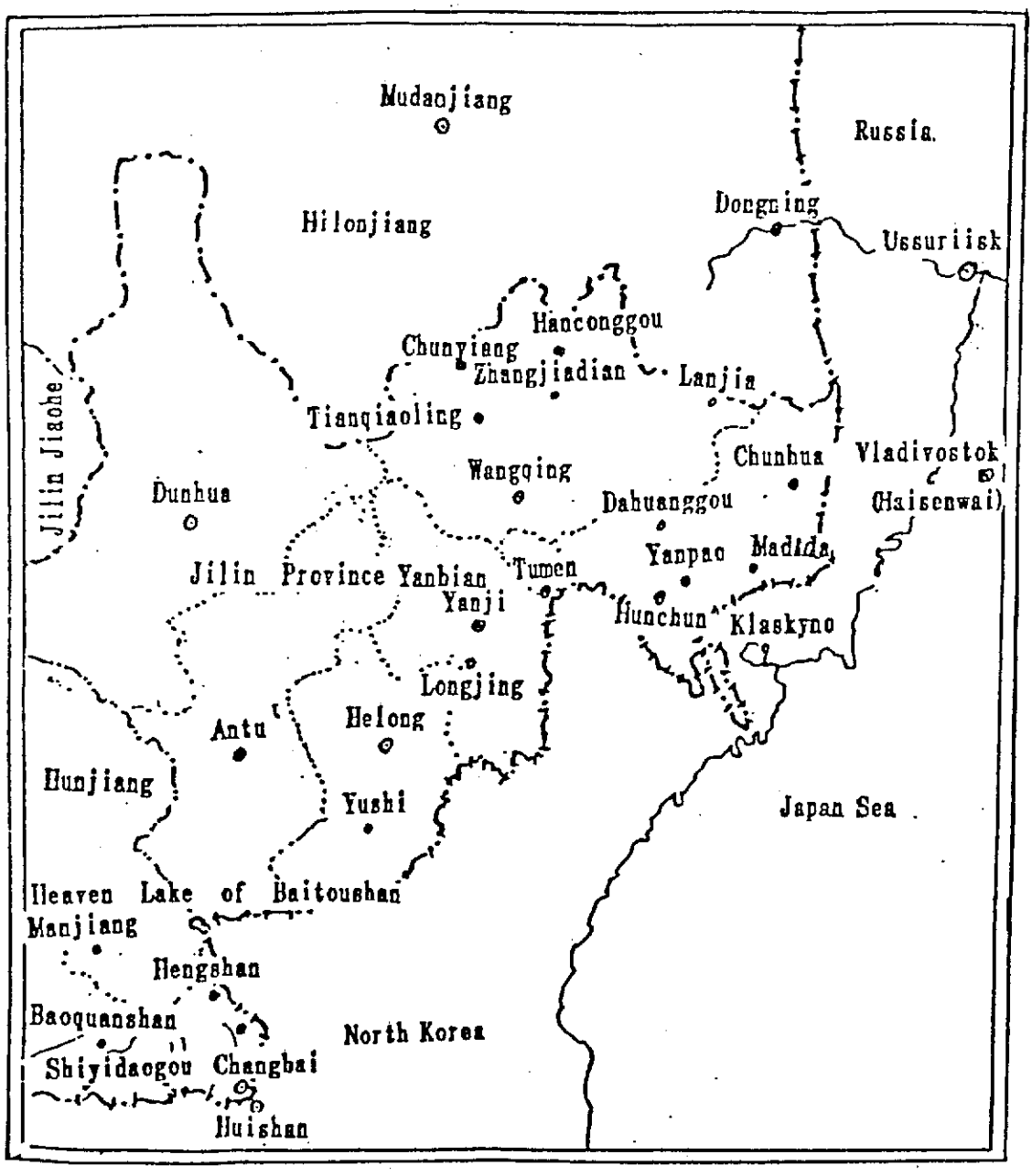
According to Table 1, the number of leopards on northeast slopes is higher than on the southwest slopes of the Changbai Mountains. Individuals inhabiting northeast slopes in the 1970's represented about 54.8% of the total population, in the 1980's about 69.9%, and in the 1990's about 80%. The northeast slope has higher numbers mainly in the border regions of Russia and North Korea. Many individuals have been captured. For example, one animal was caught in Hunchun (42°52' N, 130°21'30" E) in 1975; another was caught in Helong in 1991 (42°32'30" N, 120° E). During our recent investigation, 2 leopards were observed at Nangou Forest Farm,

Table 1. Distribution and numbers of North China leopards in Jilan Province, China, 1976-1992.

	Northeast slope					Southwest slope					
	Yanbian					Hunjiang			Toghua		
Year	Wang-qing	Hun chun	Helong	Antu	Dun-hua	Fuz-ong	Lin-jiang	Chang bai	Tong-hua	Hun jian	Total
1976-1977	10	8*	5	6	2	3	2	6	2	1	45
1982-1983	10	5*	4	4	-	2	1	4	-	-	30
1991-1992	7	3	3	2	-	-	-	3	-	-	15

*one specimen caught separately in 1975, 1982, and 1991

Figure 2. Distribution map of North China leopard in Jilin Province



National boundary
Provincial boundary
Prefecture boundary
City/County location
Distribution place

Chunyang in May 1995 (43°41'10" N, 129°17' E); and 2 leopards appeared often at Lanjia Forest Farm, Wangqing Forestry Bureau near the border of China and Russia (43°26' N, 130°59' E). In Dunhuangzi Forest Farm (43°41' N, 130°40'30" E), a leopard killed some cattle in the village. The same situation occurred at Putaogou Forest Farm (43°41' N, 129°54' E), and at Tianqiaoling Forestry Bureau and Zhangjiadian Forest Farm (43°37'20" N, 129°54'30" E), among others.

No individuals have been observed on the southwest slopes of Changbai Mountains in recent years, and even tracks are rare. According to interviews and references, there were a few traces of leopards found in Shiyidaogou, Shisandaogou, Malugou, Baoquanshan in Changbai county, Hunjiang near North Korea, and Manjiang in Fusong county and Dongbeicha in Hunjiang, among others. However, the actual number of individuals in the population is unknown because of the complex topography and poor accessibility. A future survey should investigate these regions.

4. The main factors impacting population numbers

The distribution and number of leopards in Jilin has clearly declined in recent times. Its range has narrowed over time, from its previously broad distribution in the eastern mountainous area of the province to the border regions with Russia and North Korea. The population has declined by about 70% (Figure 2). Analyses indicate the main reasons for this decline are:

4.1 Habitat modification. With economic development in the mountain regions, timber harvesting quotas have increased yearly. Because of resource reductions, cutting continuously extends further into the deepest parts of the forest. Today, a "spiderweb" of roads make almost all of the forest accessible. The once vast areas of intact forest the leopard inhabited have been replaced by increasingly extensive areas of brush and secondary forests. In this way the leopard loses suitable habitat, and is forced to move into the narrow international border region where dramatic changes in the natural condition of its habitat have not occurred.

4.2 Human disturbance. In some regions natural resources have been exhausted by the endless cutting of once large intact forests. The multifaceted development of forest resources has become the present management policy, causing great ecological disturbance and damage to the environment upon which wildlife depend. This trend has lead to severe reductions in the numbers of herbivores such as wild boar, roe deer, hare, etc., causing carnivores like the leopard to frequently go to local villages to prey on livestock.

4.3 Illegal hunting, trapping, and the use of acute rat poisons. It remains a common practice to catch wildlife indiscriminately by setting snares or leghold traps everywhere, although the department responsible for controlling this activity has worked diligently to stop it. The animals caught in snares or traps are either injured or killed. For example, in Yanbian, Hunchun and Wangqing, leopards were reportedly killed or injured in this way in 1982, 1984, and 1995. These methods are also used to trap other economically valuable species such as boar and roe deer, among others. Therefore, hunting and trapping are a big threat to the survival of the leopard as well as other wildlife.

In recent years the natural environment has been seriously polluted through the use of acute rat poisons. Cats, dogs, and other livestock have died as a result of consuming dead, poisoned rats. This vicious cycle continues when a leopard eats the dead animal and is poisoned secondarily. In this case there can be two results, the leopard dies, or reproduction is negatively affected by a reduction in the breeding ratio.

5. Conservation strategy

China has been very active regarding wildlife conservation. In 1989, the "Wildlife conservation law of the People's Republic of China" was enacted and implemented. Meanwhile, more than 200 wildlife reserves were established. The prospects for wildlife conservation, however, are not optimistic when one looks at examples such as the clear reduction in the population of leopards. Therefore we consider it necessary to strengthen the conservation and management of the leopard and other endangered wildlife.

5.1 Develop a long term plan for international cooperative investigation of the leopard. In view of the current endangered status of the leopard, it is necessary to develop a long-term joint investigation among China, Russia, and North Korea. These countries encompass the leopard's range, and cooperation between them would allow for a complete understanding of the leopard's population status and environmental factors influencing it. This research would provide a theoretical and scientific basis for further conservation efforts.

5.2 Carry out long-term observations and investigations. In order to conserve this endangered subspecies it will be necessary to apply advanced techniques and methods to carry out long-term observations on leopard dynamics and its role in the natural ecosystem. This will allow implementation of clearly defined management objectives.

5.3 Establish a natural reserve primarily for the North China Leopard. The range of the leopard is now confined to the border regions of China, Russia, and North Korea. This area is remote, peaceful, and is rarely disturbed by humans, making it good habitat for the leopard. Preserving the habitat that leopards depend on is the most effective way to restore and enlarge the natural population. Hence, we suggest the establishment of an international natural reserve in the present range of leopards and a cooperative study of the ecology of the leopard. Understanding the relationship of the leopard to its surroundings and its ecology are critical to the conservation and management of the North China Leopard.

Appendix 8.

RESEARCH PRIORITIES FOR LARGE CAT CONSERVATION AND RECOVERY PLANNING FOR WILD FAR EASTERN LEOPARDS

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With so few Far Eastern leopards remaining in the wild, developing this recovery plan will be an exacting task and implementation will be even more demanding. A key to the success of this effort will be designing a project that will continue to develop our understanding of the ecological needs of this endangered large cat. The biological and ecological portion of the research program to support the recovery the Far Eastern leopard should be nested within a larger research effort. The larger research effort must identify and quantify variables that define the problems and the context for this conservation effort. In other words we can not ignore the big picture. This is an essential lesson that we have learned from large carnivore conservation efforts over the last quarter century.

I want to emphasize this fundamental lesson, for without fully understanding it, our efforts on behalf of the Far Eastern leopard will most likely not succeed. Kellert (1996:178) puts this lesson bluntly: "A common fallacy of many endangered species programs has been the naive assumption that greater factual understanding will encourage greater public support for species restoration and recovery. Yet basic values tend to be more deeply entrenched and resistant to change. Most people use additional information simply to rationalize and reinforce their beliefs rather than to alter them. Support for endangered species conservation will emerge when people believe this effort enhances the prospects of a more materially, emotionally, and spiritually worthwhile life for themselves, their families, and communities. This may not constitute a particularly easy task, but it may be an unavoidable one."

As I read the recent report on the fate of an Far Eastern leopard in the most recent issue of *Cat News* (Korkishko 1996), it seemed clear that in spite of the critically endangered status of this leopard population, we are faced with great animosity for the leopard, at least from some the people who live with this predator on a day-to-day basis. It follows that a research priority must be a survey of attitudes concerning the Far Eastern leopard to serve as a basis for targeting key groups with education programs, building support through the use of spokespeople within the targeted groups, and integrating human and ecological concerns (Kellert et al. 1996).

In the new era of carnivore conservation our aim is to "...manage carnivore populations at socially acceptable levels" as David Mech (1996:397) recently stated. The framework for thinking about problem definition for large carnivore conservation has been significantly advanced by Clark et al. (1996:1056a): "...carnivore conservation must be made contextual relevant or it will remain unjustifiable to many opponents." And we must learn to do this as we go along. We call this approach to conservation *adaptable resource management.*

For me, and I believe for many people, large carnivores represent freedom, power, and the integrity of nature untouched. We would like to believe that large carnivores, if left alone and given wildlands as reserves, will live out their lives, and all will be fine. Stop the poaching! Remove the people! A simple task? But it just isn't happening that way. Certainly there would be far fewer large carnivores if it were not for the use of reserves and refuges and strong security arrangements that have been adopted to protect them from

purposeful takings. These are important and powerful tools in the conservation of large carnivores (Noss et al. 1996). However, the lessons to be learned from the last quarter century of efforts to conserve and restore large carnivores have shown us how much more there is to it (Clark et al. 1996b). Conservation biologists must join forces with political scientists, resource economists, lawyers, sociologists--a host of professions and professionals--to design an adaptable management approach that will serve the Far Eastern leopard population recovery process. The basis of our effectiveness in conserving the Far Eastern leopard in the wild will be our understanding of the leopard's ecological needs, especially what constitutes critical and high-quality habitat and what constitutes adequate and relatively stable food resources. But a research project to develop these understandings will need to be packaged within a larger research effort to identify and quantify the variables that define the context for the Far Eastern leopard conservation effort (Seidensticker 1987, Clark et al. 1996b). These variables have been developed for North America by Clark et al. (1996b) and I have listed them as Table 1.

Recent work by Maehr and Cox (1996) with the Florida panther is a real wake-up call alerting us that the cat is in the best position to show us what its landscape needs are and that these needs may not be contained in what we humans would naively think as best for the cat. Leopards and other large carnivores are large-landscape scale species. The hierarchy of decisions leopards make in living out their lives increases in scale from food item, to forageable patch, to habitat, to home range, and to region. Landscapes are discontinuous in their spatial and temporal properties, or grain (Holling 1992). For example, the spatial extent of leopard home ranges is determined by the productivity of the landscape. The less productive, the larger the extent of leopard foraging areas (Seidensticker et al. 1990, Bailey 1993). What we must identify and quantify is just what are the components of landscape productivity from the eyes of an adult male, a female with young, a dispersing leopard. We now have powerful tools to follow and learn the details of the lives of these secretive, nocturnal-living large predators and to exactly locate and quantify the texture of landscapes from the leopard's point of view.

Here are some essential research questions, adapted from Lubchenco et al. (1991), that allow us to begin to think of the Far Eastern leopard in a landscape context.

1) How plastic are the morphological, physical, and behavioral traits of Far Eastern leopards in the face of environmental stresses?
2) What are the determinants and consequences of Far Eastern leopard dispersal?
3) What factors explain the life history adaptations of the Far Eastern leopard?
4) What factors control the size of the Far Eastern leopard population(s)?
5) How are changes in population size mediated at the level of the individual?
6) How does the internal structure of the Far Eastern leopard population affect its response to various stresses?
7) How does fragmentation of the landscape affect the spread and persistence of the Far Eastern leopard population?
8) What factors govern the assembly of plants and animals found in the communities and ecosystems where the Far Eastern leopard lives today and where it has been extirpated? How do those systems respond to various stresses?
9) How do climatic, anthropogenic, and biotic processes regulate the ecosystems and landscapes where we find leopards living today and where they once lived?
10) What are the consequences of environmental variability, including natural and anthropogenic disturbances, at the individual, population, and community level in those ecosystems and landscapes where the Far Eastern lives today and has lived in the past?

An important lesson from the last three decades of research and conservation efforts for large carnivores is that we must take great care to ensure that all the components in a landscape that are important to leopards are recognized and included in the conservation matrix. A reserve or even system of reserves many not be adequate for the long-term survival of a large cat, as Maehr and Cox's (1995) elegant work has emphasized for the conservation of the Florida panther. Indeed, it is the ongoing work with *Puma concolor* that should be looked to as a model for the biological and ecological research needed to support the conservation efforts of the Far Eastern leopard.

The recovery program of the Far Eastern leopard can be formed around the steps outlined by Caughley (1994):

1. Use the scientific method to deduce both why the Far Eastern leopard declined and is declining and which agents caused the decline. Do not assume that the answer is already provided in folk wisdom, lay or scientific.
2. Remove or neutralize the agent(s) of decline.
3. Release a probe group to confirm that the cause of the decline has been deduced correctly.
4. If so, restock unoccupied areas by translocation, or if the remnant population is too low to risk further reduction, breed up a protected stock as fast as possible, as near to the problem site as possible, and release as soon as possible.
5. Monitor the subsequent re-establishment.

Many of you will recognize that I have placed a strong emphasis on the ecological research program for the Far Eastern leopard recovery plan based on what the late Graeme Caughley (1994) has termed the *declining-population paradigm*. I believe this is where the first emphasis on the biological research concerning the leopard should be placed. Many of you also know there is a strong, and I believe essential, tension between fair- minded conservation biologists that work within this paradigm and those that work in what Caughley termed *the small-population paradigm*. Keystones of the small-populations paradigm are genetic considerations and the development of assisted reproduction technologies. While undoubtedly important in the management of captive populations of leopards, relevance for free-living leopard populations may be limited. Demography before population genetics was the rule-of-thumb suggested by Lande (1988) because population genetics problems work on a slower time scale than environmental or demographic problems. Recent examples of how this may be the case can be seen in the ongoing work with the cheetah (Caro and Laurenson 1994) and the Florida panther (Maehr and Caddick 1995).

We should not spend energy and time debating the relative importance of the above paradigms. The elements of both can be included and turned to productive use in the recovery process. Population viability analysis (Durant and Mace 1994) provides a powerful tool to assist in the analysis of the demographic data as it emerges from the above studies over time and an important tool that can be used to adapt the Far Eastern leopard recovery plan as conditions change and more detailed information comes to light. We can expect an ongoing assessment of the genetic status of the Far Eastern leopard population to provide an essential input to the recovery planning process as it has provided for the Florida panther (O'Brien 1994). Work to advance our knowledge of leopard reproductive physiology and the development of assisted reproductive technologies should be encouraged (Holt 1994).

Right now the greatest challenge we face in the recovery of the Far Eastern leopard is the environmental consequence of human disturbance. This is where our first research priorities must be placed.

In summarizing lessons learned from large carnivore conservation efforts around the world, Weber and Rabinowitz (1996) teased out four steps that I will conclude with here:

1. Baseline information on the carnivore and its principle prey, range, and habitat requirement must play a primary role in conservation and planning.
2. Conservation does not occur in a vacuum. Local interests must be identified. Along with baseline biological information, it is essential to expand the conservation equation to include relevant cultural and political factors.
3. Based on this understanding, design a recovery program that seeks cooperation and support from across political lines.
4. Good conservation planning in an ongoing process that requires monitoring to provide feed-back for adapting the process to changing conditions.

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Table 1. Variables to be considered in a contextual problem definition of the large-carnivore conservation problems in North America.

Cultural history

1. Traditional fears and dislikes
2. Control over nature
3. Historical and cultural portrayal
4. Tradition of killing predators
5. Contemporary competition with humans
6. Improving killing technology

Valuation

7. Increasing support for carnivore conservation
8. Varied attitudes, knowledge and perceptions
9. Experiences with carnivores, context, and social setting
10. Symbolism of carnivores
11. Economic values
12. Property rights
13. Difficulty in valuing "fairly" or comprehensively

Ecology

14. Direct and indirect killing
15. Habitat loss, fragmentation, and insularization
16. Life-history features
17. Ecological characteristics
18. Stochastic factors (demographic, environmental, genetic, catastrophic)
19. Research and monitoring difficulties and adequacy of scientific models
20. Cumulative effects

Management systems

21. Agency missions, goal, and cultures
22. Organizational structures (communications and information flows)
23. Individual knowledge, training, and incentives
24. Operating procedures (coordination, control, leadership)
25. Power and authority relationships
26. Management plans, scales, follow-through
27. Multiple agency jurisdiction

Policy process

28. Policy prescriptions and formulation pitfalls
29. Policy and program implementation pitfalls
30. Policy and program evaluation, termination and succession pitfalls
31. Multiple, polarized actors (perspectives, strategies, situations)
32. Difficulty of consensus-building processes
33. Competition between many public policy issues

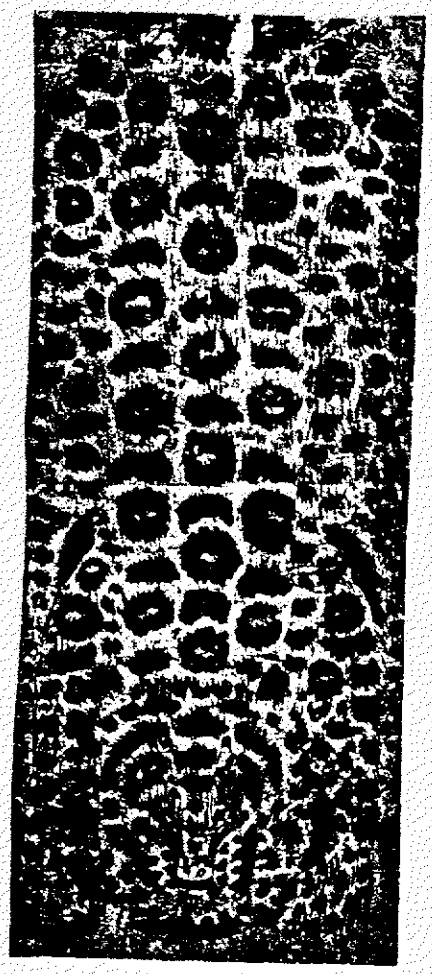
Source: Clark et al. (1996b)

Appendix 9. RECOVERY PROGRAM FOR THE FAR EASTERN LEOPARD: PROPOSED ACTIVITIES AND ESTIMATED COSTS

PROPOSED ACTIVITIES	Proposed Annual Budget 1997	1998	1999	2000	Budget: 4-year Total	Potential Financial Source	Executors of the activities
1. RESEARCH PRIORITIES							
1.1 Census Techniques	$600				$600	WWF, EPT	PIG, HWI, IBS
1.2 Census in Russia	$20,000			$20,000	$40,000	undetermined	TIG, HWI, IBS, KPZ
1.3 Census in China	$50,000				$50,000	HWI, WCS	HWI, TIG, IBS, KPZ, WCS
1.4 Land Use Analysis	see Section 2.1 and 2.2				$0		TIG, HWI,WWF,
1.5-1.8 Research program	$80,000	$80,000	$80,000	$80,000	$320,000	HWI, WWF, FOEJ, WCS	HWI, TIG
1.9 Prey Abundance/ Distribution	$22,500	$2,500	$2,500	$22,500	$50,000	EPT	TIG, ISNU
1.10 Depredation assessment	$12,000	$12,000	$12,000	$12,000	$48,000	undetermined	HWI, ISNU
1.11 Literature Reviews	$5,000	$5,000			$10,000	WWF, PRF	TIG
TOTAL					$518,600		
2. LAND USE PLANNING							
2.1 Prepare GIS plan for land use	$50,000				$50,000	USAID "ROLL"	TIG, GKOC
2.2 Information-analysis system							
2.2.1 develop GIS database	$70,000	$20,000	$15,000	$15,000	$120,000	undetermined	TIG, GKOC
2.2.2 analyze land-use planning	$7,000	$20,000	$25,000	$25,000	$77,000	undetermined	TIG, GKOC
2.3 Protected areas management							
2.3.1 inventory of protected areas		$26,000			$26,000		ISNU
2.3.2 Kedrovya Pad Zapovednik	$30,000	$30,000	$30,000	$30,000	$120,000	Regional, Federal and NGO funds	KPZ
2.3.3 creation of buffer zone	$1,000				$1,000	undetermined	GKOC
2.4 Barsovy Zakaznik							
2.4.1 "biotechnical" priorities assessment	$5,000	$4,000	$4,000	$4,000	$17,000	Regional, Federal and NG funds	OOK, BZ
2.5 Borisovskoe Plateau Zakaznik							
2.5.1 infrastructure development	$27,500				$27,500	USAID	EPT Project, WWF,
2.5.2 vehicle	$17,000				$17,000	undetermined	OOKM, BPZ
2.6 Creation of New Protected Areas							
2.6.1 organize international protected area	$5,000	$5,000			$10,000	Regional, Federal and NGO funds	GKOC, PKA, DVORAN
2.6.2 prepare assessment		$4,000	$4,000		$8,000	undetermined	
2.6.3 develop laws on creating protected areas		$1,000	$1,000		$2,000	undetermined	
2.6.4 obtain agreements with land-users	$5,000				$5,000	undetermined	GKOC
2.7. Poltavskii refuge							
2.7.1. connect to Borisovskoe Plateau Zakaznik	$3,000				$3,000	undetermined	GKOC
2.8 Strengthen status of protected areas							
2.8.1 strengthen protected area status	$5,000				$5,000	undetermined	GKOC
2.9 Unification of protected areas					?	undetermined	GKOC
TOTAL					$488,500		

PROPOSED ACTIVITIES	Proposed Annual Budget 1997	1998	1999	2000	Budget: 4-year Total	Potential Financial Source	Executors of the activities
3. CAPTIVE BREEDING OF FAR EASTERN LEOPARDS							
3.1 preserve captive population	no cost to recovery program				$0	EEP	EEP
3.2 streamline requirements for transfer of leopards	no cost to recovery program				$0	GKOC	GKOC
3.3 permit removal of injured leopards from wild	no cost to recovery program				$0	GKOC	GKOC
3.4 support temporary holding facilities	no cost to recovery program				$0	Receiving zoo.	Receiving zoo.
3.5 captive breeding in RFE (research program)	$37,900	$28,400	$28,400	$28,400	$123,100	undetermined	undetermined
TOTAL					$123,100		
4. REINTRODUCTION OF FAR EASTERN LEOPARDS							
4.1 feasibility assessment	$3,200				$3,200	undetermined	TIG, ISUN, KPZ
4.2 selection of reintroduction site		$17,100			$17,100	undetermined	TIG, ISUN
4.3 public awareness campaign			$6,000	$6,500	$12,500	undetermined	Zov Taiga, WWF, IUCN Cat Group
4.4. depredation compensation program			$12,500		$12,500	undetermined	land management organizations
4.5 reintroduction of leopards			$25,000		$25,000	undetermined	unidentified
4.6 monitoring released animals			$224,800	$147,800	$372,600	undetermined	TIG, HWI
4.7 protection of reintroduced population			$48,100		$48,100	undetermined	land management organizations
4.8 supplementation of existing population		?	?	?	?	undetermined	unidentified
TOTAL					$491,000		
5. LEGISLATION AND LEOPARD PROTECTION							
5.1 Legislative basis for protection							
5.1.1 international legal basis for protection		$4,000.00			$4,000	undetermined	EPT, WWF, GKOC
5.1.2 national legal basis for protection	no cost to recovery program				$0		GKOC, DTO
5.1.2.1 develop trade legislation	no cost to recovery program				$0		GKOC, RFGKOC
5.1.2.2 permanently employ AMBA force	no cost to recovery program				$0	CNPPKA	GKOC, RFGKOC
5.1.2.3 petition CIB for access	no cost to recovery program				$0	CNPPKA	GKOC
5.1.3. regional legislation							
5.1.3.1. transfer jurisidiction responsbilities	no cost to recovery program				$0		GKOC
5.1.3.2. krai legislation on wildlife trade	no cost to recovery program				$0		DTO
5.1.3.3. outlaw leghold traps in leopard range	no cost to recovery program				$0		GKOC, WWF, EPT
5.1.3.4. define responsibilities of land leasors	$1,000				$1,000	undetermined	KKPR, GKOC, EPO
5.1.3.5. extend jurisdiction of Kedrovya Pad	no cost to recovery program				$0		KKPR, GKOC
5.2 Improve anti-poaching efforts							
5.2.1. Improve anti-poaching efforts							
5.2.1.1. support to Ussurisky Amba team	$50,000	$50,000	$50,000	$50,000	$200,000	undetermined	GKOC, WWF
5.2.1.2. support Kedrovya Pad Zapovednik	$20,000	$20,000	$20,000	$20,000	$80,000	undetermined	WWF
5.1.2.3. improve support to Barsovy Zakaznik	$40,000	$40,000	$40,000	$40,000	$160,000	undetermined	WWF
5.1.2.4. support Borisovskoe Plateau Zakaznik	see 2.5.1	$40,000	$40,000	$40,000	$120,000	undetermined	OOK, OOTOF, WWF
5.2.2 prepare manual on wildlife violations	$1,000			$1,000	$2,000	undetermined	GKOC, EPO, WWF
5.2.3 provide training to wildlife inspectors	$5,000		$5,000		$10,000	undetermined	GKOC, EPO, WWF
5.2.4 coordinate customs and wildlife inspectors	$6,000	$6,000	$6,600	$6,600	$25,200	undetermined	GKOC, WWF, DTO
5.2.5 prepare manual for customs officials	$2,000				$2,000	undetermined	DTO
5.2.6 establish temporary leopard holding facility	see Section 3.4				$0	EEP	EEP
5.2.7 lawyer for poaching cases	$3,000	$3,000	$3,000	$3,000	$12,000	undetermined	EPO
5.2.8 obtain state level status for wildlife inspectors					$0		GKOC
5.3 Depredation compensation program	$15,000	$30,000	$30,000	$30,000	$105,000	undetermined	GKOC, WWF
5.4 Establish effective fire-fighting system	$0	$20,000	$20,000	$20,000	$60,000		AVIAOTRYAD
5.5. Group for human-carnivore conflict	$75,000	$30,000	$30,000	$30,000	$165,000	undetermined	GKOC, WWF
TOTAL					$946,200		

PROPOSED ACTIVITIES	Proposed Annual Budget 1997	1998	1999	2000	Budget: 4-year Total	Potential Financial Source	Executors of the activities
6. ECOLOGICAL EDUCATION AND PUBLIC AWARENESS							
6.1 Creation of the ecocenter "Leopard"					$50,000	undetermined	WWF
6.2 Production of movie, "The Last Leopard"					$28,500	undetermined	Zov Taiga
6.3 analyze educational approaches for leopard					$4,000	undetermined	WWF
6.4 produce educational materials based on 6.3					$4,000	undetermined	Zov Taiga
6.5 children's competition for book on leopards					$20,000	undetermined	Zov Taiga
6.6 collection of photos on leopards					$3,600	undetermined	Yu. Shibnev
6.7 creation of Kedrovya Pad museum					$37,500	undetermined	WWF, KPZ
6.8 Press conference on leopard conservation plan					$4,000	undetermined	A. Lebedev, E. Smirnova
6.9 create of section on TV program "Zapovednano"					$4,000	undetermined	A. Lebedev
6.10 Press trip to leopard habitat					$4,000	undetermined	A. Lebedev
6.11 support leopard issues in Primorye newspapers					$1,000	undetermined	A. Lebedev, V. Troinin
6.12 radio news pieces on leopard					$0	undetermined	E. Smirnova
6.13 workshop for journalists in leopard habitat					$3,000	undetermined	EPT, A. Lebedev
6.14 distribution of leopard information to populace					$3,000	undetermined	V. Troinin
6.15 clearinghouse for leopard publications	see Section 1.4				$0	undetermined	J. Augustine
6.16 education for school children					$4,000	undetermined	Arseniev Museum, Zov Taiga
TOTAL					$170,600		
7. GENETICS							
7.1 genetic analysis of existing samples	$40,000				$40,000	NIH	NIH, S. O'Brien
7.2 form genetics working group	no cost to recovery program				$0		IBS, A. Krykov
7.3 develop protocols for collections and analysis	no cost to recovery program				$0		Genetics working group
7.4-7.5 collect and analyze genetic materials		$69,000	$69,000	$69,000	$207,000	undetermined	IBS, NIH, Krykov, O'Brien
TOTAL					$247,000		
BUDGET SUMMARY							
1. Research priorities	$190,100	$99,500	$94,500	$134,500	$518,600		
2. Land use planning	$225,500	$110,000	$79,000	$74,000	$488,500		
3. Captive breeding	$37,900	$28,400	$28,400	$28,400	$123,100		
4. Reintroduction	$3,200	$17,100	$316,400	$154,300	$491,000		
5. Legislation and leopard protection	$218,000	$243,000	$244,600	$240,600	$946,200		
6. Ecological education and public awareness					$170,600		
7. Genetic researches	$40,000	$69,000	$69,000	$69,000	$247,000		
TOTAL	$714,700	$567,000	$831,900	$700,800	$2,985,000		



Leopard-skin painting, used as an evil-repelling symbol. One of eight panels, ink painting on paper, Yi Dynasty. Collection of the Emille Museum