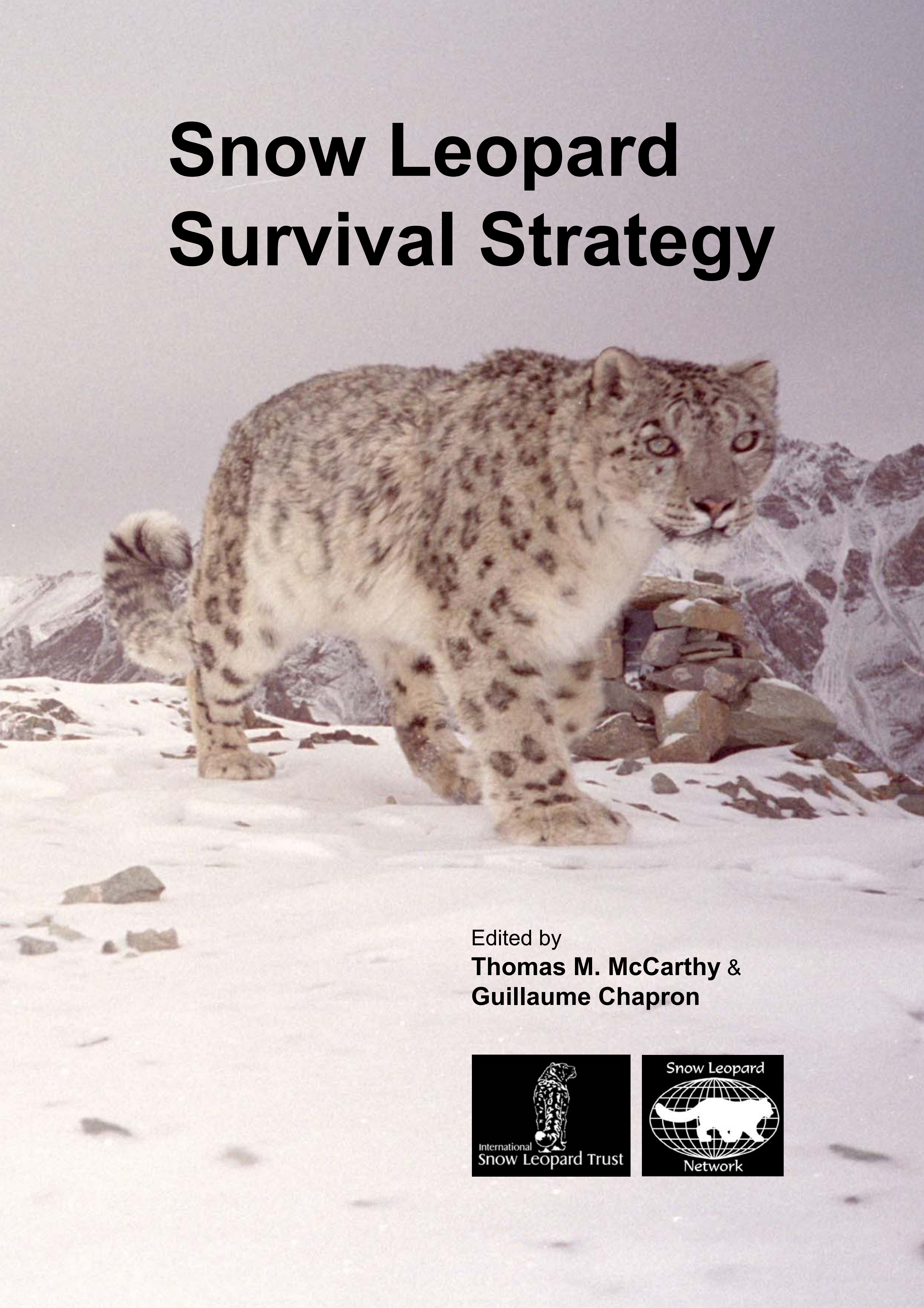


Snow Leopard Survival Strategy

Edited by
Thomas M. McCarthy &
Guillaume Chapron

International Snow Leopard Trust

Snow Leopard Network

Founded in 1981, the **International Snow Leopard Trust** is the oldest and largest organization focused solely on developing successful strategies for protecting the snow leopard and its habitat. Since its inception, the Trust has worked on more than 100 projects with local populations throughout Central Asia. The Trust strives to implement creative and visible programs that make long-lasting conservation happen. All programs are founded on the understanding that we must involve local communities in project design and implementation in order to achieve long-term success.
Website: http://www.snowleopard.org

The **Snow Leopard Network** is a partnership of organizations and individuals from government and private sector who work together for the effective conservation of the snow leopard, its prey, and their natural habitat to the benefit of people and biodiversity.
Website: http://www.snowleopard.org/sln/

Snow Leopard Survival Strategy

Edited by
Thomas M. McCarthy &
Guillaume Chapron

International Snow Leopard Trust

Snow Leopard Network

Published by: ISLT and SLN, Seattle, USA.

Citation: McCarthy, T. M. and G. Chapron. 2003. Snow Leopard Survival Strategy. ISLT and SLN, Seattle, USA.

Cover photo: Camera-trapped snow leopard in northern India. © Rodney Jackson / Snow Leopard Conservancy 2003.

Layout: Guillaume Chapron, CNRS, Ecole Normale Supérieure, Paris, France

Available at:
http://www.snowleopard.org/sln/
http://www.carnivoreconservation.org/snowleopard/

Snow Leopard Survival Strategy

Produced by:
International Snow Leopard Trust & Snow Leopard Network

Editors: Thomas M. McCarthy[1] & Guillaume Chapron[2]

[1] International Snow Leopard Trust, 4649 Sunnyside Ave. N. Suite 325, Seattle, WA 98103, USA. E: <tmccarthy@snowleopard.org>

[2] Laboratoire d'Ecologie, CNRS UMR 7625, Ecole Normale Supérieure, 46 rue d'Ulm, 75230 Paris Cedex 05, France. E: <gchapron@carnivoreconservation.org>

Senior Author: Thomas M. McCarthy
International Snow Leopard Trust, Seattle, WA, USA

Contributing Authors:

Priscilla M. Allen
International Snow Leopard Trust, Seattle, WA, USA

Guillaume Chapron
Ecole Normale Supérieure, CNRS, Paris, France

Joseph Fox
University of Tromsö, Tromsö, Norway

Rodney M. Jackson
Snow Leopard Conservancy, Los Gatos, CA, USA

Charudutt Mishra
International Snow Leopard Trust / Nature Conservation Foundation, Mysore, India

Stephanie Theile
TRAFFIC Network, Cambridge, UK

Table of Contents

Foreword	vii
Acknowledgements	viii
Executive Summary	ix
1. Snow Leopard: Review of Current Knowledge and Status	12
Rationale for a Snow Leopard Survival Strategy	12
Specific Goals	12
History of the Process	12
Brief background on the snow leopard	12
Other Names	13
Description	13
Ecology	13
Taxonomy	14
Historic Distribution	14
Range Map	14
Total Range Area and Population	15
Afghanistan	16
Bhutan	16
China	16
India	20
Myanmar (Burma)	21
Mongolia	21
Nepal	21
Pakistan	22
Former USSR	22
Russia	23
Kyrgystan (Kyrgyz Republic)	23
Kazakhstan	23
Tajikistan	23
Uzbekistan	24
Summary	24
Legal Status	24
International Level	24
National Level	24
Afghanistan	25
Bhutan	26
China	26
India	26
Kazakhstan	26
Kyrgyzstan	26
Mongolia	26
Nepal	27
Pakistan	27
Russia	27
Tajikistan	27
Uzbekistan	27

Country Strategies and Action Plans 28
Mongolia 28
Pakistan 28
Russia 28
Nepal 28

2. Threats and Conservation Actions 29
Regional Assessment 29
Threats to Snow Leopard Survival 29
Master List of Threats 29
Brief Description of Threats 29
Category 1: Habitat and Prey Related 29
1.1 Habitat Degradation and Fragmentation 29
1.2 Reduction of Natural Prey due to Illegal or Unregulated Hunting 29
1.3 Reduction of Natural Prey due to Legal Hunting 30
1.4 Reduction of Natural Prey due to Competition with Livestock 30
1.5 Reduction of Natural Prey due to Disease or Transmission of Disease 30
1.6 Fencing that Disrupts Natural Animal Movements and Migration 30
Category 2: Direct Killing of Snow Leopards 30
2.1 Killing of Snow Leopards in Retribution for Livestock Depredation Loss 30
2.2 Poaching Snow Leopards for Trade in Hides or Bones 30
2.3 Zoo and Museum Collection of Live Animals 30
2.4 Traditional Hunting of Snow Leopards 30
2.5 Secondary Poisoning and Trapping of Snow Leopards 31
2.6 Diseases of Snow Leopards 32
Category 3: Policy and Awareness 32
3.1 Lack of Appropriate Policy 32
3.2 Lack of Effective Enforcement 32
3.3 Lack of Trans-boundary Cooperation 32
3.4 Lack of Institutional Capacity 32
3.5 Lack of Awareness Among Local People 32
3.6 Lack of Awareness Among Policy Makers 32
Category 4: Other Issues 32
4.1 War and Related Military Activities 32
4.2 Climate Change 32
4.3 Human Population Growth and Poverty (indirect threat) 32
Potential Actions to Address Threats 32
Grazing Management 32
Income Generation 34
Wildlife-based Ecotourism 34
Cottage Industry 36
Ungulate Trophy Hunting Programs 38
Reducing Poaching and Trade in Snow Leopard Parts 40
Reducing Livestock Depredation by Snow Leopards 42
Animal Husbandry 44
Conservation Education and Awareness 46

3. Research and Information Needs 47
Master List of Information Needs 47
Prioritization of Information Needs 47
Comments on Priority Information Needs 47

Brief Description of Information Needs and Potential Methods to Address Them 49

R.1 Snow leopard distribution and "hot spots" 49
R.2 Snow leopard migration and dispersal routes 49
R.3 Snow leopard population size 50
R.4 Snow leopard population trends and factor responsible for changes 50
R.5 Protected Area coverage – extent and representation of habitats (gap analysis) 50
R.6 Agents of habitat degradation and relative impacts 51
R.7 Snow leopard – prey relationships 51
R.8 Prey species distribution and "hot spots" 52
R.9 Prey population baseline and trends 52
R.10 Dynamics of illegal ungulate hunting (sources, local need, uses, trade, etc.) 52
R.11 Dynamics of legal ungulate harvest and baseline statistics (sex/age, effort, trophy size, etc.) 52
R.12 Wild ungulate – livestock interactions (competition) 53
R.13 Ungulate disease – type, areas of occurrence, prevalence, virulence, treatment 53
R.14 Snow leopard poaching levels 53
R.15 Illegal trade in wildlife parts – market demand, sources and routes, value, etc. 54
R.16 Livestock depredation rates 54
R.17 Livestock depredation causes 55
R.18 Grazing pressure and range conditions 55
R.19 Snow leopard disease – type, areas of occurrence, prevalence, virulence, treatment 55
R.20 Snow leopard home-range size and habitat use 56
R.21 Snow leopard social structure and behavior 56
R.22 Snow leopard population genetics 57
R.23 Snow leopard food habits 57
R.24 Snow leopard relationship to other predators 57
R.25 Economic valuation of snow leopards 58
R.26 Snow leopard monitoring techniques development/improvement 58
R.27 Socio-economic profiling of herder communities in snow leopard habitat 59
R.28 Methods to alleviate impacts of war 59
R.29 Livestock and human population status and trends 60
R.30 Analysis of existing policies and laws 60
R.31 Human attitudes to snow leopards 60

4. Country Action Planning 62

A. The SLSS as an Action Planning Tool 62

B. Action Planning Assistance 63

5. Taking the SLSS forward 64

Literature cited 65

Appendix I. List of SLSS Participants 70

Appendix II: Abstracts of Case Studies presented in Section on Information Needs 72

Foreword

The range of *Uncia uncia* encompasses habitats diverse as the Himalayas and the Taklamakan. The superb cat called the snow leopard is found in some of the driest mountains of the world, in the open coniferous forests of the Tian Shan and the Altai, and up to an altitude of 5500 meters in Tibet. It prefers steep terrain broken by cliffs, ridges and gullies, but also inhabits in the wide flats of Mongolia and the Tibetan Plateau. All this wakes the image of remote, harsh and even hostile lands. And yet, the snow leopard is not living in a wilderness untouched by man. Within the reach of the irbis, in China and along the south slope of the Himalayas, we find some of the oldest civilisations, which have created feats in art, philosophy, science and technology thousands of years ago. From Central Asia, snow leopards have seen horsemen setting out to conquer the world throughout history. Snow leopards have shared their living space with humans for many thousand years, and they have become part of these people's cultures. As far as we know, the species' range has not much changed over the past centuries, and it is today protected by law in all twelve range countries.

And yet, we think that the survival of this animal in the future is not granted. In the IUCN Red List, the snow leopard is listed as Endangered. According to the review by Kristin Nowell and Peter Jackson in Wild Cats (1996), the species' total effective population size is below 2,500 mature breeding individuals, with a declining trend due to habitat and prey base loss and persecution. However, we lack many details for a proper assessment of the species' status across its range. Sound research using modern technology such as radio-telemetry, and advanced monitoring methods, has only recently started, mainly performed by the specialists now integrated in the Snow Leopard Network. These same women and men from all range countries, Europe and North America have, in a highly participative process, developed the Snow Leopard Survival Strategy. The SLSS is based on the best available knowledge and modern conservation strategies. It identifies the most pressing needs for additional information and describes the adequate methods to gain the knowledge. It considers ecology, trade, socio-economic aspects and policy and provides guidelines for drafting regional conservation action plans to all range country governments. We do not need to prolong this list here, as every reader will certainly recognize the value and importance of the SLSS.

The Snow Leopard Network and the SLSS became possible in part due to eminent political changes at the end of the 20th century, allowing all people involved in snow leopard conservation to come together, work cooperatively, and exchange experiences and ideas. These changes, however, also bear some risks. The range countries will experience economic progress, more trade and tourism. This may bring new threats to the habitat and the prey of the snow leopard, and opens – already very obvious – new channels for illegal trade. As a consequence, very close international cooperation in conservation is urgent, and documents such as the SLSS are more than needed.

When, in May 2002, we all met in Seattle for the Snow Leopard Survival Summit, we were still under the shock of the terrorists' attack on New York and the fighting in Afghanistan, an important range country. We all felt pretty lost and utterly helpless in a world of hate and violence. But we shared a similar vision that -- across mountain ridges and deserts, national borders and cultural barriers -- the common values for which we fight, far outweigh the few differences that separate us. It was in this spirit of mutual respect, trust and friendship that the Snow Leopard Survival Strategy was born. And everyone who reads the SLSS should be aware of the fact that, through the process of conserving the snow leopard, we also work toward a better future for the people who share the living space with this wonderful cat of the mountains.

Urs and Christine Breitenmoser
Co-chairs IUCN/SSC Cat Specialist Group

Acknowledgements

The Snow Leopard Survival Strategy (SLSS) is the product of the Snow Leopard Network, and of all the individuals and organizations that comprise that Network, thus it would be very difficult to name each person that has contributed to this Strategy. However, several people and organizations have made notable contributions and should be acknowledged here.

The SLSS process was initiated and facilitated by the International Snow Leopard Trust (ISLT) and as such benefited greatly by the wisdom of their Founder, Helen Freeman. Brad Rutherford, ISLT's Executive Director gave a high priority to the SLSS process over a 2-year period, assuring that needed funds and staff time were available for a project he strongly believed in. ISLT's Board of Directors backed the process as well, making special efforts to secure the additional funds needed for completion.

After much input was gathered from the snow leopard experts in the field and from all the range countries, the Snow Leopard Survival Summit was convened in Seattle, USA in May 2002. This undertaking, where more than 60 experts came together for a 5-day period to reach consensus on numerous topics related to snow leopard conservation, could not have been the huge success it was without the cooperation and incredible support of the Woodland Park Zoo. The Summit was hosted on the Zoo grounds and WPZ Director Mike Waller made sure that adequate staff time and facilities were available to us. The Woodland Park Zoo Docents and Zoo Keepers gave of their time and funds to make the Summit participants, who came from 17 countries, comfortable and productive. Norma Cole coordinated much of the "behind the scenes" activities that kept the Summit working smoothly. Harmony Frazier made the facilities of the Zoo's Conservation program available to us, and her staff of Andrea Sanford Gates and Suzanne Riley kept minutes of the proceedings and transcribed them to electronic medium. Simultaneous translation services were provided by Linda Noble and Marina Proutkina. Janis Weltzin edited the Contributed Papers submitted by specialists.

The Summit itself was a highly participatory process, with sessions and workshops led by a number of experts including Don Hunter, Chris Emmerich, Ashiq Ahmad Khan, Rodney Jackson, Nazgul Esengulova, Charudutt Mishra, Joe Fox, Some Ale, Deki Yonten, Yash Veer Bhatnagar, Kathleen Braden, Saeeda Inayat, Priscilla Allen, Hongfei Zou and Elena Mukhina. Other specialists contributed on technical panels and included A. Bayarjargal, Shafqat Hussain, Stan Tomkiewicz, Sam Wasser, Urs Breitenmoser, B. Munkhtsog, Andrey Subbotin, Ghana Gurung, Birga Dexel, G. Sumya, Stephanie Thiele, Darla Hillard, Evgeny Koshkarev, Lyle Glowka, Dan Wharton and Christine Breitenmoser-Wursten.

Helen and Stan Freeman helped start things off on a positive note by hosting an ice-breaker on the first night. Bonnie and Dick Robbins and Marilyn and Bartow Fite graciously hosted the Summit banquet at their home for the participants.

Numerous authors contributed to this Document and are listed on the title page. Early drafts of the manuscript were reviewed and greatly improved by the contributions of Kristin Nowell, Ahmad Khan, Terry O'Connor, Javed Khan, Dave Ferguson, Rich Harris, Birga Dexel, Ashiq Ahmad Khan, Cholpon Dyikanova, Yash Veer Bhatnagar, A. Bayarjargal, Peter Graham and Som Ale.

Manuscript layout and editing was done by Guillaume Chapron.

Financial, material and logistical support was provided by CGMK Foundation, U.S. Fish and Wildlife Service, The Silver Cloud Inn, Starbucks Coffee, Puget Sound Chapter of AAZK, Seattle Aquarium, Mandarin Associates Ltd., Colchester Zoo (UK), Cleveland Metroparks Zoo, Blank Park Zoo, Oregon Zoo, San Diego Zoo, and the AAZK Chapters of Beardsley Zoo, Wildlife Safari, Fort Worth Zoo, Milwaukee, and Baltimore.

The Snow Leopard Network (SLN) came about when SLSS participants recognized the need to continue the close collaboration established up to and during the Summit. The early development and activities of the SLN have been financially, and motivationally, supported by Charlie Knowles.

For all of these contributions, I am extremely grateful.

Tom McCarthy,
Editor and Senior Author

Executive Summary

I. SNOW LEOPARD: REVIEW OF CURRENT KNOWLEDGE AND STATUS

This Snow Leopard Survival Strategy (SLSS) was undertaken to provide comprehensive conservation and research guidelines to ensure a range-wide coordinated effort in the fight to save the endangered snow leopard and had the following specific goals:

- Assess and prioritize threats to snow leopard survival on a geographic basis.
- Define and prioritize conservation, education, and policy measures appropriate to alleviate threats.
- Prioritize subjects for snow leopard research and identify viable or preferred research methods.
- Build a network of concerned scientists and conservationists to facilitate open dialogue and cross-border cooperation.
- Gain consensus on a fundamental Snow Leopard Survival Strategy document that will be made available to the range states to aid conservation planning at national and local levels.

The highly participatory process started with a survey of specialists designed to gather information on perceived threats to snow leopards, appropriate actions to address threats, knowledge gaps, protected area status, policy and law issues, impediments to achieving conservation of snow leopards, and cultural relevance of snow leopards. Drafts of a Strategy were circulated and then the Snow Leopard Survival Summit was convened in Seattle, USA from 21-26 May 2002 and was attended by 58 of the specialists to debate issues and refine the Strategy. This SLSS document is the end product of that process.

Background on the snow leopard

The snow leopard (*Uncia uncia*) is a member of the Felidae subfamily Pantherinae and on the basis of morphology and behavior it is placed alone in a separate genus. They are found in 12 countries across Central Asia (China, Bhutan, Nepal, India, Pakistan, Afghanistan, Tajikistan, Uzbekistan, Kyrgyzstan, Kazakhstan, Russia, and Mongolia). China contains as much as 60% of the snow leopard's potential habitat. Inaccessible and difficult terrain, along with the secretive nature of this rare cat helps account for the fact that large parts of its range have yet to be surveyed. Between 4,500 and 7,350 snow leopards are thought to occur within a total potential habitat area of 1,835,000 km^2 .

Snow leopards are generally solitary and mating usually occurs between late January and mid–March, and one to five cubs are born after a gestation period of 93 to 110 days, generally in June or July. Snow leopards are closely associated with the alpine and subalpine ecological zones, preferring broken, rocky terrain with vegetation that is dominated by shrubs or grasses. Home range size and shape is not well known. The home range size of five snow leopards in prime habitat in Nepal ranged from 12 to 39 km^2, with substantial overlap between individuals and sexes. In Mongolia, where food resources may be scarcer, home ranges of both males and females exceeded 400 km^2. Snow leopards are opportunistic predators capable of killing prey up to three times their own weight. They will also take small prey such as marmot or chukar partridge. In general, their most commonly taken prey consists of wild sheep and goats (including blue sheep, Asian ibex, markhor, and argali). Adult snow leopards kill a large prey animal every 10-15 days, and remained on the kill for an average of 3-4 days, and sometimes up to a week. Predation on livestock can be significant, which often results in retribution killing by herders.

Snow Leopards are listed as Endangered on the IUCN Red List in that they do not meet the standards of Critically Endangered but are projected to decline by 50% or more over next 3 generations due to potential levels of exploitation (trade in pelts/bones and conflict with livestock), and due to declining: 1) area of occupancy, 2) extent of occurrence, and 3) quality of habitat (prey depletion). They appear in Appendix I of both CITES and the Convention on Conservation of Migratory Species of Wild Animals (CMS).

Snow Leopards are protected nationally over most of its range, with the probable exception of Afghanistan. However, in some countries the relevant legislation may not always be very effective, e.g. because penalties are too low to function as deterrent, or they contain some significant loopholes.

II. THREATS AND CONSERVATION ACTIONS

Regional Assessment

This document attempts to list and discuss the threats, conservation actions and information needs pertinent to snow leopard survival. However, these vary substantially across the vast extent of snow leopard range, so no prescription will be universally applicable. We used a regional approach and for purposes of grouping areas where conditions may be similar, we looked at geography, political boundaries, cultural/religious influences, and rural livelihoods. Within that framework we defined four broad regions:

- Himalaya (HIMLY),
- Karakorum/Hindu Kush (KK/HK),
- Commonwealth of Independent States and W. China (CISWC),
- The Northern Range of Russia, Mongolia and N. China (NRANG)

Threats to Snow Leopard Survival

A key component of the SLSS process was to identify threats to long-term snow leopard survival across their range. The following list is the result of extensive consultations with stakeholders in Asia and the expert group at the SLSS Summit. Threats are grouped into four broad categories 1) Habitat and Prey related, 2) Direct Killing of Snow Leopards, 3) Policy and Awareness, and 4) Other Issues.

List of Threats

Category 1: Habitat and Prey Related

1.1 Habitat Degradation and Fragmentation
1.2 Reduction of Natural Prey due to Illegal Hunting
1.3 Reduction of Natural Prey due to Legal Hunting
1.4 Reduction of Natural Prey due to Competition with Livestock
1.5 Reduction of Natural Prey due to Disease
1.6 Fencing that Disrupts Natural Migration

Category 2: Direct Killing or Removal of Snow Leopards

2.1 Killing of Snow Leopards in Retribution for Livestock depredation
2.2 Poaching Snow Leopards for Trade in Hides or Bones
2.3 Museum Collection of Live Animals
2.4 Traditional Hunting of Snow Leopards
2.5 Secondary Poisoning and Trapping of Snow Leopards
2.6 Diseases of Snow Leopards

Category 3: Policy and Awareness

3.1 Lack of Appropriate Policy
3.2 Lack of Effective Enforcement
3.3 Lack of Trans-boundary Cooperation
3.4 Lack of Institutional Capacity
3.5 Lack of Awareness among Local People
3.6 Lack of Awareness among Policy Makers

Category 4: Other Issues

4.1 War and Related Military Activities
4.2 Climate Change
4.3 Human Population Growth and Poverty (indirect threat)

Potential Actions to Address Threats

Several methods are identified and elaborated in this document and they include:

- *Grazing Management*: Promote livestock grazing practices that reduce impacts on native wildlife, in particular snow leopard prey species.
- *Wildlife-based Ecotourism*: Establishing wildlife-based tourism that provides jobs and financial benefits to local people will add economic value to wildlife and create incentives to protect the resource.
- *Cottage Industry*: Provide income generation opportunities for communities in snow leopard habitat through handicraft manufacture and marketing opportunities with direct and transparent linkages to wildlife conservation via contracts that provides positive incentives for compliance.
- *Ungulate Trophy Hunting Programs*: Establish or restructure trophy hunting programs that are sustainable, well monitored and provide return to local people as an incentive to protect ungulates. Community co-management of hunting program should be encouraged where ever appropriate.
- *Reducing Poaching and Trade in Snow Leopard Parts*: Determine location, nature and extent of snow leopard poaching for trade and bring pressure, both legal and educational, to limit same.
- *Reducing Livestock Depredation by Snow Leopards*: Encourage livestock husbandry practices that reduce depredation by snow leopards and other predators.
- *Animal Husbandry*: Provide training in animal husbandry and veterinary care to improve monetary return at lower stock levels, limit exposure to predation, and reduce impacts on pasture and rangelands.
- *Conservation Education and Awareness*: Raise awareness of snow leopard conservation issues, concerns, need for action, legal matters, etc, through variety of media among different audiences.

III. RESEARCH AND INFORMATION NEEDS

During the process of listing the threats to snow leopards and the required conservation actions, a set of information needs was also identified. Hence, the list below encompasses the knowledge required to carry-out urgent conservation actions.

Master List of Information Needs

R.1 Snow leopard distribution and "hot spots"
R.2 Snow leopard migration and dispersal routes
R.3 Snow leopard population size
R.4 Snow leopard population trends and factor responsible for changes
R.5 Protected Area coverage – extent and representation of habitats (gap analysis)
R.6 Agents of habitat degradation and relative impacts
R.7 Snow leopard – prey relationships
R.8 Prey species distribution and "hot spots"
R.9 Prey population baseline and trends
R.10 Dynamics of illegal ungulate hunting (sources, local need, uses, trade, etc.)
R.11 Dynamics of legal ungulate harvest and baseline statistics (sex/age, effort, trophy size, etc.)
R.12 Wild ungulate – livestock interactions (competition)
R.13 Ungulate disease – type, areas of occurrence, prevalence, virulence, treatment
R.14 Snow leopard poaching levels
R.15 Illegal trade in wildlife parts – market demand, sources and routes, value, etc.
R.16 Livestock depredation rates

R.17 Livestock depredation causes
R.18 Grazing pressure and range conditions
R.19 Snow leopard disease – type, areas of occurrence, prevalence, virulence, treatment
R.20 Snow leopard home-range size and habitat use
R.21 Snow leopard social structure and behavior
R.22 Snow leopard population genetics
R.23 Snow leopard food habits
R.24 Snow leopard relationship to other predators
R.25 Economic valuation of snow leopards
R.26 Snow leopard monitoring techniques development/improvement
R.27 Socio-economic profiling of herder communities in snow leopard habitat
R.28 Methods to alleviate impacts of war
R.29 Livestock and human population status and trends
R.30 Analysis of existing policies and laws
R.31 Human attitudes to snow leopards

IV. COUNTRY ACTION PLANNING

The SLSS should be seen as a tool to aid in the development of country-specific Action Plans. In general Action Planning leaders should review the SLSS and then:

- Analyze the problems and choose the proper scale,
- Identify the key stakeholders and integrate them into the planning process at the beginning, (i.e. ensure a broadly participatory process),
- Choose a multi-level approach if the problems and stakeholders are particularly diverse,
- Seek to identify achievable and appropriate actions,
- Build monitoring of results into the Plan.

The Action Planning process need not be done in a vacuum. The Snow Leopard Network (see below), can provide much needed assistance in terms of expertise and advice during the planning process. Collectively, the SLN membership has experience in nearly every area of snow leopard related conservation, research, education, and policy. They can be approached for assistance through the International Snow Leopard Trust, 4649 Sunnyside Ave. N., Suite 325, Seattle, Washington, 98103, USA, on their website http://www.snowleopard.org/sln/ or via email at <info@snowleopard.org>.

V. TAKING THE SLSS FORWARD

A key outcome of the SLSS Workshop was the creation of the Snow Leopard Network (SLN). The SLN is a partnership of organizations and individuals from government and private sector who work together for the effective conservation of the snow leopard, its prey, and their natural habitat to the benefit of people and biodiversity. The initial members of the SLN are the specialist who worked together on the SLSS. Carrying the SLSS forward was the impetus for developing the Network.

© Milan-Trykar

1. Snow Leopard: Review of Current Knowledge and Status

Rationale for a Snow Leopard Survival Strategy

This Snow Leopard Survival Strategy (SLSS) was undertaken to provide comprehensive conservation and research guidelines to ensure a range-wide coordinated effort in the fight to save the endangered snow leopard. The Strategy would be arrived at after a thorough analysis of the threats facing the species, the potential conservation actions to address those threats, and determination of the information needs. The SLSS will then be taken back to the range-countries for further review and input at the local level after which area specific action plans can be developed based on the guidelines of this Strategy. The target users of the SLSS are range-country policy makers and natural resource managers, conservation biologists, development specialists, researchers, and students, any of who are engaged in, or contemplating, snow leopard studies and conservation programs.

Specific Goals

- Assess and prioritize threats to snow leopard survival on a geographic basis.
- Define and prioritize conservation, education, and policy measures appropriate to alleviate threats.
- Prioritize subjects for snow leopard research and identify viable or preferred research methods.
- Build a network of concerned scientists and conservationists to facilitate open dialogue and cross-border cooperation.
- Gain consensus on a fundamental Snow Leopard Survival Strategy document that will be made available to the range states to aid conservation planning at national and local levels.

History of the Process

In February 2001 the International Snow Leopard Trust initiated the development of a Snow Leopard Survival Strategy by inviting 40 knowledgeable individuals to participate in the process. Over the ensuing year the number of participants grew to more than 60. The participant list included 32 representatives from 12 snow leopard range countries (all of snow leopard range except Myanmar where snow leopard occurrence remains unconfirmed). The remaining participants came from the USA and Europe. The specialists involved represented national and international conservation NGOs, range-country governments, academies of science, universities, zoos and independent conservationists. Most individuals had a strong familiarity with snow leopards or issues related to snow leopard conservation. Specialities of participants covered conservation, community development, protected area management, policy and law, research, conservation education, and captive management.

The highly participatory process started with a survey of specialists designed to gather information on perceived threats to snow leopards, appropriate actions to address threats, knowledge gaps, protected area status, policy and law issues, impediments to achieving conservation of snow leopards, and cultural relevance of snow leopards. The results of the survey were provided to participants through an internet website and served as the basis for initiating open discussion among the group. Dialogue was via an email-based discussion group.

The plan of bringing the group together for a Workshop to refine the SLSS document in November of 2001 was put on hold due to the tragic events of September 11 that year. In lieu of that meeting, further email-based discussion was continued and the Workshop was rescheduled for May 2002. In the interim, a second survey was designed to gain additional input from government level policy makers and resource managers. This survey was undertaken to ensure the SLSS would meet the needs of governments using the Strategy as a guide to develop national action plans.

The Snow Leopard Survival Summit was convened in Seattle, USA from 21-26 May 2002 and was attended by 58 of the specialists to debate issues and refine the Strategy. This SLSS document is the end product of that process.

Brief background on the snow leopard

Portions of this section are reprinted directly from Wild Cats - Status Survey and Conservation Action Plan (Nowell and Jackson 1996), Snow Leopard Survey and Conservation Handbook (Jackson and Hunter 1996), Ecology of the Snow Leopard (Fox 1994), Status and Ecology of the Snow Leopard in Mongolia (McCarthy 2000), Snow Leopard Status, Distribution and Protected Area Coverage (Jackson 2002) and Trade in Snow Leopards (Theile 2003).

Other names:

Ounce (English); panthère des neiges, léopard des neiges, once (French); Schnee Leopard, Irbis (German); leopardo nivai, pantera de las nieves (Spanish); xue bao (Chinese); palang-i-berfy (Dari: Afghanistan); bharal he, barfani chita (Hindi, Urdu: India, Pakistan); shan (Ladakhi: India); hi un chituwa (Nepal); Ikar (Pakistan); irbis, irvis (Russia, Central Asian republics, Mongolia); snezhnai bars (Russian); sarken (Tibetan); chen (Bhutan), Sah (Tibetan).

Description:

The snow leopard exhibits superb camouflage for its mountain environment of bare rocks and snow, being whitish-grey (tinged with yellow) in color, and patterned with dark grey rosettes and spots. Further adaptations for high altitude life include an enlarged nasal cavity, shortened limbs (adult shoulder height is about 60 cm), well developed chest muscles (for climbing), long hair with dense, woolly underfur (belly fur grows as long as 12 cm), and a tail up to one meter long, 75-90% of head-body length (Hemmer 1972, Fox 1989, Jackson 1992). Snow leopards molt twice a year, but the summer coat differs little from the winter in density and length (Heptner and Sludskii 1972). The long tail is thought to aid balance, and snow leopards will wrap their tails around themselves when lying or sitting for added warmth. Males are larger than females, with average weights between 45-55 kg as opposed to 35-40 kg for females (Jackson 1992).

Ecology:

Snow leopards are generally solitary, although groups of up to six snow leopards have been reported – presumably these groups consist of a female and her nearly independent young, and possibly a male. Mating usually occurs between late January and mid–March, a time of intensified social marking. These social markings include scrapes, feces, scent sprays and claw rakings, which are deposited along travel routes used by snow leopards. One to five cubs are born after a gestation period of 93 to 110 days, generally in June or July.

Snow leopards are closely associated with the alpine and subalpine ecological zones, preferring broken, rocky terrain with vegetation that is dominated by shrubs or grasses. In the Sayan Mountains of Russia and parts of the Tien Shan Range, they are found in open coniferous forest, but they usually avoid dense forest. They generally occur between elevations of 3,000 to 4,500 m, except within their northern range limit where they are found at lower elevations (900 to 2,500 m). Reports suggest that they migrate to lower elevations during winter in northern Pakistan, the Tien Shan Mountains, ranges in Russia, and parts of India, following movements of their primary prey species such as ibex and markhor. Snow leopards prefer steep terrain broken by cliffs, ridges, gullies, and rocky outcrops, although they may traverse relatively gentle country, especially if ridges offer suitable travel routes and shrubs or rock outcrops provide sufficient cover. They show a strong preference for irregular slopes in excess of 40° and well–defined landform edges, such as ridgelines, bluffs and ravines, along which to travel about their home range.

Home range size and shape is not well known. The home range size of five snow leopards in prime habitat in Nepal ranged from 12 to 39 km^2, with substantial overlap between individuals and sexes. In Mongolia, where food resources may be scarcer, home ranges of both males and females exceeded 400 km^2. Individual cats often move straight line distances of 1 to 2 km between consecutive days, but are capable of periodic long–distance movement in excess of 20 km in a single day. Typically, a snow leopard remains within a relatively small area for 7 to 10 days, then shifts its activities to another relatively distant part of its home range. A study in Nepal indicated that 42–60% of home–range use occurred within only 14–23% of the animal's total home area, indicating strong use of core areas, although this use was separated temporally. Core areas were marked significantly more than non–core sites suggesting that social marking plays an important role in spacing individuals. Home ranges overlap in other areas, as reported from Ladakh and Mongolia.

Snow leopards are opportunistic predators capable of killing prey up to three times their own weight (Schaller 1977, Jackson and Ahlborn 1988, Fox 1989), with the exception of fully grown yak or wild ass. They will also take small prey: in China's Qinghai province, Schaller et al. (1988a) found that 45% of their summer diet consisted of marmots. In general, their most commonly taken prey consists of wild sheep and goats (including blue sheep, Asian ibex, markhor, and argali), but also includes pikas, hares, and game birds (chukor partridge and snowcocks) (Hemmer 1972, Heptner and Sludskii 1972, Schaller 1977, Jackson 1979, Mallon 1984a, Schaller et al. 1987, 1988a, Fox 1989). Jackson and Ahlborn (1984) estimated a snow leopard's annual prey requirements to be about 20-30 adult blue sheep, while McCarthy (2000) estimated 12–15 ibex would be taken in a year. Adult snow leopards kill a large prey animal every 10-15 days, and remained on the kill for an average of 3-4 days, and sometimes up to a week.

Predation on livestock can be significant (Schaller 1977, Mallon 1984a, Fox and Chundawat 1988, 1991, Schaller et at. 1988a,b, Chundawat and Rawat 1994, Oli 1994, Jackson et al. 1994), with stock losses on the Tibetan Plateau averaging about 2% per village, but up to 9.5% in some «hotspots» (Jackson and Fox 1997a). Oli et al. (1994) analyzed 213 scats of snow leopards living around villages within Nepal's Annapurna Conservation Area, and found livestock remains in 17.8%. The proportion increased to 39% in winter, probably in relation to marmot hibernation, deep snow, and a tendency for yak to be less widely dispersed at this time. Snow leopards in this area took live stock despite the availability of blue sheep in relatively high numbers (Oli 1991)

Taxonomy:

The snow leopard (*Uncia uncia*) is a member of the Felidae subfamily Pantherinae (Blomqvist 1978, Nowak and Paradiso 1983). On the basis of morphology and behavior it is placed alone in a separate genus (Pocock 1917, Peters 1980, Rieger 1980, Hemmer 1967, 1972). The snow leopard's vocal fold is less developed than in the other pantherines, lacking a thick pad of fibro-elastic tissue, so that it cannot make the low and intense «roars» of which the other big cats are capable (Hemmer 1972, Peters 1980, Hast 1989). Kitchener (1993, in litt) has suggested that the snow leopard, for which two subspecies have been described (Stroganov 1962) but are not generally recognized (e.g., Hemmer 1972, Wildt et al. 1992), is a prime candidate for subspeciation because of the insular and patchy nature of its high mountain habitat. Similarly, Fox (1994) draws attention to the gap between the main southern snow leopard population and the northern population in Russia and Mongolia, and suggests that the two populations may differ genetically. On the other hand, instances of snow leopards migrating up to 600 km have been reported from the former USSR (Heptner and Sludskii 1972, Koshkarev 1990). As in other Pantherinae, the diploid chromosome number in snow leopards is 38 and the fundamental number is 36. There are 17 metacentric and 2 acrocentric chromosomes (Soderlund et al. 1980). The karyotypic banding pattern is almost identical to that in other Pantherinae (Gripenberg et al. 1982). There is virtually no fossil record of snow leopard, the only positive identifications being upper Pleistocene remains from Altay caves (Hemmer 1972).

Historic Distribution:

The historical range of the snow leopard is restricted to the mountains of Central Asia. With core areas in the Altay, Tien Shan, Kun Lun, Pamir, Hindu Kush, Karakoram, and Himalaya ranges. Its north to south distribution occurs within the countries of the Soviet Union, Mongolia, China, Afghanistan, Pakistan, India, Nepal and Bhutan. Early reports of snow leopards from as far west as Asia Minor and as far east as Sakhalin Island are apparently incorrect (Rieger 1980).

Range Map

The United States Geological Survey (USGS) in cooperation with the International Snow Leopard Trust, produced a range-wide model of potential snow leopard habitat and presented it at the 8th International Snow Leopard Symposium in 1995. The map (Figure 1) is based on the Digital Chart of the World (DCW) 1:1,000,000 series, the digital equivalent of the United States Defense Mapping Agencies Operational Navigation Chart series. Using paper maps, polygons were drawn around estimated elevation limits for snow leopard range. Likewise the boundaries for protected areas were drawn in. These polygons were digitized and combined with the DCW country borders to create an initial range map with permanent snow fields and water bodies excluded. The resultant map of potential habitat was categorized as "fair" for areas of slope less than 30 degrees or within designated buffer limits of human habitation, and as "good" for areas with greater than 30 degrees slope. Standard GIS tools were used to extract potential habitat tables for snow leopard range countries. Table I provides estimates of total habitat, good habitat, fair habitat, and the percent of habitat within protected areas.

The model suggested that there was more potential snow leopard habitat than previously estimated, especially in China, Afghanistan, Mongolia, and Russia. Yet there were several limitations that had to be recognized when interpreting the results of that mapping exercise. Small map scales and hand drawn polygons of imprecise protected area boundaries added a confounding factor and served to limit accuracy. This model also used only geographic habitat selection figures, omitting criteria such as prey distribution, competition, grazing pressure, and other important parameters. This model was a step in an evolving process, and specialists must continue to correct discrepancies and create more sophisticated models. We present this map here as the best available product to date, but in full recognition of its short-comings. The SLSS offers a good opportunity to begin the process of improving on the above model.

The total area of suitable habitat within the region indicated by the range map is approximately 1,230,000 km^2. The area of suitable snow leopard habitat for each country in which it occurs has been calculated on the basis of published estimates and range maps, and where only general range descriptions are available, an assumption of the leopard's restriction to mountain ranges (Table I). In Bhutan, regions above 3000 m were included as suitable habitat, whereas in the Soviet Union all mountainous regions within its reported range were considered as suitable.

Much of the range-wide information on protected areas (PAs) coverage is taken from Green (1988, 1992), selected country reports (e.g., Singh et al. 1990), or from unpublished sources (e.g., Nepal and Bhutan). Green and Zhimbiev (1997) identified 109 protected areas covering an area of 276,123 km^2, comprising of those places known to have snow leopards or as lying within potential snow leopard habitat. According to the information set contained in SLIMS (Jackson 1992), the number of protected areas is more like 120, but a vast majority are far too small to harbor a significant number of snow leopards. For example, of 102 protected areas, only 25% exceeded 1,000 km^2 in size, while 55% covered an area of 500 km^2 or less (Nowell and Jackson 1996). Another point of note is that many PAs contain relatively high percentages of non-habitat in the form of rock and permanent ice (WWF-US in prep.), so that size alone can be rather misleading.

There is little information on the current management status of protected areas or their role in sustaining snow leopard populations (Fox 1994, Green 1992, 1994, Green and Zhimbiev 1997). Jackson and Ahlborn (1990) felt that a large proportion of Nepal's snow leopard population probably occurred outside of the country's protected areas, where they were at greater risk from human activity. Transboundary or transfrontier protected areas may play an especially important role in sustaining the overall snow leopard population, since much of the species' range encompasses mountain ranges that constitute international borders (Fuller and Ahmed 1997, Green 1994, Singh and Jackson 1999). Green and Zhimbiev (1997) claimed that 66% of the snow leopard protected areas serve as de facto or potential transboundary protected areas.

To date, only Mongolia, Pakistan and Russia have implemented or drafted National Snow Leopard Conservation Plans (SLSS 2002), and although India initiated such a process at the 5th International Snow Leopard Symposium in 1986, it has yet to be followed through.

Total Range Area and Population:

As shown in Table II, Snow leopards are found in 12 countries across Central Asia (China, Bhutan, Nepal, India, Pakistan, Afghanistan, Tajikistan, Uzbekistan, Kyrgyzstan, Kazakhstan, Russia, and Mongolia). China contains as much as 60% of the snow leopard's potential habitat.

Inaccessible and difficult terrain, along with the secretive nature of this rare cat helps account for the fact that large parts of its range have yet to be surveyed, or have been surveyed only on rare occasions. Much of the snow leopard's distribution is located along contentious international borders, adding to the difficulty of reliably establishing the species' current status and distribution. In addition, many surveys were conducted over a decade ago, so that the existing database may be seriously outdated. There is now general agreement that population estimates of around 2,000 made in the early 1970's, when the endangered species regulations were enacted, are too low. Fox (1989) placed the total snow leopard range at 1.23 million km^2, with a world population of 3,350 - 4,050 animals. These figures were updated to between 4,510 and 7,350 snow leopards within a total potential habitat area of 1,835,000 km^2 (Fox 1994).

Drawing on the 1:1,000,000 World Digital Charts, and using GIS, Hunter and Jackson (1997) estimated potential habitat for snow leopard at about three million km^2, with some six percent falling within the existing or proposed network of PAs (Table I). For a map of potential habitat, see Figure 1 in Jackson and Ahmad (1997). At a uniform density of one cat per 300 km^2 this would translate into a total population of about 10,000 individuals. Obviously, not all of this area is occupied by the species because of excessive hunting pressure, lack of sufficient prey, disturbance by livestock and attendant humans, presence of marginal habitat or other factors.

Table I: Potential Habitat Area (in square kilometers) for Snow Leopard across its Range in Central Asia (Hunter and Jackson, 1997).

Country	Total Potential Habitat *(Estimated occupied habitat)*	Good	Fair	Percent Protected
Afghanistan	117,653 *(50,000)*	32,748	84,905	0.3
Bhutan	7,349 *(15,000)*	1,269	6,080	57.4
China	1,824,316 *(1,100,000)*	290,766	1,533,550	6.3
India	89,271 *(75,000)*	33,996	55,275	14.4
Kazakhstan	71,079 *(50,000)*	14,775	56,304	1.7
Kyrgyzstan	126,162 *(105,000)*	32,783	93,379	1.1
Mongolia	277,836 *(101,000)*	21,180	256,656	2.5
Myanmar (Burma)	4,730 *(0)*	3,094	1,636	0.0
Nepal	27,432 *(30,000)*	12,388	15,044	26.7
Pakistan	81,016 *(80,000)*	32,348	48,668	6.6
Russia	302,546 *(130,000)*	41,166	261,380	4.5
Tajikistan	78,440 *(100,000)*	27,337	51,103	13.3
Uzbekistan	13,834 *(10,000)*	5,083	8,751	5.8
Disputed Areas	3,064	773	2,291	0.0
All Countries	3,024,728	549,706	2,475,022	6.0

However, on the basis of available habitat, there could easily be as many as 6,000 to 8,000 snow leopards, especially given densities in known "hotspots" of the order of 5-10 individuals per 100 km^2. Conversely, areas classified as offering good habitat may no longer support good numbers of snow leopard. This exemplifies the difficulty of making population estimates without ground-truthing maps for their accuracy along with also verifying population extrapolations with data accruing from credible field status surveys.

It is often difficult to validate the reliability of published information, especially in the rapidly changing world we have seen over the past decade or so. For example, with the emergence of four entirely new independent "snow leopard " states in the Post-Soviet Central Asia, it is not hard to see why so much confusion exists over what were formerly well established permanent or temporary nature reserves given the radical political, social and economic change the region has undergone. Even in a relatively stable country, protected areas recognized by the State government may not receive equivalent recognition from the central government, such as the case of Jammu and Kashmir in India. There is often considerable variation in the reported size of a protected area among different sources.

Country by Country Status Accounts:

Afghanistan

The area of potential habitat in this country been estimated at 80,000 km^2, 50,000 km^2, and 117,653 km^2 respectively by Fox (1989), Fox (1994), and by Hunter and Jackson (1997). Sayer (1980) and Adil (1997) reported on distribution and conservation of snow leopards in Afghanistan, but neither authors offered a population estimate. There are reliable sightings from the Big Pamirs, the Wakhan corridor, and the small Pamirs (specifically the Qule Chaqmaktin, Tegar Qarom and Berget valleys). It is also reported from Zebak in the southern part of Badakhshan. Reports from the Ajar valley by local people have not been substantiated. In the past, snow leopards have been widely hunted because of the fur trade and stock theft (Petocz 1978). No doubt snow leopards and their ungulate prey have been very significantly impacted by the past 20 years of war, but information is lacking (Adil 1997; Zahler and Graham 2001).

The current status of snow leopard in Afghanistan is not known. Given the long history of civil war and armed conflict, it is hardly surprising that Afghanistan's wildlife laws are not being enforced nor are its PAs receiving any protection or management.

Bhutan

Potential snow leopard range in Bhutan totals as much as 15,000 km^2 according to Fox (1994). The 7,349 km^2 GIS-generated estimate provided by Hunter and Jackson (1997) is probably somewhat low. However, due to extensive forest cover the lower elevational limit for the species in Bhutan is probably closer to 3,800 than the 3,000 - 3,500 m typically of other parts of the Himalaya. As much as 57% of potential snow leopard range falls within existing PA system (Hunter and Jackson 1997). Assuming a density of one cat per 100 km^2, there would be about 100 snow leopards in Bhutan (Jackson and Fox 1997b).

Sign surveys have been conducted in two portions of Jigme Dorje National Park (Jackson and Fox 1997b; Jackson et al. 2000). Both surveys confirmed presence, but suggested lower average densities than in the Shey-Phoksundo National Park in Nepal, despite the greater abundance of blue sheep in Bhutan compared to Nepal (Fox and Jackson,2002).

When the Jigme Dorje Wildlife Sanctuary was declared in 1974, it encompassed the entire northern border of the country totaling 7,892 km^2 in area (Blower 1986). In 1995 the reserve was upgraded to national park status, but reduced in area to a contiguous 4,350 km^2 area along the country's western border with China (WWF-Bhutan unpub. data). Surveys are needed to confirm snow leopard presence in Torsa Strict Nature Reserve (650 km^2), the 1,184 Kulong Chhu Wildlife Sanctuary and possibly also the 755 km^2, Sakteng Wildlife Sanctuary. Occurrence within the 890 km^2 Thrumshingla National Park is deemed very unlikely, while the 1,730 km^2 Black Mountain National Park is isolated by extensive forest cover from the main distributional range of snow leopard in Bhutan (Jackson et al. 2000).

China

Fox (1994) estimated the total amount of snow leopard habitat in China at 1,100,000 km^2 with a population of 2,000-2,500 individuals (assuming a mean density of 1 animal per 250-300 km^2). Potential habitat was computed at as much as 1,824,316 km^2 (Hunter and Jackson 1997), making China, potentially at least, the single most important country with as much as 60% of all snow leopard range. Approximately 6% of this is thought to be is under PA coverage (Hunter and Jackson 1997).

Snow leopards occur in six provinces or autonomous regions (Qinghai, Gansu, Sichuan, Yunnan, Xinjiang and Xizang or Tibet), but are on the verge of extinction in a seventh (in Inner Mongolia). Wildlife was severely affected during cultural revolution throughout China, but especially in Qinghai Province. The trading in snow leopard bones and body parts for use in the traditional Chinese medicine (TCM) constitutes an increasingly serious threat throughout this region.

The largest reserve complex (in excess of 478,000 km^2) is that located on the Tibetan Plateau within Tibet and along the boundary of Xinjiang and Qinghai. However, these reserves harbor few snow leopards, because of unfavorable terrain, sporadic and generally low blue sheep numbers, or the presence of habitat rendered marginal by the high base altitude of the northwestern portions of the Tibetan Plateau (Schaller 1998). This protected area complex consists of Kokixile (83,500 km^2) in Qinghai, the 300,000 km^2 Chang Tang Reserve (including the Memar addition) in Tibet, and the 45,000

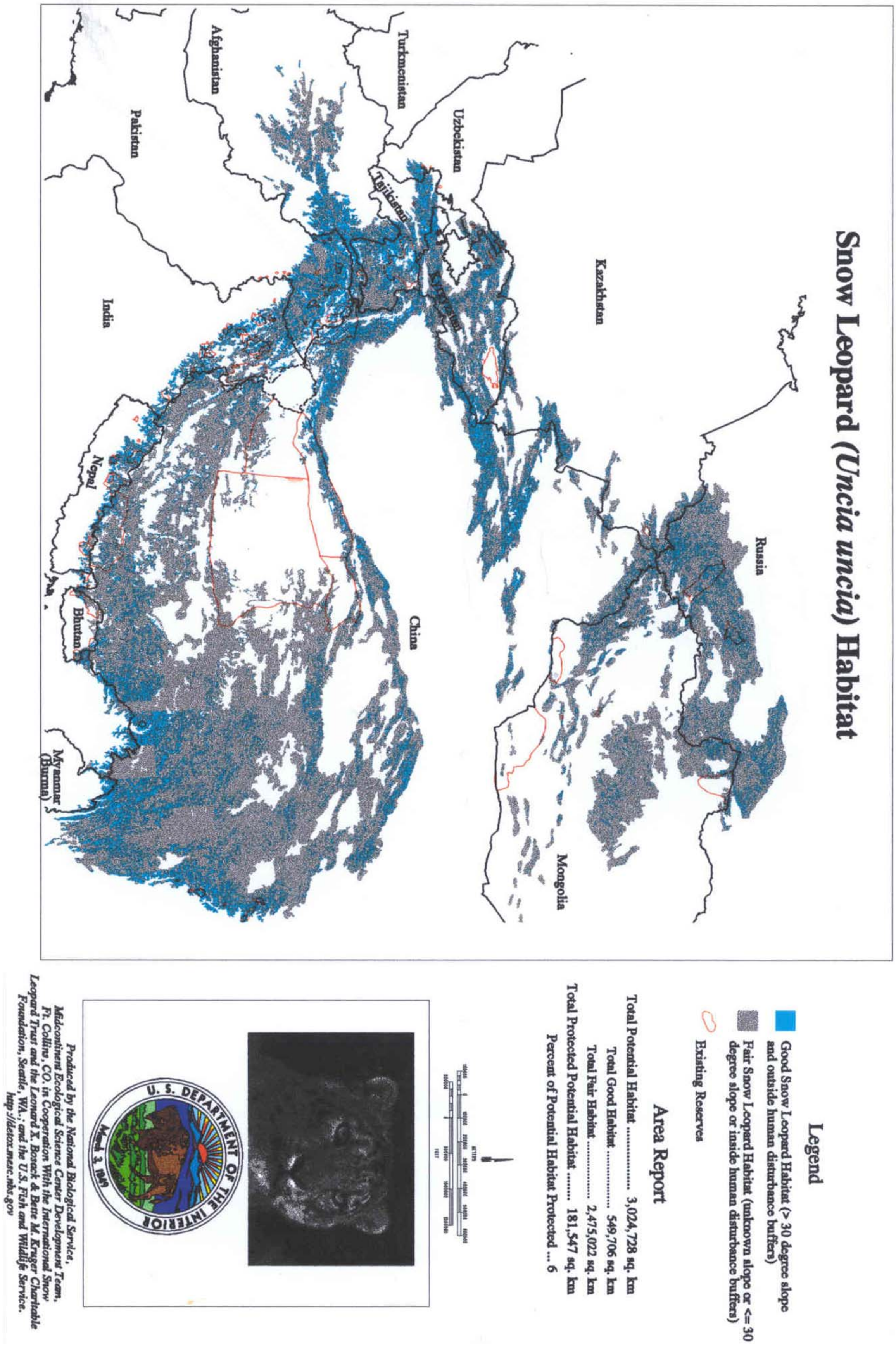


Figure 1: Range wide model of potential snow leopard habitat.

Table II: Distribution and population estimates for Snow Leopard (Derived from Fox (1994) except where more current citations available. See Source of Data.)

Range State	Area of habitat (km²)	Estimated population	Source of Data
Afghanistan	50,000	? (100-200)	Area-based estimate, low density
Bhutan	15,000	? (100-200)	Area-based estimate, medium density
China	1,100,000	2 000-2 500	Schaller, 1990; Jackson, 1992
India	75,000	200-600	Chundawat et al. 1988; Fox et al. 1991
Kazakhstan	50,000	180-200	Annenkov, 1990; Zhirjakov, 1990
Kyrgyzstan	105,000	150-500	Koshkarev 1989, Koshkarev, 2000
Mongolia	101,000	500-1 000	Green, 1988; Schaller et al. 1994; McCarthy, 2000a
Nepal	30,000	300-500	Jackson and Ahlborn, 1990
Pakistan	80,000	200-420	Schaller, 1976 and 1977; Hussain, 2003
Russia	130,000	150-200	Poyarkov and Subbotin, 2002
Tajikistan	100,000	180-220	Bykova et al., in litt 2002.
Uzbekistan	10,000	20-50	Kreuzberg-Mukhina et al., 2002

km^2 Arjin Shan Reserve in Xinjiang, with a proposed 50,000 km^2 addition along the central Kun Lun Range, also in Xinjiang. With the recent addition of the Xianza Reserve in Tibet's Siling County, this is the second largest protected area in the world (the largest, in Greenland, is mostly under permanent snow and ice cover).

Gansu Province: Liao and Tan (1988) listed 9 counties that reported snow leopards, but the species occurs along the periphery of this province, with most or all populations having been seriously depleted. It is now only marginally present in the Qilian Shan range along the border with Qinghai and in the Die Shan (several individuals only) along the border with Sichuan. Snow leopards have been extirpated from the Mazong Shan and the other outlying ranges along the Gansu-Inner Mongolia boundary (Wang and Schaller 1996).

The 5,000 km^2 Yanchiwan Reserve contains a small population (Schaller et al 1988b). The Qilian Shan National Nature Reserve, with a total area in excess of 20,000 km^2 was formerly offered good habitat, but there are now very few snow leopards or blue sheep left there (Jackson and Hunter 1994, unpub. data). More abundant blue sheep and argali populations, along with snow leopard sign, was found in a relatively small area in Subei County south of Zhangye (Jackson and Hunter1996, unpub. data), but there is apparently a decrease in number toward the Xinjiang boundary. Status surveys are urgently needed in the western edge of the province, as well as the central and eastern section of the Qilian Shan Reserve. Depletion of prey (blue sheep, argali, white-lipped and red deer) by unregulated hunting and poaching is probably the most important factor in the decline of snow leopard in this area. The status of poaching for the bone trade is unknown, here and in most other parts of snow leopard range in China.

Qinghai Province: Liao and Tan (1988) listed a dozen counties which contain snow leopard, Liao (1994) prepared a range map for the species, and Yang (1994) reported on recent field sightings. However, the most comprehensive and also wide-ranging field surveys were undertaken by Schaller and his co-workers during the mid-1980's.

Schaller et al. (1988b) estimated the total population at about 650 snow leopards within an occupied range of some 65,000 km^2 (based on an average of one cat per 100 km^2). This amounts to about nine percent of the total area of Qinghai and fringing parts of Gansu Province. Their range map shows a highly fragmented range including the Arjin Shan (bordering Xinjiang), the Danghe Nanshan, Shule Nanshan, and Qilian Shan bordering Gansu Province, and the Kunlun Shan which bisects Qinghai and terminates in the Anyemaqen Shan, along with a series of small massifs in the south near Tibet and Sichuan. Within the latter range section, Schaller et al. identified three «hotspots» (North Zadoi, South Zadoi, and Yushe), where the snow leopard density was placed at about one cat per 25-35 km^2. Abundant sign was also noted in parts of Eastern Anyemaqen and the Shule Nanshan in the extreme north of Qinghai Province. While the map prepared by Liao (1994) has important differences in the snow leopard's geographical distribution pattern from that of Schaller, it also illustrates the cat's range is highly fragmented in Qinghai.

Snow leopards have only been confirmed from two protected areas: the Dulong Hunting Reserve which covers about 75 km^2 and is obviously an area too small to harbor more than one or two cats, and Wild Yak Valley which is considered marginal snow leopard habitat (D. Miller, pers. comm.). At least 6 other areas (Kokixili 83,500 km^2, Arksai County Liqiaru Snow Leopard Area, Arba Snow Leopard Reservation, Ganza Snow Leopard Reservation, and Baoxin Snow Leopard Reservation) were proposed for reserve status at the 7th International Snow Leopard Symposium (Fox and Du, 1994). However, the legal status of these remains uncertain.

Sichuan Province: There is virtually no information on snow leopard distribution and status in Sichuan Province. Even its presence in selected giant panda reserves has yet to be confirmed, it is probably present in low numbers in various areas above timberline (Schaller 1998). Liao and Tan (1988) listed 10 counties where snow leopard have been reported, including Yaan, Baoxing, Jinchaun, Xiaojin, along with Aba, Garze, Dege and Batang. Clearly, surveys are urgently needed to confirm and establish the current distribution of snow leopard in Sichuan.

Yunnan Province: Information on snow leopard status and distribution in Yunnan is lacking, and field surveys are also urgently needed in this province. The amount of potential habitat, however, is limited to a small area in the Hengduan Shan where the TAR, Sichuan and Myanmar meet.

Inner Mongolia Autonomous Region: According to Schaller (1998), snow leopards once occupied most of the large desert ranges on the Inner Mongolia-Ningxia border, including the Dongda Shan, Yabrai Shan, Ulan Shan, Daqing Shan and the Helan Shan, along with the Longshou Shan on the Inner Mongolia - Gansu border.

The species is now on the verge of extinction in Inner Mongolia and its continued survival is considered unlikely (Wang and Schaller 1996). A few cats may persist in the Arqitu area of the Lang Shan, and transients are occasionally killed along the border with Mongolia. Wang and Schaller (1996) cite three areas which receive some protection, but none of these any longer support snow leopard. These areas are the Helan Shan (2,225 km^2) on the Inner Mongolian-Ningxia border, Ludansuoulin (not suitable snow leopard habitat) on the Mongolian border (106° 3" - 107° E) and the Lerenzhouer Reserve (which probably harbors the area's largest argali population).

Tibet Autonomous Region (TAR): As noted by Schaller (1998), the status and distribution of snow leopards within the species' core range still remains largely unknown. However, it occurs sporadically across the entire Tibet Autonomous Region, with a more or less continuous distribution along the northern slopes of the Himalaya, and along the larger mountain ranges which bisect the Tibetan Plateau.

Surveys by Schaller (1998) indicate snow leopards are scarce in the Gandise and Nyainqentangla ranges, and both rare and localized in the vast Chang Tang Reserve, which he attributes to a paucity of blue sheep and cliff or other suitable escape habitat. Despite wide-ranging surveys across much of northwestern Tibet, Schaller rarely encountered snow leopard sign. This pattern may hold for other parts of Tibet, for example, a survey of over 40,000 km^2 area south of Lhasa along the Bhutan border indicated snow leopards had been virtually exterminated in the last decade. Several areas with reasonable blue sheep populations lacked snow leopard sign. Furthermore, initial surveys across parts of eastern Tibet indicate that blue sheep, the snow leopard's primary prey across the Tibetan Plateau, are very sparse and highly localized. The more extensive forest cover of SE Tibet further limits potential habitat for snow leopard, a fact not accounted by in the potential range map developed by Hunter and Jackson (1997). Elsewhere in eastern or northeastern Tibet, the more intensified human settlement and animal husbandry practices would be expected to adversely affect both snow leopard and their prey species, but these need to be validated through surveys.

The best habitat for the species seems to occur in the sparsely populated and more broken western parts of Tibet, especially along the international border with Nepal and India. Jackson (1994a) reported up to 100 cats in the Qomolangma Nature Preserve, a 33,910 km^2 area along the main Himalaya and Nepalese border and centered on Mt. Everest.

Other reserves that may harbor snow leopard include the Xianza Reserve in central Tibet and the Medog (626 km^2) or Namche Barwa Reserve on the Yarlung Tsangpo in southern Tibet which is a comprised of a series of adjacent areas including the Dongjiu red goral reserve, the Bomi Gangxiang nature reserve, the Niela Tsangpo, and the Deyanggou takin reserve - a number of which are located in the area under Indian administration (Jiang and Bleisch 1996). In addition, there are three small reserves near the town of Zayu and the India's Arunachal Pradesh border which may harbor a few snow leopards, but this needs to be confirmed with ground surveys (Schaller, pers. comm.).

Thus, snow leopard status and habitat in Tibet urgently needs to be delineated. Areas with the highest priority for status surveys are the Nayainqentanglha, Taniantaweng and Ningjing Shan mountains in eastern and south-eastern Tibet, and along with western Nepal, the mountains bordering Uttar Pradesh in India, and the Nganlang Kangri mountains bordering Ladakh.

Xinjiang Autonomous Region: Schaller et al. (1988a) judged there were about 750 snow leopards in 170,000 km^2 of suitable habitat in Xinjiang, or about 10.6% of its total land area. Snow leopards are found in the Tien Shan mountains almost to the Mongolian border (Nan Shan and Karlik Shan); along the Mongolian-China border in the Altay, Baytik and Khavtag Shan complexes, in the Dhungarian Alatau (along the Kazakhstan border), the Arjin Shan and Kun Lun range along the northern edge of the Tibetan Plateau, the Pamirs along the Tajikistan/Afghanistan border, and the Karakorum mountains along the Pakistani border (see distribution map published by Schaller et al. 1987). There are three known reserves, but more if hunting areas are included too. The information in Schaller's distribution map is probably out-of-date now.

Known reserves are the (1) Taxkorgan Reserve (14,000 km^2 estimated population of 50-75 leopards, mainly in Mariang area) (Schaller et al. 1987); (2) A Er Jin Shan or Arjin Mountains (45,120 km^2), home to only a few snow leopard because of marginal habitat, with most snow leopards ranging across the south-eastern edge of the reserve (Butler et al. 1986; Schaller 1998); and (3) the Tomur Feng Reserve (100 km^2), which harbors fewer than 15 cats and with reports of 12 snow leopards having been killed during the winter of 1986-6 in a nearby area (Schaller et al. 1987). There are several proposed or de facto hunting reserves in Xinjiang that may harbor snow leopard. These are located in Hamu, Altay and Aksu (Pamir) prefectures, but no further information is available at the time of writing.

Judging by the number of pelts displayed in the Kashgar (Kashi) bazaar, poaching of snow leopard and other felid species is a serious problem. In 1992, one observer reported more than 30 snow leopard pelts being openly displayed for sale.

India

Chundawat et al (1988) estimated potential habitat for snow leopard in India at 95,000 km^2, of which 72,000 km^2 are located within Ladakh (a figure which includes about 20,000 km^2 within the disputed area between Pakistan and China). Mallon's (1984a) report of only 100 - 300 snow leopards in Ladakh is certainly too low. Fox et al. (1991) reported that there were about 400 cats in North West India within the 72,000 km^2 area. These authors placed India's total snow leopard number at about 500, derived by extrapolating from an average density of one animal per 110 km^2 for good habitat along the north slopes of the Himalaya (an area of 30,000 km^2) and one per 190 km^2 for lower quality habitat along the southern slopes of Himalaya (area of 22,000 km^2). Hunter and Jackson estimated the amount of potential habitat in India at 89,271 km^2 of which about 14.4% under PA status.

There are at least 18 and possibly as many as 34 existing and proposed protected areas which could harbor snow leopard (Rodgers and Panwar 1988; Government of India 1988; Fox et al. 1991; Green 1992; Singh et al. 1990; ISLT, unpub. data). Bhatnagar et al (2001) listed 25 protected areas, totaling 7.6% of the biogeographic zone supporting the species. Snow leopards are reported or may be present in the following protected areas (asterisk * indicates confirmed presence):

Jammu and Kashmir State: A total of 12 areas, but the status of many is uncertain. These are Hemis National Park* (4,100 km^2 - good population); Dachigam National Park (141 km^2 - reported seasonally); Overa-Arun Wildlife Sanctuary (425 km^2); Kishtwar National Park* (425 km^2) ; Rangdum (Nunkun) Wildlife Sanctuary* (200 - 550 km^2); Kanji Wildlife Sanctuary (100 - 340 km^2); Lungnag Wildlife Sanctuary* (400 - 1,000 km^2); Tongri Wildlife Sanctuary (25 - 70 km^2); Karakorum (Saichen-Shyok) Wildlife Sanctuary* (5,000 km^2); Daultberg Depsang Wildlife Sanctuary (500 - 1,000 km^2); Changtang Wildlife Sanctuary (1,000 - 3,000 km^2); and Rupshu Wildlife Sanctuary* (1,000 - 3,000 km^2).

Himachal Pradesh State: the Pin Valley National Park* (675 km^2); Great Himalayan National Park*? (1,716 km^2); Kanwar Wildlife Sanctuary (61 km^2); Khokhan Wildlife Sanctuary (592 km^2); Kugti Wildlife Sanctuary (118 - 379 km^2); Lippa Asrang Wildlife Sanctuary (31 - 109 km^2); Nargu Winch Wildlife Sanctuary (278 km^2); Raksham Chitkul Wildlife Sanctuary (34 - 138 km^2); Rupi Bhaba Wildlife Sanctuary (125 - 269 km^2); Sechu Tuan Nala Wildlife Sanctuary (103 km^2); Tirthan Wildlife Sanctuary (61 km^2); and the Tundah Wildlife Sanctuary (64 km^2).

Uttaranchal State (formerly Uttar Pradesh): Nanda Devi National Park* (630 km^2); Kedarnath National Park* (967 km^2); Valley of Flowers National Park (88 km^2); Govind Pashu Vihar Wildlife Sanctuary* (953 km^2); and Yamunotri Wildlife Sanctuary (200 km^2).

Sikkim State: Kangchendzonga National Park* (850 km^2); Dzongri Wildlife Sanctuary (468 km^2); and Tolung Wildlife Sanctuary (230 km^2).

Arunachal Pradesh State: Dibang Valley (2,000 km^2). Reports of snow leopard from the 1,807 km^2 Namdalpha National Park are highly likely to be erroneous, since the small amount of alpine habitat present is separated from the main Himalaya by extensive forest cover.

A density estimate is available only for one protected area, namely Hemis National Park. Mallon and Bacha (1989) estimated 75-120 cats in a 1,200 km^2 area of Hemis National Park of Ladakh. On the basis of tracks, Fox et al. 1988 concluded there were 5 to 10 snow leopards in the reserve or as many as 14 on the basis of available prey, a number later increased to 50-75 (Fox and Nurbu 1990).

Following in the apparent success of its tiger conservation initiative, in 1986 the Government of India launched Project Snow Leopard at the 5th International Snow Leopard Symposium which was held in Srinagar, Jammu and Kashmir. However, there has been very little follow-through, unlike the Project Tiger model. Basically, the snow leopard 'conservation plan' (Government of India 1988) identified reserves with known or potential snow leopard habitat and offered management and staffing recommendations for the key 13 snow leopard protected areas. Other than the surveys by Fox et al (1989) and centered in Jammu and Kashmir, there has been no systematic survey of the species in other parts of its range within India. Bhatnagar et al. (2001) offer a regional perspective for snow leopard conservation in the tans-Himalaya of India.

Myanmar (Burma)

A small area of potential habitat occurs in Myanmar along the Yunnan border (Hunter and Jackson 1977). While a few blue sheep remain, the presence of snow leopards is deemed unlikely (Rabinowitz and Schaller, pers comm.). A focused survey along the 4,700 km^2 area of high mountains is required to verify presence/absence of snow leopard. If presence were to be confirmed, Myanmar would become the 13th country with a wild snow leopard population. The only potential protected area is Mt. Hkakabo Raza, National Park which harbors the remaining blue sheep (Wikramanyake et al. 1998, 2001).

Mongolia

McCarthy (2000) estimated total range at 103,000 km^2, a figure similar to the Mallon's (1984b) estimate of 130,000 km^2, and the Schaller et al. (1994) estimate of 90,000 km^2 -- but substantially different from Hunter and Jackson's figure 277,836 km^2. However, the latter is based on GIS modeling rather than field observation or interviews of local residents. The main populations are said to occur in the Altay and Transaltai Gobi mountain ranges, with smaller populations in the Khangai, Hanhohiy Uul and Harkhyra Uul ranges. Koskharev (1998) reported sightings made along sections of the Mongolia - Russian border (see account under Russia). Schaller et al. (1994) placed the eastern-most range extent at about 103 degrees longitude (see note under Inner Mongolia, China).

Thornback and Holloway (1976) placed Mongolia's total population at less than 300, which is certainly too low a number. Bold and Dorzhzunduy (1976) estimated a total snow leopard population of 500-900. They judged there were 190-250 snow leopards in a 6,600 km^2 area in the South Gobi Province, and a calculated density of 4.4/100 km^2 in a 1,000 km^2 area encompassing the Tost Uul Range. Based on field surveys in the Altai and South Gobi area, Schaller et al. (1994) placed the total at about 1,000 snow leopards, and published a detailed range map that highlighted the very fragmented distributional pattern. Schaller et al. (1994) found sign of at least 10 cats within a 200 km^2 area of the Burhan Budai of the Altay, a density substantially above that existing elsewhere.

McCarthy (2000) provided a detailed range map and assessment of snow leopard status and distribution in Mongolia, based on 328 sign transects across the snow leopard's entire range in this important range country. Presence is reported or suspected from up to 10 aimags, with population estimates varying from 800 to 1,700 individuals (McCarthy 2000). The highest densities are said to occur in the South Gobi, Central Transaltai, and Northern Altai, with remnant populations in Khangai and possibly Khovsgol where the last snow leopards were sighted in the 1960s. McCarthy's surveys indicated that snow leopards cross 20-65 km of open steppe in traveling between isolated massifs. McCarthy concluded the snow leopard distribution in the Khangai is much reduced over that previously reported by Mallon (1985) and Schaller et al. (1994).

At least 10 protected areas harbor snow leopards (McCarthy 2000), totaling about 18% of the snow leopard's range within Mongolia. The protected areas include: (1) the Transaltay Gobi Strictly Protected Area or SPA (consisting of Great Gobi 'A' 44,190 km^2 and 'B' 8,810 km^2), (2) Khokh Serkh SPA; (3) Otgontenger SPA; (4) Tsagaan Shuvuut SPA; (5) Turgen Uul SPA; (6) Gobi Gurvansaikhan National Conservation Park or NCP, a 12,716 km^2 area in the south Gobi (Reading 1995); (7) Altai Tavaan Bogd NCP; and (8) The Burhan Buudai Nature Reserve, Alag Khairkhan Nature Reserve and Eej Uul National Monuments, in all totaling 1,110 km^2 within the snow leopard's range in the central Transaltai Gobi. Snow leopard sign has not been observed in the 723 km^2 Khokh Serkh SPA by either Schaller or McCarthy. Gurvan Saikhan and Altai Tavaan Bogd are the two largest PAs totaling some 28,080 km^2. McCarthy (2000) provides a list of areas meriting consideration for protected area status.

Nepal

The total amount of potential range is about 30,000 km^2 with a country-wide population of 150-300 animals (Jackson 1979, unpub. data). By applying a computerized habitat suitability model, Jackson and Ahlborn (1990) placed the hypothetical population for Nepal at between 350 and 500 individuals. Hunter and Jackson estimated the potential habitat at 27,432 km^2 with 26.7% under PA status.

Snow leopards are distributed along the northern border of Nepal with Tibet, with the largest populations occurring in the western parts (Mustang, Mugu, Dolpo and Humla districts) of Nepal (Jackson 1979). Snow leopards have been sighted north of the Annapurna Range, in the Langtang Himal, Rolwaling Himal, Makalu, Walunchung and Kanchenjunga massifs. Jackson and Ahlborn (1989) reported a density of at least 5-10 snow leopards per 100 km^2 in the remote, uninhabited Langu Valley of west Nepal. These are slightly higher than estimates from Manang (north of the Annapurna Range) in the Annapurna Conservation Area (Oli 1995), where blue sheep and livestock biomass exceeds 1,200 kg per km^2 (Jackson et al. 1994b).

Snow leopard presence has been confirmed in all but one of the following protected areas (Ahlborn and Jackson 1990, Dhungel 1994, Kattel and Bajimaya 1997): Langtang National Park (1,710 km^2); the Shey-Phoksundo National Park (3,555 km^2); Dhorpatan Hunting Reserve (1,325 km^2); Annapurna Conservation Area (7,629 km^2 in area, including the Manang, Nar Phu and Mustang sectors each offering good to excellent snow leopard habitat); Sagarmatha National Park (1,148 km^2); Kangchenjunga Conservation Area (2,035 km^2); Manaslu Conservation Area (1,663 km^2); and possibly elevation portions of the 2,233 km^2 Makalu-Barun National Park and Conservation Area. The 35,000 km^2 Qomolangma Nature Preserve in Tibet and centered on Mt. Everest, provides a corridor linking the protected areas of Makalu-Barun, Sagarmatha, Langtang, Manaslu and Annapurna, thus offering a potentially vast transfrontier protected area (Singh and Jackson 1999).

Based upon a computerized habitat model, Jackson and Ahlborn (1990) concluded that 65% of Nepal's snow leopard population was located outside of its protected areas. Populations of 50 or more individuals might be expected in three reserves (Shey-Phoksundo, Langtang and Annapurna), but no protected area is expected to contain more than 180 animals even assuming mean densities as high as 5 snow leopards per 100 km^2 as suggested from sign surveys (Jackson and Ahlborn 1989; Fox and Jackson, 2002).

Pakistan

Fox (1994) estimated snow leopard range in Pakistan at 80,000 km^2, while Schaller (1976) placed the total number at 100-250. Schaller searched a 300 km^2 area in Chitral known for snow leopard, but found evidence of only four or possibly five. Density estimates are lacking, but assuming a mean density of 1/250 km^2, the total population for Pakistan would be no more than about 320 snow leopards. Snow leopards occur in the Hindu Kush range in the Northwest Frontier Province's Chitral District, and in the Karakorum Range of the Northern Areas in the Gilgit, Hunza and Baltistan districts. A good population of snow leopard is reported from the Shimshal area in Hunza, but no density estimate is available (Wegge 1988). Its presence in Azad Kashmir Province remains unconfirmed (Roberts 1977). Malik (1997) described key threats to the species.

Hunter and Jackson (1997) estimated potential habitat at 81,016 km^2, of which some 6.6% is under PA status. Green (1988) reports the total amount of protected area supporting snow leopard is 3,190 km^2, but this figure has been greatly increased with the establishment of Conservancies under a United Nations Development Programme sponsored project. In addition, The Mountain Areas Conservancy Project (MACP) of UNDP/IUCN has delineated four areas or Conservancies totaling 16,300 km^2, where community-based biodiversity conservation initiatives are currently being undertaken (MACP 2001). All of these areas likely support snow leopards. Two, the Nanga Parbat and Gojal Conservancies, are located in the Northern Areas, with the other two (Tirichmir and Qashqar Conservancies) in the North-West Frontier Province. With the exception of the Khunjerab National Park and the recently established Conservancy areas, these PAs are too small to protect more than a very few cats, whose likely wander well beyond the PA boundary. The list in Fuller and Ahmed (1997) indicates there almost existing protected areas within potential snow leopard range in Pakistan (an asterisk below indicates protected areas where the species' presence has been confirmed):

North-West Frontier Province (NWFP): Chitral Gol National Park* (77.8 km^2); Agram Besti Game Reserve* (25 km^2); Goleen Gol Game Reserve *(442 km^2); Gahriat Gol Game Reserve* (48 km^2); Parit Gol Game Reserve (55 km^2), and Tirichmir and Qashqar Conservancies (size unknown).

Northern Areas: Khunjerab National Park* (2,669 km^2); Baltistan Wildlife Sanctuary* (414 km^2); Kilik/Mintaka Game Reserve (650 km^2); Naz/Ghoro Game Reserve (72 km^2); Sherquillah Game Reserve (168 km^2); Askor Nullah Game Reserve (129 km^2); Astore Wildlife Sanctuary (415 km^2); Chassi/Bowshdar Game Reserve (370 km^2); Danyor Nallah Game Reserve (443 km^2); Kargah Wildlife Sanctuary* (443 km^2); Nazbar Nallah Game Reserve* (334 km^2); and Pakora Game Reserve (75 km^2). Snow leopards also occur in the proposed Central Karakorum National Park, but this PA was never formally declared. However, portions appear to fall within the Gojal Conservancy of MACP. The species is also very likely to occur in the Nanga Parbat Conservancy.

Azad Kashmir: Machiara National Park (including adjacent Bichla Manur protected area in NWFP) (260 km^2); Ghamot Game Reserve (273 km^2).

Former USSR

With an estimated range of about 400,000 km^2, the USSR was said to support 1,000 to 2,000 snow leopards before its breakup (Braden 1982; Bannikov 1984). In Kyrgyzstan and Tajikistan alone, Koshkarev and Vyrypaev (2000) reported at least 1,200 - 1,400 snow leopards, a figure that represents 75% of the total estimated USSR snow leopard population. According to these authors and Bannikov (1984), there were 150 - 200 cats in the Russian Union Republic, 100 in Uzbekistan and 180-200 in Kazakhstan for a total of about 2,000. Koshkarev (1989) estimated about the population of the Tien Shan and Dzhungarsky Alatau at 400-500 individuals.

Snow leopard and large ungulate populations have plummeted in Kyrgyzstan, Kazakhstan and Tajikistan since the dissolution of the Soviet Union in 1990, in large part due to rampant poaching exacerbated by the shift to a market economy and failure of government to pay its workers regular wages. Based upon a 3-4 fold increase in poaching, Koshkarev and Vyrypaev (2000) concluded that snow leopard numbers in Kazakhstan and Kyrgystan have decreased by at least 50%, along with a loss of habitat and greatly weakened protected areas management. Prior to 1990, as many as 25 protected areas may have harbored snow leopard (Braden 1984; ISLT, unpub. data). The current legal and management status of many reserves is unknown, but most are adversely affected by severe reductions in funding, poor staffing, and lack of political will for conservation shown by most independent Central Asian States.

The following paragraphs detail population estimates according to new sovereign states:

Russia

Potential habitat totals 131,000 km^2 (Koshkarev, pers comm.), with snow leopards being reported from the Altay and Sayan ranges bordering the People's Republic of Mongolia. Sopin (1977, cited in Fox 1989b) estimates the mean density at 0.75 - 1.5 individuals per 100 km^2 in parts of the Altai Mountains, for a total population of about 40. Until recently, there were no confirmed sightings from the Eastern Sayan Mountains, although tracks had been reported by local herdsmen in the early 1980's (Medvedev 1990). Koshkarev (1996) found sign in all three areas he surveyed in the central and eastern Sayan region, concluding that the Kropotkinskiy, Okinskiy and Tunkinskiy Mountains probably contained a core population of 20-30 snow leopards. This investigator (Koshkarev 1998) reported an average density of 1.5 snow leopards per 100 km^2 in the Tunkinskiy Range.

Smirnov et al (1990) estimated about 80 snow leopards resided in southern Siberia, including animals that wandered into Mongolian territory. There are unsubstantiated reports from the Southern Muisky and Kodar Mountains east of Lake Baikal (Koshkarev 1998). Koshkarev (1998) found old snow leopard sign in the mountains of western Hovsgol on the Mongolian side of the border.

Hunter and Jackson (1997) listed potential habitat at 302,546 km^2, with 4.5% under PA status. This is a significant increase in the area of potential range within Russian territory.

The presence of snow leopard is confirmed in two protected areas: the 389 km^2 Sayano Shushensky State Nature Reserve (where densities may be as high as one per 100 km^2 according to Zavatsky 1988), and the 864 km^2 Altaiskiy State Nature Reserve. Also reported from the following Zakazniki or short-term reserves: 1,030 km^2 Ininskiy, 2,413 km^2 Kosh-Agachskiy, 1,780 km^2 Shavlinskiy and the 3,200 km^2 Khindiktig-Khol'skiy.

Kyrgystan (Kyrgyz Republic)

Snow leopards occur in the Talasskiy Alatau and Ferganskiy mountains, as well as the Tien Shan bordering China and Kazakhstan (Braden 1982, Koshkarev 1989). Koshkarev (1989) mapped snow leopard occurrence over much of its range in Kyrgystan, recording 20 inhabited areas (totaling 6,554 km^2), with an estimated population of 113-157. Densities ranged between 0.8-4.7 per 100 km^2, averaging 2.35 animals per 100 km^2. Over the entire snow leopard range in Kyrgyzstan (65,800 km^2), Koshkarev (1989) judged the mean density to be one snow leopard per 100 km^2. In 1992, Koshkarev (unpub. report prepared for International Bank for Reconstruction and Development, London) estimated 800 snow leopards inhabited the Tien Shan Mountains of Kyrgyzstan and adjacent regions of Kazakhstan. Hunter and Jackson(1997) estimated potential habitat at 126,162 km^2, with about 1.1% under PA status.

Snow leopards occur in the 182 - 1,167 km^2 Besh-Aral'skiy State Reserve, the 173 - 190 km^2 Issyk-kul'skiy Reserve, the 182 - 242 km^2 Narynskiy zakaznik Reserve, the 237 km^2 Sary-Chelekskiy Nature Reserve (also Biosphere Reserve), and the 194 km^2 Ala Archa National Park. The government recently established the Sarychat-Ertush Nature Reserve in the central Tien Shan, which offers good habitat for snow leopard, argali and ibex.

Kazakhstan

Hunter and Jackson (1997) estimated potential snow leopard habitat at 71,079 km^2, with about 1.7% currently under PA status. In the south, snow leopards occur along the Khigizskiy Range and Tasskiy Alatau bordering Kyrgystan, in the Sarytau Mountains near Alma Ata, and bordering China in the Dzungarsky Alatau (where they are reportedly most common). Annenkov (1990) reported some 65-70 snow leopards in an 8,200 km^2 area, a mean density of 0.83 individuals per 100 km^2. Zailiskiy Alatau or northern Tien Shan has about 20 leopards according to Zhirjakov (1990), with the average number of tracks seen along a 10 km route being 0.2-1.2. The ratio of cats to ungulates (primarily ibex) is 1:160. The Alma Ata Sanctuary, located in the northern Tien Shan in the Zailisky Alatau has an estimated density of one snow leopard per 100 km^2, for a total population of about 20 (Zhirjakov 1990).

Snow leopards are reported from the 744 km^2 Aksu Dzhabagliy State Reserve and the 915 km^2 Alma Atinskiy Nature Reserve. Its presence in the 714 km^2 Markakol'skiy State Reserve is suspected, but unconfirmed (E. Koshkarev, pers comm.).

Tajikistan

Little is known about the current status and distribution of snow leopard in this Republic. Sokov (1990) estimated numbers at 200 - 300, significantly higher than a later estimate by Bururukov and Muratov (1994) who placed the total at 80-100 snow leopards. These authors attributed the decrease to a decline in the number ibex, the snow leopards primary large ungulate prey species across the Pamir and into the Tien Shan.

Snow leopards are said to occur in the central and western parts in the Zeravshanskiy, Gissarskiy, Karateginskiy, and Petr Pervyi mountains, and in the Hazratishog and Darvaskiy Mountains, and in the Gorno-Badahshansk area, including the Pamirs.

Hunter and Jackson (1997) estimated potential habitat at 78,440 km^2, with about 13.3% under PA status (a figure which assumes the Great Pamir NP is a functional entity since it was declared in 1992). Snow leopards are present in two of the three protected areas: Six animals were reported from the 161 km^2 Ramit State Reserve and the 197 km^2 Dashti-Dzhumskiy Reserve (Sokov 1990). Also reported from the 300 km^2 Iskanderskul'skiy lake reserve (but there is little habitat), the 680 km^2

Muzkul'skiy, 5,006 km^2 Pamisskiy, and the 510 km^2 Sangvorskiy Zakazniki reserves.

Uzbekistan

This range country stands at the far western edge of the snow leopard's range. They are reported from the Turkestanskiy, Chatkalskiy and Gissarskiy ranges bordering Tajikistan and Kyrgystan (Braden 1982), with the total population estimated at about 50 animals (Sludskiy 1973, cited in Braden 1982). More current estimates are not available. Hunter and Jackson (1997) estimated potential habitat in Uzbekistan at 13,834 km^2, of which about 5.8% is under PA status.

Snow leopards are reported from the 106 km^2 Zaaminskiy State Reserve and the 324 km^2 Uzbek National Park, as well as the 875 km^2 Gissarskiy State Reserve, which was formed by the Kyzylsuiskiy and Mirakinskiy reserves. The Chatkal'skiy State Reserve, consisting of two areas 111 and 242 km^2 in size, and separated by 20 km, also harbors snow leopards (ISLT, unpub. data).

Summary

Population estimates of snow leopards have been upgraded over the figure reported in the first Red Data Book, with the world's total remaining population now placed at between about 4,000 and 7,000 individuals. However, this estimate is really a 'guestimate' based upon surveys which were mostly undertaken over a decade ago, and or in the case of the Central Asia Independent States when protected areas were in better shape than they are today.

Legal Status

International Level:

Snow leopards are classified as Endangered in the IUCN Red List of Threatened Species since 1988. The most recent assessment was done in 2001 for the 2002 Red List and was based on the estimate that the snow leopard's total effective population size is below 2,500 mature breeding individuals, with a declining trend due to habitat and prey base loss and persecution, and no subpopulation containing more than 250 mature breeding individuals (IUCN, 2002).

Snow leopards have been included in Appendix I of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) since 1975, and hence all international commercial trade in the species, its parts and derivatives is prohibited. With the exception of Kyrgyzstan and Tajikistan, all snow leopard range states are a Party to CITES (see Table III), however some range states joined the Convention only recently (e.g. Bhutan), and in general, implementation and enforcement of the Convention's provision varies in the different countries and is in some cases insufficient. For example, Afghanistan, which joined CITES in 1986 (see Table III), but has to date not yet submitted an annual report.

At the twelfth meeting of the Conference of the Parties to CITES, Parties to the Convention decided to expand the scope of Resolution Conf. 11.5 Conservation of and trade in tigers to include all Asian big cats listed in Appendix I of the Convention (leopard *Panthera pardus* populations within the Asian range, the snow leopard, the clouded leopard *Neofelis nebulosa* and the Asiatic lion *Panthera leo persica*). This new Resolution Conf. Res. 12.5 Conservation of and trade in tigers and other Appendix-I Asian big cat species formally recognises that all Asian big cats are threatened by the illegal use and trade of live specimens and their body's parts and derivatives and calls upon CITES Parties, and range states in particular to improve national legislation and increased efforts at national, regional and international level to combat the illegal killing of and trade in Asian big cats. In addition, the Parties to CITES adopted at the last Conference of the Parties four decisions (Decision 12.29-12.32), of which two are directed to the Parties: Decision 12.29 request Parties to communicate the details of 'a significant illegal shipment of Asian big cat parts or derivatives' to relevant Parties and to the CITES Secretariat and to conduct appropriate investigations. Decision 12.30 requests that range states report to the 49th meeting of the Standing Committee on ways and initiatives that are being considered to encouraged local communities to play a part and benefit from the conservation of Asian big cats and their habitats. Because only a small number of Parties had provided information in response to this Decision until the 49th meeting of the Standing Committee the agenda item was postponed until the 50th meeting of the Standing Committee that will be held in March 2004.

Snow leopard is listed in Appendix I of the Convention on Migratory Species of Wild Animal Species (CMS) since 1985. Five of the twelve snow leopard range states are a Party to CMS (see Table III). With regard to species listed in Appendix I, Parties to the Convention are requested to 1) conserve and restore the species habitat; 2) prevent, remove, compensate or minimize adverse effects of activities or obstacles that seriously impede their migration; and 3) prevent, reduce or control factors that are endangering or are likely to further endanger the species. In addition, the Convention requests Parties of species listed in Appendix I to prohibit the taking of animals belonging to such species. At the 7th Conference of the Parties to CMS the snow leopard attained the status of a "concerted action" species, which may include co-operative activities such as the development of a CMS Agreement (CMS, 2002).

National Level:

Snow leopards are protected nationally over most of its range, with the probable exception of Afghanistan. However, in some countries the relevant legislation may not always be very effective, e.g. because penalties are too low to function as deterrent, or they contain some significant loopholes: for example in Pakistan where the species is only protected in some states, but not at federal level. Based on the CITES National Legislation Project the legislation of Afghanistan, Mongolia, Nepal, Pakistan and Uzbekistan was classified as into Category 3 and is therefore believed to generally not meet the requirements for the implementation of CITES (Anon., 2002a). Likewise, the enforcement of existing laws and regulations is sometimes poor and remains a major challenge for most range states. Ineffective or non-existent enforcement of the regulations and laws in place is often due to lack of awareness, political will and priority and resources given to species conservation at governmental level. However, the economic and political situations of many of the snow leopard range states also negatively affect law enforcement activities greatly. Wildlife rangers and enforcement personnel are often poorly equipped and live on extremely low wages. In addition, corruption seems to be a rather common problem in a number of snow leopard range states and plays a considerable role in the inability of some range states to tackle wildlife crime effectively (Anon., 2003). This is not surprising given the sometimes poor salaries paid to governmental officials such as wildlife wardens and the high profits to be made from the trade in snow leopard skins and other body parts.

Afghanistan

No up-to-date information is currently available on the legal status of snow leopards in Afghanistan. In 2002, UNEP undertook a post-conflict environmental assessment and the findings of that assessment were published in early 2003. The report concluded, among others, that "the legal status of all protected animals in Afghanistan is currently in question and no management is taking place to protect and conserve their ecological integrity and wildlife" (UNEP, 2003). Following the events of the 11th September 2001, a project has been initiated in cooperation with the United Nations Environmental Programme to draft a legislative framework on environmental protection (Baker, 2002). The country is currently led by the Transitional Authority with a cabinet of 31 ministers. The Ministry of Agriculture and Animal Husbandry is responsible for the management of forests, wildlife, wetlands and fisheries; protected areas management was conducted in co-operation with the Afghanistan Tourist Organisation. With the new environmental policies yet to be defined, no new environmental legislation has been developed and the country's legal system is currently governed by the constitution enacted under the monarchy in 1964 as well as by laws enacted later, provided that they are not inconsistent with the Bonn Agreement or laws adopted previously. In this regard, the Nature Protection Law of 1986 (amended in 2000) and the Hunting and Wildlife Protection Law of 2000 provide an important framework. In the absence of new environmental laws, the Transitional Authority has issued various decrees banning hunting and timber harvesting,

Table III: Snow Leopard range States and their Participation in Relevant Multi Environmental Agreements.

Country	CITES	Date of entry into force	Category NLP*	CMS	Date of entry into force
Afghanistan	Yes	Jan 1986	3	No	-
Bhutan	Yes	Nov 2002		No	-
China	Yes	April 1981	2	No	-
India	Yes	Oct 1976	2	Yes	Nov 1983
Kazakhstan	Yes	Jan 2000	*In review*	No	-
Kyrgyzstan	No	-		No	-
Mongolia	Yes	April 1996	3	Yes	Nov 1999
Nepal	Yes	Sept 1975	3	No	-
Pakistan	Yes	July 1976	3	Yes	Dec 1987
Russian Federation	Yes	Jan 1992	2	No	-
Tajikistan	No	-		Yes	Feb 2001
Uzbekistan	Yes	Oct 1997	3	Yes	Sept 1998

** = National Legislation Project of CITES, based on Doc. 28 presented at CoP 12, November 2002; Category 1 = legislation is believed to meet the requirement for the implementation of CITES, Category 2 = legislation is believed not to meet all requirements, Category 3 = legislation that is believed not to meet the requirements.*

however, difficulties have been reported in the enforcement of these decrees (UNEP, 2003).

Bhutan

Hunting of snow leopard is prohibited in Bhutan through the Forest and Nature Conservation Act 1995. Killing of a snow leopard can result in a fine of BTN 15,000 (approx. USD 309), which is among the highest fines for killing an animal in Bhutan and approximately twice the amount of the annual cash income of a wildlife warden (around BTN 7,000 or USD 150) (D. Yonten, Nature Conservation Division, Department of Forestry of Bhutan, in litt. to TRAFFIC, May 2003).

China

The Wildlife Animal Protection Law (WAPL) of the People's Republic of China (1989) and the Enforcement Regulations for the Protection of Terrestrial Wildlife of the People's Republic of China (1992) are the two principal laws providing full protection to snow leopard in China. The WAPL distinguished between Class I and II State-protected wildlife, referred to as 'animals under special state protection' (ASSP). Provinces may also adopt provincial wildlife protection regulations, which may include species not listed on the national WAPL. These regulations may be more, but not less, stringent than the national legislation. Yunnan, for example, prohibited all hunting and sale of live animals in 1997. Snow leopard are listed a Class I protected species in China. The illegal hunting of Class I protected species constitutes a criminal offence punishable in accordance with the provisions of Article 130 of the Criminal Law. Sale and purchase of Class I protected wildlife or their products is strictly prohibited although scientific research, domestication, breeding, or exhibition is allowed with permit (O'Connell-Rodwell and Parry-Jones, 2002). Article 31 of the WAPL states that a person that kills animals under special state protection shall be prosecuted for criminal responsibility under the Criminal Law. The Criminal Law, last amended in 1997, provides severe penalties for unlawful taking, killing transporting, purchase or selling of state protected animal species. Depending on the severity of the crime this can result in a prison sentence of more than 10 years, a fine and the confiscation of property (H. Xu, TRAFFIC East Asia, in litt. to TRAFFIC, 2003).

India

The snow leopard is protected in India under the National Wildlife (Protection) Act of 1972 as well as under the Jammu and Kashmir Wildlife (Protection) Act of 1978, and is listed in Schedule I of both acts. In 1986, the National Wildlife (Protection) Act was amended through the inclusion of a new chapter that prohibited the trade in all scheduled species. After this amendment the maximum penalty for offences against animals listed in schedule I of this Act is seven years imprisonment and INR 25,000 (=USD 516) fine. However, as the Jammu and Kashmir Wildlife (Protection) Act was not amended until 2002, the punishment under the latter remained as maximum imprisonment of six years and a maximum fine of INR 2,000. However, the trade in snow leopard skins continued in Jammu and Kashmir until the end of the 1990s, due to loopholes in the legislation and a long pending court case in the Supreme Court of India against the general ban on trade in any part derived from protected scheduled species (Panjwani, 1997). Following the most recent amendment of the Wildlife Protection Act of Jammu and Kashmir in 2002, nowadays all trade in parts of scheduled animals is considered illegal and the maximum penalties are the same as under the national Wildlife Protection Act (M. Misra, TRAFFIC Consultant, in litt. to TRAFFIC, 2002).

Kazakhstan

The snow leopard is protected in Kazakhstan under the Law on Wildlife Protection of January 1993 and hunting, possession and sale is prohibited. It is also included in the Red Data Book of 1978. The maximum fine for illegal hunting of snow leopards in Kazakhstan is KZT 150,000 (=USD 1,000) (Y. Yuchenkov, Katon-Karagay State National Park, in litt. to TRAFFIC, 2002).

Kyrgyzstan

Hunting, possession and trade of snow leopard is prohibited in Kyrgyzstan through the Law on the Animal World (1999). After a revision of the relevant Penalty Code the maximum fine for the illegal killing of Snow Leopards is now KYS 63,000 (=USD 1,300) and up to three years imprisonment. In addition, the authorities are authorised to confiscate the specimen (Anon., 2001). In 1999, the German NGO NABU established a specialised anti-poaching team that works in close cooperation with the Kyrgyz Ministry of Environment, Emergencies and Civil Defence. This anti-poaching unit is specifically targeting illegal killing of and trade in snow leopard or their parts, but also focuses on other wildlife offences, such as poaching of snow leopard prey species, such as ibex, marmots or argali sheep (Dexel, 2002).

Mongolia

In 1972, the snow leopard is listed in the Mongolian Red Data Book as 'very rare' and hunting is prohibited since then. However, sport hunting of the species was legal until 1992. The new Hunting Law of 1995 prohibits the hunting, trapping, or selling of snow leopard hides and any other part. However, until April 2000 there was no legal restriction on purchasing, owing, or possessing of snow leopard parts. After strong lobbying activities by several national conservation NGOs, the Hunting Law of 1995 was revised and a new Law of Fauna (2000) was enacted. This law specifically prohibits the sale or purchase of any snow leopard part. In addition, the law includes provisions to provide 'whistle-blowers' with 15% of the total fines paid by the offender. According to the 'List of Rare Animals and Wild Animal Ecology-Economic Valuation' the snow leopard economic value has been set at MNT 500,000 (=USD 450) and that of its prey species, such as the argali sheep at MNT 9,000 000 (= USD 8,060) or the ibex also at MNT 500,000. The penalty for killing of an endangered animal is twice the economic value of the species. However, similar to other snow leopard range states enforcement of existing laws and regulations is very limited and remains a major challenge. In 1999, the Mongolian Snow Leopard Conservation Management Plan was developed by WWF Mongolia, the International Snow Leopard Trust and other stakeholders and in cooperation with the relevant governmental agencies. However, the plan is not yet fully recognised as a official policy document by the Mongolian government.

Nepal

The snow leopard is fully protected in Nepal under the National Parks and Wildlife Conservation (NPWC) Act 2029 since 1973. Under the Fourth Amendment of the Act it is illegal to hunt, acquire, buy or sell snow leopard parts such as its skin, and the penalties for persons convicted of such offences range from NRS 50 to NRS 100 000 (=USD 1 300), or five to fifteen years in prison. Nepal also established 'whistle-blower' regulations and there is a provision for NRS 50,000 paid for information that is leading to the conviction of an offender (Kattel and Bajimaya, 1997).

Pakistan

The snow leopard is protected in Pakistan, however there is no federal act or law at national level and instead each province has different wildlife laws and therefore a species that is protected and illegal to hunt in one province, may not be provided the same status in another region (J. Khan, International Snow Leopard Trust/WWF Pakistan, in litt. to TRAFFIC, 2002). Snow leopard is legally protected in the North-West Frontier Province (NWFP), the Northern Areas and in Azad Jammu and Kashmir through individual Wildlife Acts. The NWFP Wildlife Act of 1975, for example, prohibits the hunting, capturing and killing of any 'protected animal'. Section 14 of the Act, specifically refers to trade and prohibits the trade and/or sale in snow leopard, their trophies and its meat (Khan, 2002). The maximum fine for violations of the Act is two years of imprisonment and/or a fine of one thousand PKR (approx. USD 17). In the Northern Areas, snow leopards are protected through the Wildlife Conservation Act of the Northern Areas and hunting of snow leopards is prohibited. However, there is a provision under section 22 of the Act that sanctions the eradication of so-called "problem animals". Under this provision a designated official of the wildlife department or a private individual can eradicate an animal that threatens private property or human life. In cases where an animals inflicts damage to property, however, such as by killing of livestock, there is no mechanism for compensation to the affected individual (Hussain, 2003). According to the Northern Areas Wildlife Department no charges have been made that related to the killing of snow leopards or illegal possession and trade in snow leopard body parts. Low ranking officials of the Wildlife Department indicated that they are aware of cases of illegal killings of snow leopards in the Northern Areas and know of cases where snow leopard skins have been offered for sale, but due to the often high social or political status of people who buy the skins they see themselves unable to take appropriate action, i.e. seize the specimen (Khan, 2002). Led by WWF Pakistan, various governmental and non-governmental agencies developed a Strategic Plan for the Conservation of Snow Leopards in Pakistan that was presented in 2001. The plan identifies the most important threats to snow leopards in Pakistan and offers strategies to be undertaken with input from local agencies, NGO's and the private sector.

Russia

At federal level there are three main laws that apply to snow leopard protection: 'the Law of Environment Conservation', 'the Law of the Animal World (Fauna) No 52 of March 1995' and 'the Law of Strictly Protected Natural Areas No 33 of 15 February 1995'. The snow leopard is also included in the Red List of the Russian Federation and the Law of the Animal World makes special reference to species listed in the Red Book. The maximum fine that can be imposed for the killing, illegal possession, trade under paragraph 258 of the Criminal Code is up to 2 years of imprisonment. However, enforcement of this legislation is limited. Moreover, the recent re-structuring of the authorities in Moscow e.g. the establishment of the new 'Ministry of Natural Resources' that replaced the former 'Committee of Nature Protection', and the following personnel changes have led to a shift in responsibilities and decreased the effectiveness of the agency (A. Poyarkov, Russian Academy of Science, in litt. to TRAFFIC, 2002). Since the mid-1990s, the WWF Russia facilitated the development of a Snow Leopard Conservation and Management Plan in cooperation with several governmental and non-governmental agencies, and in 2002 the Strategy for the Conservation of the Snow Leopard in the Russian Federation was officially approved by the Head of the State Service for Environment Protection (Anon., 2002b).

Tajikistan

Snow leopards in Tajikistan are listed in the Red Data Book as 'rare'. The species is protected under the Law on Nature Protection and the Law on Preservation and use of Fauna. The maximum fine for the illegal killing of a snow leopard is ten months the minimum wages. However, laws are not obeyed and effective enforcement is generally not existent (M. Kadamshoev, Pamir Institute of Biology, in litt., to TRAFFIC, 2002).

Uzbekistan

The snow leopard is protected in Uzbekistan under the Law on Nature Protection of January 1993 and hunting, possession and sale is prohibited. It is also included in the Red Data Book of Uzbekistan. The maximum fine for violations of the Law on Nature Protection are 50 times the minimal wage of the offender or 2 years imprisonment. However, similar to other range states law enforcement especially in the field of nature protection is low in Uzbekistan (E. Kreuzberg-Mukhina, IUCN National Committee/Academy of Science, Uzbekistan, in litt. to TRAFFIC, 2002).

Country Strategies and Action Plans

Snow Leopard Action Plans or Strategies exist for three countries at the present time. (See page 62 for a discussion of how the SLSS can be best used to aid in Action Planning for snow leopards in other range states).

Mongolia:

The Mongolian Snow Leopard Conservation Plan (McCarthy 2000) was developed in 1999 after consultation with stakeholders and in cooperation with agencies of the Mongolian government (Ministry for Nature and Environment, National Endangered Species Commission, Nature Conservation Agency, and Academy of Sciences). Although accepted and signed by all cooperators, to be recognized as official policy by the present government of Mongolia, the plan must be discussed and approved at the National Endangered Species Commission of Mongolia. ISLT and WWF-Mongolia are working to elevate the Plan within the appropriate government organizations.

Pakistan:

Government agencies, conservation NGOs, and other stakeholders met in spring 2001 to develop a Strategic Plan for the Conservation of Snow Leopards in Pakistan. The planning process was led by WWF- Pakistan. The Strategic Plan has been distributed to relevant stakeholders and is already serving as a guiding tool for agencies and organizations participating in the conservation of snow leopards. The objectives of the plan include; providing information on major conservation issues of snow leopard in Pakistan, providing guidelines on resolving controversial issues in relation to the conservation of snow leopard, providing a strategic framework for the collection and use of information in the conservation of snow leopard on long term basis, and providing a basis for close collaboration between range-states in the conservation of snow leopard. The Plan has been approved at various levels of government and is now awaiting final ratification by the National Council for Conservation of Wildlife, at which point it will become official policy of the government of Pakistan. This action is expected before the end of 2003.

Russia:

A Strategy for Conservation of the Snow Leopards in the Russian Federation has recently been developed by a working group comprised of representatives of the Ministry of Natural Resources of the Russian Federation, representatives of state and environmental authorities of the republics Altai, Khakasia, Tyva, Krasnoyarsk region, Commission on Large Carnivores of the Theriological Society of the Russian Academy of Sciences and WWF Russia. The strategy has been approved by the Conservation of Biodiversity Section of the Scientific Technical Council of the Ministry of Natural Resources of the Russian Federation. The Strategy was approved by the Ministry of Natural Resources of the Russian Federation in December 2001. A more specific Action Plan will follow.

Nepal:

A Snow Leopard Conservation Action Plan has been drafted for Nepal for the Department of National Parks and Wildlife Conservation – Ministry of Forests and Soil Conservation of His Majesty's Government of Nepal in collaboration with WWF Nepal Program and King Mahendra Trust for Nature Conservation. The conservation action plan was developed based on a synthesis of literature, on-going monitoring activities, information through field reports, and consultation with local stakeholders, particularly those concerned with livestock development and conservation of the snow leopard in Nepal. The goal of the action plan is to continue Nepal's credible effort to maintain viable populations of the snow leopard, minimize habitat fragmentation, resolve conflict with resident communities and thus maintain ecosystem integrity of the Nepal Himalaya.

The Snow Leopard Conservation Action Plan for Nepal has been submitted to His Majesty's Government of Nepal and is currently awaiting further directives for its endorsement.

Copies of the Mongolia, Pakistan and Russia plans can be found on the SLSS website or requested from ISLT.

2. Threats and Conservation Actions

Regional Assessment

This document attempts to list and discuss the threats, conservation actions and information needs pertinent to snow leopard survival. However, these vary substantially across the vast extent of snow leopard range, so no prescription will be universally applicable. On the other end of the spectrum, it is beyond the scope of this document to define threats and information needs for each unique geographical unit (county, village, valley, etc.) Any attempt to define practical geographical divisions that are addressable within the context of this Survival Strategy will be somewhat artificial, yet we believe useful generalizations can be made at a Regional scale. For purposes of grouping areas where conditions may be similar, we looked at geography, political boundaries, cultural/religious influences, and rural livelihoods. Within that framework we defined four broad regions:

- Himalaya (HIMLY),
- Karakorum/Hindu Kush (KK/HK),
- Commonwealth of Independent States and W. China (CISWC),
- The Northern Range (NRANG)

Threats to Snow Leopard Survival

A key component of the SLSS process was to identify threats to long-term snow leopard survival across their range. The following list is the result of extensive consultations with stakeholders in Asia and the expert group at the SLSS Summit. In some cases the individual threats are closely related. For example, habitat degradation often stems from over-grazing by domestic livestock, which may lead to loss of wild ungulates. In turn, the reduction of wild snow leopard prey can lead to increased depredation on livestock, and to retribution killing by herders. However, it is useful to list the threats separately so that conservation actions most appropriate to reduce that specific threat are easier to identify. Threats are grouped into four broad categories 1) Habitat and Prey related, 2) Direct Killing of Snow Leopards, 3) Policy and Awareness, and 4) Other Issues.

Master List of Threats

<u>Category 1: Habitat and Prey Related</u>
1.1 Habitat Degradation and Fragmentation
1.2 Reduction of Natural Prey due to Illegal Hunting
1.3 Reduction of Natural Prey due to Legal Hunting
1.4 Reduction of Natural Prey due to Competition with Livestock
1.5 Reduction of Natural Prey due to Disease
1.6 Fencing that Disrupts Natural Migration

<u>Category 2: Direct Killing or Removal of Snow Leopards</u>
2.1 Killing of Snow Leopards in Retribution for Livestock depredation
2.2 Poaching Snow Leopards for Trade in Hides or Bones
2.3 Museum Collection of Live Animals
2.4 Traditional Hunting of Snow Leopards
2.5 Secondary Poisoning and Trapping of Snow Leopards
2.6 Diseases of Snow Leopards

<u>Category 3: Policy and Awareness</u>
3.1 Lack of Appropriate Policy
3.2 Lack of Effective Enforcement
3.3 Lack of Trans-boundary Cooperation
3.4 Lack of Institutional Capacity
3.5 Lack of Awareness among Local People
3.6 Lack of Awareness among Policy Makers

<u>Category 4: Other Issues</u>
4.1 War and Related Military Activities
4.2 Climate Change
4.3 Human Population Growth and Poverty (indirect threat)

Brief Description of Threats

<u>Category 1: Habitat and Prey Related</u>

1.1 Habitat Degradation and Fragmentation

While snow leopards make marginal use of several habitat types, the species is most strongly associated with high alpine tundra, which itself constitutes a very fragile ecosystem. This narrow habitat use makes snow leopards particularly vulnerable to habitat changes. Alteration of habitat over much of snow leopard range does not fit what may be the common image of habitat degradation and fragmentation. Large scale resource extraction, road building, and urbanization occurs within snow leopard range, yet is relatively rare due to remoteness and inaccessibility. Perhaps the most commonly observed form of habitat alteration within snow leopard range is more subtle, yet still potentially destructive, and comes in the form of livestock grazing and disturbance by their human owners.

1.2 Reduction of Natural Prey due to Illegal or Unregulated Hunting

Mountain ungulates are hunted, either illegally or without regulation, for meat and trophies by local residents. Additionally, wild game meat can be highly prized for its medicinal value or used as traditional food for honored guests or special holidays. In some cases illegal hunting may constitute a commercial activity. There is rarely any provision for legal hunting by local people, which disenfranchises them and makes compliance with laws minimal. The illegal harvest likely far exceeds the legal harvest in many areas, with resultant declines in snow leopard food resources.

1.3 Reduction of Natural Prey due to Legal Hunting

In many snow leopard range-states trophy hunting for wild sheep and goats is a lucrative business, bringing in substantial income to government, hunting organizations and both private and state hunting reserves. These can play an important role in community based conservation, if they are sustainable and provide economic incentives to local communities to protect wildlife and habitat. However, in some cases these hunts are not well managed and harvest levels result in medium-term social instability and/or long-term genetic problems. A conflict of interest can exist when the management agency receives a large portion of its income from foreign trophy hunting. Wild ungulate stocks are in decline in many areas, reducing carrying capacity for snow leopards and other carnivores. Declines in other snow leopard prey species such as marmots are attributable to an unsustainable harvest for fur markets, and pika are targets of widespread vermin poisoning programmes.

1.4 Reduction of Natural Prey due to Competition with Livestock

Competition between livestock and wild mountain ungulates may result in declines of wild stock, thus reducing the natural prey base for snow leopards. The potential consequences of prey reduction are two-fold: direct losses of snow leopards as carrying capacity diminishes, and increased use of domestic livestock by snow leopards, increasing conflict perceptions and retribution killing by graziers.

1.5 Reduction of Natural Prey due to Disease or Transmission of Disease

A poorly understood situation is known to exist in some parts of snow leopard range where ungulate numbers are in decline and the apparent cause is disease. The types of diseases responsible and what role humans or livestock may be playing a role as vector is yet unclear.

1.6 Fencing that Disrupts Natural Animal Movements and Migration

In several range countries, particularly the former Soviet Block states, borders have been extensively fenced for national security reasons. These fences impede or prohibit natural movements and migrations of wild ungulates. This can impede dispersal, breeding aggregation, etc. Importantly, areas with declining populations can be cut off from potential source populations of immigration, thus disrupting metapopulation dynamics over a broad range. [Note: Many of these fences are in disrepair and not being maintained, hence, the problem may be resolving itself]

<u>Category 2: Direct Killing of Snow Leopards</u>

2.1 Killing of Snow Leopards in Retribution for Livestock Depredation Loss

Snow leopards use domestic livestock as a food resource in nearly all areas where they overlap with resultant retribution killing by herders. In many areas, encroachment of herders into snow leopard habitat is increasing. Given the reliance on livestock for food, clothing, and trade goods, retribution killing by poor grazier families may seem understandable. Yet predation on domestic livestock is a complex situation. Greatest losses occur where native prey species (ibex, blue sheep, argali, and marmot) have been reduced, but are also more serious where herders employ poor guarding practices. Conservation actions must take into consideration all aspects of the issue.

2.2 Poaching Snow Leopards for Trade in Hides or Bones

Snow leopards have long been hunted for their pelts, and demand remains high. A pelt can bring a few hundred dollars for a herder or upwards of one thousand dollars on the international black market. In some parts of Central Asia, poaching is rampant within and near Protected Areas as unemployed or unpaid rangers seek to overcome extreme financial hardship by poaching the animals they once protected. Kyrgyzstan may have lost more than 30% of its snow leopard population to poaching in the past eight years. There is demand for snow leopard bones for use as substitutes for tiger bone from the traditional Asian medicine trade. Traders will pay up several thousand dollars for a complete fresh snow leopard skeleton. Ironically, the demand for snow leopard bones may be increasing, as it serves as a replacement for tiger bone which has been the subject of extensive anti-poaching campaigns. Organized crime is playing an increasingly important role in illegal trade in many areas.

2.3 Zoo and Museum Collection of Live Animals

Live trapping and sale of snow leopards, particularly cubs, may be a growing threat in some areas. Private zoos and menageries appear to be the target market for live animals but little is known about the geographic centers of such demand or the dynamics of the market, although there is clear demand within Asia. Reputable zoos have little need for wild captured snow leopards. There are well managed breeding programs for captive populations in the west and an excess capacity to produce cubs now exists.

2.4 Traditional Hunting of Snow Leopards

Snow leopard hides are traditional adornments for homes and clothing in many parts of their range. They can be a status symbol and a highly valued gift. Snow leopard hunters and trappers have long been held in high stead among village peers. Reversal of these cultural values is both a difficult and sensitive process. A considerable portion of illegally traded hides actually remain in country in the hands of officials or other powerful individuals.

2.5 Secondary Poisoning and Trapping of Snow Leopards

Snow leopards overlap with other predators which are often the focus of indiscriminate trapping or poisoning campaigns. Snow leopards are frequently the unintentional victims. The extent of these loses are generally unreported and, thus, difficult to assess.

Table IV: Prioritized Threats to Snow Leopard Survival by Region. Threat will vary by specific location. This is only a general guide.

Regions are broadly defined as:

HIMLY - Himalaya: Tibetan Plateau and other S. China, India, Nepal, Bhutan

KK/HK - Karakhorum and Hindu Kush Range of Afghanistan, Pakistan, SW China

CISWC - Commonwealth of Independent States and W. China: Uzbekistan, Tajikistan, Kyrgystan, Kazakhstan, Xinjiang Prov. China

NRANG - Northern snow leopard range: China Altai and Tien Shan, Mongolia, Russia

Primary Threats (dark shading)
Secondary Threats (light shading)

Threats by Category	Region: HIMLY	KK/HK	CISWC	NRANG
Category 1: Habitat and Prey Related				
1.1 Habitat Degradation and Fragmentation	Secondary	Primary		
1.2 Reduction of Natural Prey due to Illegal Hunting	Secondary	Primary	Primary	Secondary
1.3 Reduction of Natural Prey due to Competition with Livestock	Primary	Secondary	Secondary	Secondary
1.4 Reduction of Natural Prey due to Legal Hunting	Secondary		Secondary	
1.5 Reduction of Natural Prey due to Disease				Secondary
1.6 Fencing that Disrupts Natural Migration				
Category 2: Direct Killing or Removal of Snow Leopards				
2.1 Killing of Snow Leopards in Retribution for Livestock Depredation	Primary	Primary		Secondary
2.2 Poaching Snow Leopards for Trade in Hides or Bones		Secondary	Primary	Primary
2.3 Museum Collection of Live Animals				
2.4 Traditional Hunting of Snow Leopards				
2.5 Secondary Poisoning and Trapping of Snow Leopards		Secondary		Secondary
2.6 Diseases of Snow Leopards				
Category 3: Policy and Awareness				
3.1 Lack of Appropriate Policy		Secondary		Primary
3.2 Lack of Effective Enforcement	Primary	Primary	Secondary	Primary
3.3 Lack of Trans-boundary Cooperation	Secondary		Primary	Secondary
3.4 Lack of Institutional Capacity	Secondary	Primary	Secondary	Primary
3.5 Lack of Awareness among Local People	Secondary	Primary	Secondary	Primary
3.6 Lack of Awareness among Policy Makers	Secondary	Primary	Secondary	Primary
Category 4: Other Issues				
4.1 War and Related Military Activities	Primary	Secondary	Primary	
4.2 Climate Change				
4.3 Human Population Growth or Poverty (indirect threat)	Primary	Primary	Primary	Primary

2.6 Diseases of Snow Leopards

Perhaps even less well documented than diseases of prey species, is disease in snow leopards themselves. In western Mongolia numerous reports have been made of a debilitating mange-like affliction. No tissue samples have been collected and how diseases of snow leopards are possibly impacting populations is unknown.

Category 3: Policy and Awareness

3.1 Lack of Appropriate Policy

At both local and national levels there has been limited effort to establish conservation policies for snow leopards or their prey. Those that do exist may be ill-advised and inappropriate. Action Plans are lacking for the species in most range states. Top-down action plans tend to be the norm and very hard to implement.

3.2 Lack of Effective Enforcement

What laws and policies do exist for snow leopards, their prey and their habitat are often poorly enforced. This can be due to lack of awareness by enforcement staff, lack of resources to carry-out enforcement, no priority or political will on the issue, unclear responsibilities between different government agencies, and corruption at several levels.

3.3 Lack of Trans-boundary Cooperation

Because much of snow leopard habitat occurs in the mountainous regions that constitute the borders of central Asian countries, trans-boundary cooperation and protected areas are crucial to conserving the species. There are very few good examples of effective trans-boundary cooperation for the species or its habitat. Trade is another threat that is directly linked to trans-boundary cooperation. To reduce illegal trade in snow leopard products and live animals, effective trans-boundary enforcement of national and international trade regulations and information exchange is critical, but lacking.

3.4 Lack of Institutional Capacity

Government agencies and protected area administrations across the range often lack the capacity to carry-out even modest protective measures for snow leopards and their habitat. In many important snow leopard reserves, rangers and staff are poorly paid and lack even the most basic of equipment. This condition exists at nearly all levels of government and in some states is the main constraint of protected areas, which should form the backbone of wild snow leopard populations.

3.5 Lack of Awareness Among Local People

For individuals who live in poverty, the snow leopard may represent a source of cash through trade and in some cases they may be unaware of laws restricting that. From a broader perspective, conservation is a poorly understood concept for many people who live in snow leopard habitat. The reasons for conserving a large predator which impacts their lives by taking livestock has not been adequately conveyed to most local people.

3.6 Lack of Awareness Among Policy Makers

While lack of awareness is acute at the local level, it can also be a serious problem among policy makers who may have a poor understanding of conservation principals.

Category 4: Other Issues

4.1 War and Related Military Activities

Armed conflict in various parts of snow leopard range is an on-going reality. Snow leopards and other wildlife fall victims to armed combatants and land mines. Refugees displaced by war turn to wildlife for food and trade goods, and illegal trade in wildlife is known to finance paramilitary activities in some areas. Important habitats, particularly mountainous border areas, are off limits to biologists and conservation measures are impossible to initiate. International Peace keeping forces have also recently been found to be involved in illegal purchase of pelts of endangered species during post-war operations.

4.2 Climate Change

Global warming may bring about unprecedented changes in the snow leopard's mountain habitat.

4.3 Human Population Growth and Poverty (indirect threat)

Human numbers are increasing rapidly within the region. More people live in poverty and may turn to more marginal habitats to eek out a living. This will place more and more people in direct competition with wildlife for limited resources. Snow leopards, their prey, and their habitat will suffer.

Potential Actions to Address Threats

Grazing Management

Promote livestock grazing practices that reduce impacts on native wildlife, in particular snow leopard prey species.

Research required prior to taking actions within conservation target area:

- Determine ungulate range and identify key areas (e.g. kidding/lambing sites or important pastures)
- Determine human land use patterns
- Determine the extent and nature of threats to wild ungulates
- Collect baseline data on pasture quality, numbers of wild and domestic ungulates, with emphasis on establishing levels of competition between the two

- Where possible, estimate carrying capacity of grazing areas
- Identify ways in which pastoral livelihoods can be sustained with minimal impact to rangelands

<table>
<tr><th>Action Guidelines</th><th>Policy level</th><th>Community level</th></tr>
<tr><td>Steps:</td><td>• Review legal and traditional land tenure systems and ensure wildlife needs are considered
• Support the development of community-generated grazing plans, give them official recognition, and assist in monitoring compliance</td><td>• Identify all stakeholders e.g. those with grazing rights or other interests
• In consultation with stakeholders, define grazing patterns that meet needs of wildlife and livestock
• Consider creation of livestock-free conservation areas, even if small in size
• Collaboratively develop grazing plan
• Collaboratively develop monitoring protocols and identify success indicators
• Raise awareness of grazing plan and monitoring process
• Monitor and make adjustments to grazing plan as required.</td></tr>
<tr><td>Stakeholders:</td><td>• Local, regional, national governments
• Protected Area administration
• Buffer zone councils
• Conservation agencies and NGO’s
• Development agencies and NGO’s
• Veterinary agencies</td><td>• Community livestock owners, including herders and absentee livestock owners
• Users of plant resources (medicinal, dye, food, etc)
• Agriculturalists
• Eco-tourism operators</td></tr>
<tr><td>Potential Pitfalls:</td><td colspan="2">• Especially in economies in transition, where land tenure systems are in a state of flux, determining grazing patterns may be a subject of contention
• Where human and livestock populations have dramatically increased in recent decades, grazing management may need to include reduction of livestock numbers
• Prescriptive top-down grazing plans designed without community consultation will likely fail</td></tr>
<tr><td>Monitoring Protocols / Success Indicators:</td><td colspan="2">To be defined collaboratively by input from natural resource managers, local community and conservation experts. May include:
• Measuring pasture quality
• Indicators developed by local herders based on traditional knowledge
• Numbers, health and productivity of wild ungulates and domestic livestock
• Level of compliance with grazing plan</td></tr>
<tr><td>Public Awareness:</td><td>• Raise awareness of legal grazing limitations especially where Protected Area regulations apply</td><td>• Display publicly a map of natural resource use, key wild ungulate areas and grazing restrictions
• Disseminate copies of grazing plan to community
• Sharing of grazing agreements</td></tr>
</table>

Income Generation

Wildlife-based Ecotourism

Establishing wildlife-based tourism that provides jobs and financial benefits to local people will add economic value to wildlife and create incentives to protect the resource.

Research required prior to taking actions:

- Identify target communities where tourism may alleviate a conservation issue, and where the community has indicated a willingness to initiate a program (using PRA or APPA)
- Identify potential physical attractions: sites, views, locations, cultural events (festivals, etc. in particular ones connected to the snow leopard)
- Identify wildlife attractions and determine chances of satisfying wildlife oriented tourists
- Conduct market research to determine demand and identify target market
- Conduct a feasibility study to assess infrastructure: access; transport; lodging etc.
- Conduct socio-economic assessment of target community to enable positive impact monitoring
- Conduct biological baseline survey to enable negative impact monitoring

Action Guidelines	**Policy level**	**Community level**
Steps:	• Review country tourism policy • Educate decision makers about potential benefits of ecotourism • Integrate tourism development with any national or international campaigns such as Year of Tourism, or Year of the Mountain, etc. • Leverage any available government or multi-lateral aid funding for tourism development	• Determine stakeholder groups, including local community representatives • Assess capacity of local community to provide guest service, wildlife guiding, etc, build on that to make it better • Determine training needs and sources of training • In collaboration with all stakeholders develop wildlife-tourism Plan with transparent distribution of financial benefits • Identify specific actions to be taken to benefit wildlife, such as establishment of conservation fund, grazing set asides, etc. • Develop monitoring protocols and success indicators with community input • Develop wildlife-tourism marketing strategy
Stakeholders:	• Local, regional, national governments • NGO's	• Local communities • Tour operators and travel agencies • Transportation agencies • NGO's, Community Based Organizations (CBO's)
Potential Pitfalls:	• Snow leopards inhabit remote, inaccessible areas with unpredictable weather and a short season, tourist health and wellbeing should be carefully considered • Political instability and health issues are a concern in many parts of snow leopard range and the tourist market is easily impacted by negative media image • Relatively low abundance of wildlife (compared to popular viewing destinations such as east Africa) and extreme unlikelihood of seeing snow leopard • Market saturation; all of snow leopard range can not be made a tourist destination • The financial benefits of tourism may not be equitably distributed leading to resentment and of lack of commitment to the conservation goals • May expose otherwise remote snow leopard area to international poachers	

Monitoring Protocols / Success Indicators:	*Biological:* • Numbers, trends and productivity of wild ungulates • Density of snow leopard sign • Quality of pasture lands *Socio-economic* • Level of economic benefit from eco-tourism to local people • Local attitudes toward wildlife and tourists • Involvement of travel agents and other providers • Tourist awareness of local conservation issues	
Public Awareness:	• Publicize examples of best practice conservation linked wildlife-tourism at policy making levels	• Publicize examples of best practice conservation linked wildlife-tourism • Promote ecofriendly business partners • Publicize success indicators, both biological and socio-economic

SLC-trained nature guides help bring direct benefits of ecotourism to their village. © Nakul Chettri

Cottage Industry

Provide income generation opportunities for communities in snow leopard habitat through handicraft manufacture and marketing opportunities with direct and transparent linkages to wildlife conservation via contracts that provides positive incentives for compliance.

Research required prior to taking action:

- Identify the nature and extent of the conservation threat to be addressed and actions required
- Conduct socio-economic assessment of target community to assess income generation needs and opportunities
- Conduct biological baseline survey to enable impact monitoring

<table>
<tr><th>Action Guidelines</th><th>Policy level</th><th>Community level</th></tr>
<tr><td rowspan="2">Steps:</td><td>• Gain government recognition of need and importance of community generated conservation contracts
• Gain local governments and/or Protected Area administration support in development of conservation contracts
• Establish communication channels for reporting contract violations</td><td>Contract development
• Identify stakeholders who have an active or passive influence on the conservation threat
• With stakeholders, determine benefits of added income through marketing handicrafts
• With stakeholders, define conservation actions the community will commit to in exchange for additional income generation opportunities
• Prepare conservation contract with explicit conservation and business commitments
• Establish incentive structure (e.g. bonus payment) to encourage compliance with conservation contract
• Develop monitoring protocols and success indicators

Handicraft development
• Evaluate skills, available materials, production capacity, and training needs
• Undertake market research to determine demand and product development needs
• Initiate product development with designer input based on materials; capacity; and market demand
• Identify possible support partners (micro-credit, business development, skills training and capacity building)
• Prepare and implement a business plan that considers production, transportation, and marketing costs, and includes a distribution strategy</td></tr>
<tr><td colspan="2">• Conduct ongoing independent scientific monitoring to ensure contract compliance</td></tr>
<tr><td>Stakeholders:</td><td>• Protected Areas administration and wildlife conservation agencies
• International or local development and conservation NGO’s
• Micro-credit banks and agencies</td><td>• Local communities in snow leopard habitat, particularly in buffer zones of Protected Areas
• Local businesses and traders</td></tr>
</table>

Potential Pitfalls:	• High logistical costs associated with production by communities in snow leopard habitat due to remoteness and difficulty of access • Time constraints imposed by climate and production cycles • Difficulty of semi-skilled artisans to manufacture products that consistently meet quality expectations of broad market • Inconsistent participation of trained artisans • Potential pressure on natural resources if materials used are in short supply
Monitoring Protocols / Success Indicators:	*Biological:* • Numbers, trends and productivity of wild ungulates • Density of snow leopard sign • Other indicators as determined collaboratively by community and conservationists *Socio-economic:* • Numbers of local people gaining benefit from the handicraft initiative • Financial impact at household and community levels • Public attitudes to snow leopards • Meeting goals of Business Plan
Public Awareness:	• Publicize examples of best practice conservation linked income generation • Publicize success indicators, both biological and socio-economic • Marketing: reach wide audience with positive message of conservation

Weaving is a winter-time activity in Dolphu village, Nepal
© Rodney Jackson, Snow Leopard Conservancy

Ungulate Trophy Hunting Programs

Establish or restructure trophy hunting programs that are sustainable, well monitored and provide return to local people as an incentive to protect ungulates. Community co-management of hunting program should be encouraged where ever appropriate.

Research required prior to taking action:

- Consolidate available information on population status of wild ungulates in the target area, include data on hunting pressure, competition with domestic livestock, and others
- Determine sustainable trophy harvest level using scientifically appropriate methods, combined with approximate – but objective and periodic – population monitoring
- Assess trophy hunting demand and potential value via market analysis
- Determine local (tribal) social structure and their authoritative role in hunt management
- Conduct biological baseline survey of ungulates to enable impact monitoring,
- Conduct biological baseline survey of snow leopard presence and relative density
- Conduct socio-economic assessment of target community to enable impact monitoring

Action Guidelines	Policy level	Community level
Steps:	• Engage government agencies responsible for hunt management • Review hunting laws and propose changes needed to ensure financial benefits go to local communities • Establish transparent policies under which to develop community co-managed trophy hunting • Establish harvest monitoring system and database by which harvest quotas are annually set • Assess current import policies of most important markets (US, EU) for trophies of CITES-listed species (note: the US and EU currently do not allow the import of a number of threatened species and these differ from range state to range state depending on local management)	• Assess current levels of legal and illegal hunting by community and evaluate motives • Introduce community to potential economic benefits of trophy hunting and need to conserve resource • Examine potential (legal and biological) and local desire for including subsistence harvest by community as part of hunt program • Assess local capacity to participate in delivering high quality hunting experience to trophy hunters, and take steps to raise capacity • With government, hunting organizations and community input, develop trophy hunting plan with a financial distribution structure that is equitable and transparent • Develop local capacity to conduct wildlife surveys, monitoring, and reporting to ensure sustainability
Stakeholders:	• Local and national governments • Tribal authorities • Hunting organizations • NGO's, intergovernmental organisations (IUCN), international conventions (CITES) • International NGO's	• Legal hunters • Poachers • Herders • Tourism operators

Potential Pitfalls:	• Corruption at government level with the sale of illegal licenses • Corruption at local level to allow illegal hunting to take place regardless of hunt management plans • Lack of awareness and respect for the law among foreign hunters • Lack of seed funds to initiate program • Insufficient hunting receipts reach local level (held at higher government levels)
Monitoring Protocols / Success Indicators:	*Biological:* • Numbers and trends of wild ungulates • Density of snow leopard sign • Basic harvest indicators such as hunting effort, trophy size, etc. *Socio-economic:* • Numbers of local people gaining benefit from the eco-tourism initiative • Financial impact at household and community levels
Public Awareness:	• Publicize examples of best practice community managed trophy hunting • Publicize examples of poorly community managed trophy hunting • Publicize success indicators, both biological and socio-economic • Marketing of conservation linked, community managed trophy hunting: convey the conservation message to international hunting audience

Blue sheep male in Hemis National Park © Rodney Jackson, Snow Leopard Conservancy

Reducing Poaching and Trade in Snow Leopard Parts

Poaching and trade in snow leopard parts occurs for a variety of reasons (retribution, economic, etc.) and it will require an understanding of the forces involved to apply the most appropriate counter measures.

Research required prior to taking action:

- Determine location, nature and extent of snow leopard poaching for trade (this may be accomplished through an Adaptive Management approach by immediate establishment of anti-poaching activities and under-cover investigations).
- Understand poacher motivation (financial gain, threat to livestock, etc.)
- Determine the nature of trade in snow leopard parts including supply, demand, value, trade centers and routes, participants (organized crime, government officials/agencies, individuals), etc.
- Identify end consumers

Action Guidelines	Policy level	Community level
Steps:	• Review and revise national laws on killing and trading in endangered species • Establish anti-poaching units with broad authority to combat illegal trade • Review national infrastructure, roles and responsibilities among relevant governmental agencies (federal vs. provincial, overlapping roles, gaps, etc) • Launch awareness campaigns targeting decision makers • Ensure national legislation meets requirements of international conventions such as CITES and CMS and is effectively implemented and enforced • Make fines for violations substantial enough to be a deterrent and provide for frequent review • Enact “whistle-blower” laws • Establish international information exchange mechanisms among governments agencies and institutions (CITES secretariat, Interpol) for cross-border enforcement • Collect data on killing and trade in Snow Leopard and its products • Encourage range state that are not yet CITES parties to accede	• Raise awareness of illegality of trade in snow leopard parts, penalties, • Raise awareness of “whistle-blower laws” and potential for rewards for information, establish simple procedures, substantial rewards, and safeguards for confidentiality • Establish a locally based informant ring where practical and socially acceptable • Police market centers where pelts and other body parts are being sold • Raise awareness of the potential value of live snow leopards to local communities (ecotourism, etc.) • Assess feasibility of proving alternative income to poachers (e.g. work as wildlife guards)
Stakeholders:	• Legislative branch of government • National CITES Authorities • Wildlife and Protected Area agencies • Legal agencies • Police and other law enforcement agencies • Customs • International and national NGO’s, Intergovernmental organisations (IUCN) • CITES Secretariat and other Parties	• Hunters • Poachers in snow leopard parts • Traders in snow leopard parts • Visitors and foreign military • Aid agency workers

Potential Pitfalls:	• Organized crime rings may present danger • Government corruption at all levels may obstruct enforcement of wildlife trading laws • Lack of awareness, or lack of interest among agencies responsible for enforcement (police, customs, protected area staff, etc.) • Insufficient rewards for whistle blowers or lack of confidentiality
Monitoring Protocols / Success Indicators:	• Level of awareness of laws governing trade in protected species • Attitudes among local communities towards poaching and trade in snow leopards • Level of snow leopard poaching • Level of trade in snow leopard and other protected species • Level of cross-border communication and cooperation • Number of cases or seizures reported in press • Number of cases brought to justice and penalties applied
Public Awareness:	• Develop campaign to raise awareness of legal issues concerning trade in endangered species • Develop campaign to raise awareness of the endangered status of snow leopards

NABU anti-poaching team Gruppa Bars in Kyrgystan
© Birga Dexel German Society for Nature Conservation - Naturschutzbund Deutschland

Reducing Livestock Depredation by Snow Leopards

Encourage livestock husbandry practices that reduce depredation by snow leopards and other predators.

Research required prior to taking action:

- Determine the location, nature and extent of the depredation problem, identify hotspots – depredation may occur very widely; with limited resources worst areas must be focused on
- Determine trends in depredation using historic and current documentation

<table>
<tr><th>Action Guidelines</th><th>Policy level</th><th>Community level</th></tr>
<tr><td>Steps:</td><td>Establish livestock depredation monitoring methods for all predators
Establish systematic database for storing records of depredation by predators
Develop policies to allow for removal of individual snow leopards which are known repeat livestock depredators</td><td>Using PRA methodology identify the exact nature, location and extent of depredation in target area
Determine appropriate strategies for alleviating the conflict, e.g.:
Predator-proof livestock corrals
Effective guarding dogs
Community financed livestock insurance program
Other
Determine materials/resources/skills required to implement strategy
Identify locally available resources and external sources of support
If necessary establish community structure to manage implementation of the program
Integrate with income generation opportunities such as wildlife-tourism, cottage industry, or trophy hunting to provide sustainable funding support
Develop action plan and implement
Collaboratively determine monitoring protocols and success indicators</td></tr>
<tr><td>Stakeholders:</td><td>Protected Area authorities
Local government
Wildlife departments
Livestock / vet department</td><td>Livestock herders
Absentee livestock owners</td></tr>
<tr><td>Potential Pitfalls:</td><td colspan="2">Long term sustainability may be difficult to maintain if resources are required to maintain predator proof housing
Difficult to separate scavenging from actual predation
Guard dog programs require rigorous management to ensure good guarding breeds do not become genetically diluted
Insurance programs may not be economically sustainable if funded entirely by community paid premiums, external support will be required.</td></tr>
</table>

Monitoring Protocols / Success Indicators:	• Numbers of animals lost to predators (as opposed to other factors) • Number of incidences of depredation • Number of predators killed in retribution for livestock losses • Snow leopard sign density in target area • Ungulate density in target area
Public Awareness:	• Publicize best practice examples of livestock depredation reduction strategies among policy makers and communities with similar concerns • Raise awareness of potential pitfalls to ensure widespread commitment to success

Typical corral in Mustang, Nepal, protecting livestock from predators. © Rodney Jackson, Snow Leopard Conservancy

Animal Husbandry

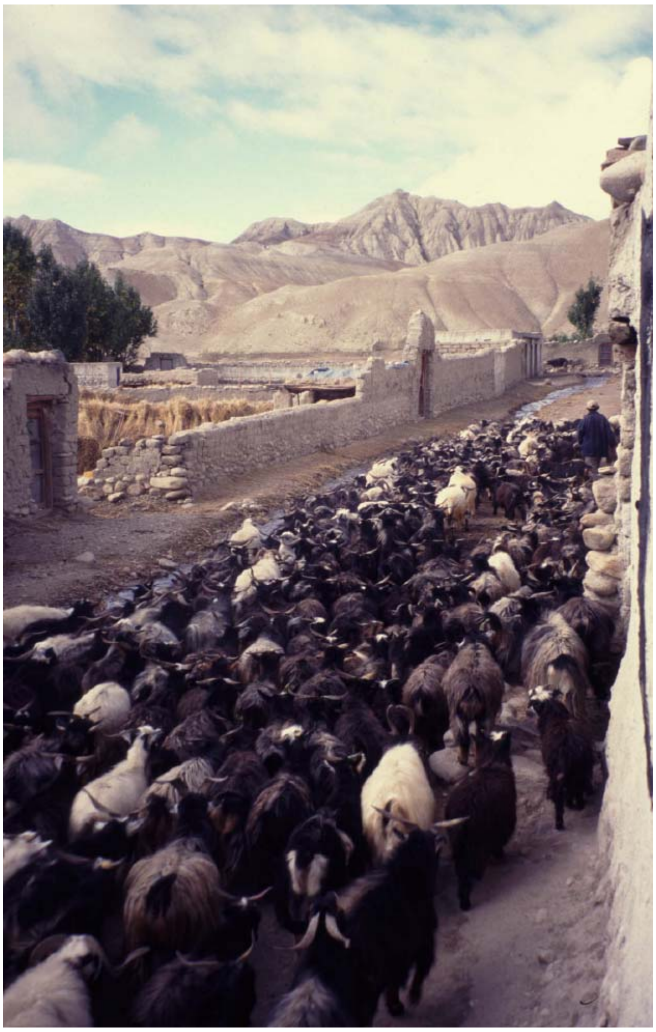
Provide training in animal husbandry and veterinary care to improve monetary return at lower stock levels, limit exposure to predation, and reduce impacts on pasture and rangelands.

Research required prior to taking action:

- Identify target area where wildlife and livestock conflicts exist.
- Determine the nature and extent of the problem from a wildlife conservation perspective, e.g. overgrazing; disturbance of key ungulate kidding/lambing areas; forage competition and disease transference between wild and domestic ungulates
- Determine baseline data in terms of livestock health and financial impact of disease
- Determine baseline data on livestock numbers and financial returns

Action Guidelines	Policy level	Community level
Steps:	• Review livestock health policies and practices at local and national level • Engage departments of agriculture and/or livestock in identifying nature of the problem and developing appropriate strategies	• Using PRA methodology, collaboratively determine appropriate strategies for alleviating the problem, e.g.: o Improved livestock nutrition o Improved breeding management o Improved grazing management o Supplying basic vaccination services o Training/capacity building of community vet o Basic prophylactic measures e.g. vaccination, dusting for internal and external parasites o Training/capacity building of community livestock health and husbandry workers • Develop strategy that incorporates specific actions to benefit wildlife e.g. stabilization or reduction of livestock numbers or avoidance of key wildlife grazing areas or other • Determine materials, resources and skills required to implement strategy • Identify locally available resources and external sources of support • If lacking, establish community structure to manage implementation of the program • Develop financial business plan to determine financial feasibility or need for external support, establish appropriate internal funding mechanisms e.g. fees for vaccinations, etc. and rolling funds • Collaboratively determine monitoring protocols and success indicators
Stakeholders:	• Government livestock departments • Local government • Wildlife departments • District veterinary services • Development and Conservation NGO's • Micro-Credit services	• Herders • Absentee livestock owners • Veterinary care workers • Livestock husbandry and health workers

Potential Pitfalls:	• Requires long-term commitment of community and implementing organization • May require supplementary funding: integrate with community income generation activities such as eco-tourism, cottage industry, etc • Basic education levels in target communities may be low for implementing effective veterinary training program • Local acceptance of fewer high-quality animals versus large unproductive herds
Monitoring Protocols / Success Indicators:	• Numbers of livestock and financial returns • Livestock health, incidence of diseases, livestock production level, human health (due to availability of dairy products) impact of vaccination programs • Numbers of wild ungulates and snow leopard sign density • Stocking density and carrying capacity of pastures
Public Awareness:	• Prepare effective livestock health public information materials as deemed to be appropriate during action planning • Publicize success indicators, both socio-economic and biological



Villagers in Mustang, Nepal, depend upon their sheep and goats.
© Rodney Jackson, Snow Leopard Conservancy

Conservation Education and Awareness

Raise awareness of snow leopard conservation issues, concerns, need for action, legal matters, etc through variety of media among different audiences

Research required prior to taking action:

- Current attitudes or level of understanding of specific issue among the target audience
- Level of education, literacy, cultural factors influencing the choice of appropriate media

Action Guidelines	Policy level	Community level
Steps:	• Integrate conservation education on high altitude ecosystems into national curriculum • Prepare education campaign for law enforcement officers • Develop communication channels for integrating different departments in awareness campaigns: e.g. wildlife; environment; education	• Identify local "coordinators" of conservation education, provide training in basic concepts if needed • Identify key conservation issue in target area • Determine desired outcome of conservation education campaign (change in behavior or attitude) • Identify audience(s) to be targeted to achieve specified goal • Determine message to be delivered • Determine appropriate media for delivering message to various audiences • Carry out baseline surveys to determine current levels of awareness • Develop educational materials and disseminate • Conduct monitoring assessment during and after the program
Stakeholders/ Potential Audiences:	• Government officials in departments that deal with wildlife conservation • Law enforcement officials who may deal with poaching and/or trade in parts of endangered species • Protected Area administration and ranger • Local and foreign development agency staff	• Livestock herders • Hunters • Poachers • Women • Young people • Community elders • School teachers • Journalists
Potential Pitfalls:	• Low levels of education and literacy among residents of many parts of snow leopard range • Linguistic and cultural barriers between different groups even in the same country • Capacity & infrastructure of education systems are often very limiting • Financial sustainability of any education campaign is difficult to maintain, usually reliant on external funding	
Monitoring Protocols / Success Indicators:	• Change in attitudes and behavior • Level of knowledge of wildlife in target audience	
Public Awareness:	• Disseminate lessons learned regarding successful strategies for raising awareness or implementing a conservation education campaign • Promote hands-on education, such as nature clubs	

3. Research and Information Needs

During the process of listing the threats to snow leopards and the required conservation actions, a set of information needs was also identified. Hence, the list below encompasses the knowledge required to carry-out urgent conservation actions. While any new information about an animal and its basic ecology are welcome, studies designed to answer questions with limited relevance to immediate conservation concerns may be a luxury that we can not afford with a species in danger of extinction. Therefore, the list of information needs contained in this Survival Strategy can, and should, serve as a guide for prioritizing and funding research programs across snow leopard range.

The following Master List of Information Needs is not arranged according to priority. A matrix of priority by region and range-wide follows the list.

Master List of Information Needs

R.1 Snow leopard distribution and "hot spots"
R.2 Snow leopard migration and dispersal routes
R.3 Snow leopard population size
R.4 Snow leopard population trends and factor responsible for changes
R.5 Protected Area coverage – extent and representation of habitats (gap analysis)
R.6 Agents of habitat degradation and relative impacts
R.7 Snow leopard – prey relationships
R.8 Prey species distribution and "hot spots"
R.9 Prey population baseline and trends
R.10 Dynamics of illegal ungulate hunting (sources, local need, uses, trade, etc.)
R.11 Dynamics of legal ungulate harvest and baseline statistics (sex/age, effort, trophy size, etc.)
R.12 Wild ungulate – livestock interactions (competition)
R.13 Ungulate disease – type, areas of occurrence, prevalence, virulence, treatment
R.14 Snow leopard poaching levels
R.15 Illegal trade in wildlife parts – market demand, sources and routes, value, etc
R.16 Livestock depredation rates
R.17 Livestock depredation causes
R.18 Grazing pressure and range conditions
R.19 Snow leopard disease – type, areas of occurrence, prevalence, virulence, treatment
R.20 Snow leopard home-range size and habitat use
R.21 Snow leopard social structure and behavior
R.22 Snow leopard population genetics
R.23 Snow leopard food habits
R.24 Snow leopard relationship to other predators
R.25 Economic valuation of snow leopards
R.26 Snow leopard monitoring techniques development/improvement
R.27 Socio-economic profiling of herder communities in snow leopard habitat
R.28 Methods to alleviate impacts of war
R.29 Livestock and human population status and trends
R.30 Analysis of existing policies and laws
R.31 Human attitudes to snow leopards

Prioritization of Information Needs

Because threats and conservation concerns vary by region, state, and even local area, it follows that information needs would vary as well. A generalized priority matrix depicts the needs on a regional basis (Table V).

Comments on Priority Information Needs

Across the snow leopard's range, gaining a more accurate picture snow leopard distribution and identifying 'hotspots' is a critical conservation need. Over most of the range, we are uncertain about where the species now occurs. This emphasizes the need for snow leopard surveys and distribution mapping, the results of which will help identify areas for conservation. Another important and related need is estimating snow leopard population size and monitoring population trends. This reflects a concern that snow leopard researchers share with other carnivore biologists: population estimation techniques for carnivores are poorly developed. Although the tiger has received some attention recently in this regard, there has been limited if any progress in the last two decades in snow leopard population estimation techniques. Considering the globally felt need for estimating snow leopard population and trends, urgent methodological advancement is needed. This will perhaps be best achieved through collaborations with other carnivore biologists, especially tiger researchers.

The need for understanding the extent of snow leopard poaching is a high priority across the range, except in the Himalaya. This is not unexpected, since poaching for skin and bones is a very serious threat to the snow leopard in all areas except in the Himalaya. Closely tied to this is the need for quantifying the illegal trade in wildlife parts. This calls for sensitization of and co-operation with law enforcement agencies for better intelligence gathering and law enforcement. An equally strong need is gaining an understanding of human attitudes to snow

Table V: Prioritization of Information Needs by Region

Regions are broadly defined as:

HIMLY - Himalaya: Tibetan Plateau and other S. China, India, Nepal, Bhutan

KK/HK - Karakhorum and Hindu Kush Range of Afghanistan, Pakistan, SW China

CISWC - Commonwealth of Independent States and W. China: Uzbekistan, Tajikistan, Kyrgystan, Kazakhstan, Xinjiang Prov. China

NRANG - Northern snow leopard range: China Altai and Tien Shan, Mongolia, Russia

RW - Range-wide as determined by international experts

Scores: 3 = High, 2 = Medium, 1 = Low

Top 10 (plus any ties)

Second 10 (plus any ties)

Research or Information Needs	Region HIMLY	KK/HK	CISWC	NRANG	RW
R1 - Snow leopard distribution and "hot spots"	3.0	2.6	3.0	3.0	3.0
R2 - Snow leopard migration and dispersal routes	2.3	1.3	2.8	3.0	1.9
R3 - Snow leopard population size	2.5	2.6	3.0	3.0	2.6
R4 - Snow leopard population trends and factors involved	2.5	1.6	2.9	3.0	2.5
R5 - Protected Area coverage—extent, presentation of habitats	2.3	2.0	2.0	3.0	2.1
R6 - Agents of habitat degradation and relative impacts	2.3	1.6	2.1	3.0	1.5
R7 - Snow leopard –prey relationships	2.6	1.7	1.9	2.0	1.7
R8 - Prey species distribution and "hot spots"	2.4	2.9	2.5	3.0	2.0
R9 - Prey population baseline and trends	2.4	2.9	2.5	3.0	2.3
R10 - Dynamics of illegal ungulate hunting	1.5	1.7	2.8	2.0	2.5
R11 - Dynamics of legal ungulate harvest and statistics	1.5	2.1	2.8	2.0	1.7
R12 - Wild ungulate—livestock interactions (competition)	2.7	2.0	1.3	1.0	1.9
R13 - Ungulate disease	1.7	2.7	2.3	2.0	1.2
R14 - Snow leopard poaching levels	1.9	2.9	3.0	3.0	2.9
R15 - Illegal trade in wildlife parts	1.9	2.9	2.9	2.0	2.6
R16 - Livestock depredation rates	2.1	2.7	1.6	2.0	2.0
R17 - Livestock depredation causes	2.1	2.7	1.1	2.0	2.0
R18 - Grazing pressure and range conditions	2.4	1.4	1.8	2.0	1.6
R19 - Snow leopard disease	1.2	1.3	2.6	1.0	1.1
R20 - Snow leopard home range size and habitat use	2.0	2.6	2.5	2.6	1.8
R21 - Snow leopard social structure and behavior	1.8	1.3	2.6	3.0	1.7
R22 - Snow leopard population genetics	1.8	1.1	2.4	2.0	2.1
R23 - Snow leopard food habits	1.7	1.3	2.5	2.0	1.8
R24 - Snow Leopard relationships to other predators	1.8	2.0	2.8	2.0	1.6
R25 - Economic valuation of snow leopards	1.8	2.4	2.8	3.0	1.4
R26 - Snow Leopard monitoring techniques development	2.6	1.7	3.0	2.0	2.9
R27 - Socio-economic profiling of herder communities	2.4	2.6	2.0	2.0	2.4
R28 - Methods to alleviate impacts of war	1.6	1.3	2.0	1.0	1.3
R29 - Livestock and human population status and trends	2.4	1.1	2.3	2.0	1.9
R30 - Analysis of existing policies and laws	2.0	3.0	2.4	1.0	1.6
R31 - Human attitudes to snow leopards	2.5	2.8	1.9	3.0	2.2

leopards. This reflects the fact that the snow leopard habitat faces pervasive human presence and use of natural resources, and that the survival of the snow leopard will ultimately be determined by attitudes of people who share its habitat.

Understanding people's attitudes entails an understanding of their socio-economic status. By profiling herder communities, who share habitat with the snow leopard, cultural norms and attitudes can be assessed. This means that field research projects, in addition to ecology and natural history, need to include socio-economic and anthropological research. Equally important is the need for better understanding of snow leopard prey populations – their distribution, population sizes, and trends in populations over time.

Thus, across the range, the important information needs for snow leopard conservation, in addition to research aimed at better understanding the species ecology and life history patterns, could be categorized as those of (a) development and implementation of snow leopard population estimation techniques, (b) a better understanding of poaching pressures, (c) evaluation of the attitudes and lifestyles of herder communities who share the snow leopard's habitat, and (d) better understanding of prey species distributions and populations. Against this background information, in the following section, we highlight the points of difference region-wise.

Brief Description of Information Needs and Potential Methods to Address Them

<u>R.1 Snow leopard distribution and "hot spots":</u>

The extent of snow leopard range across Asia has yet to be adequately defined. Much of our estimates of existing range are based on old data and GIS habitat-based maps. Areas where snow leopards occur in high numbers (hot spots) have not been identified in more than a few parts of their range.

Potential Methods

- Use improved digital imagery that is now available to refine existing model and map.
- Collect data on snow leopard sightings and sign to add validity to model, collecting data within the SLN.
- Incorporate the large body of existing SLIMS data into the model.
- Define areas where ground-truthing is still an important need and carry out surveys.

Case Studies

Hunter, D. O. and R. J. Jackson. 1997. **A range-wide model of potential snow leopard habitat.** Pages 51-56. in R. Jackson and A. Ahmad, editors Proceedings of the Eighth International Snow Leopard Symposium, Islamabad, Pakistan. International Snow Leopard Trust, Seattle, WA.

Kobler, A. and M. Adamic, 2000. **Identifying brown bear habitat by a combined GIS and machine learning method.** Ecological Modelling 135:291-300.

Maehr D. S. and J. A. Cox. 1995. **Landscape features and panthers in Florida.** Conservation Biology 9(5):1008-1019.

McCarthy, T. M. 2000. **Ecology and conservation of snow leopards, Gobi brown bears, and wild Bactrian camels in Mongolia.** Ph.D. Dissertation. University of Massachusetts, Amherst, MA. 133 pp.

Meegan, R. P. and D. S. Maehr. 2002. **Landscape conservation and regional planning for the Florida panther.** Southeastern Naturalist 1(3):217-232.

Ortega-Huerta, M. A. and K. E. Medley. 1999. **Landscape analysis of jaguar (Panthera onca) habitat using sighting records in the Sierra de Tamaulipas, Mexico.** Environmental Conservation 26(4): 257-269.

Poyarkov, A.D., G.S. Samoylova and A.E. Subbotin. 2002. **Evaluation of potential habitats of snow leopard (Uncia uncia, Schreb.) in Altay-Khangay-Sayan region and in the territory of Russian Federation: GIS approach.** Pages 148-158 in T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

Stith, B. M. and N. S. Kumar. 2002. **Spatial distributions of tigers and prey: mapping and the use of GIS.** Pages 51 – 59 in Karanth, U. K. and J. Nichols, editors. Monitoring tigers and their prey: A manual for researchers, managers and conservationists in Tropical Asia. Centre for Wildlife Studies, Bangalore, India.

Woolf, A., C. K. Nielsen, T. Weber, and T. J. Gibbs-Kieninger. 2002. **Statewide modelling of bobcat, Lynx rufus, habitat in Illinois, USA.** Biological Conservation 104:191-198.

<u>R.2 Snow leopard migration and dispersal routes:</u>

There is no information available on the extent to which snow leopards migrate or disperse. This includes cub/sub-adult dispersal away from natal range after separation from the mother, and also any long-distance travel by adults to new range. There is some indication that snow leopards cross broad expanses of open lowland between mountain ranges, however, it remains unclear if this constitutes true migration, range expansion, or if individual home-ranges are simply very large in marginal habitat. In particular, no metapopulation system has been suggested or shown for snow leopard population and this requires more investigation since this would be critical in designing conservation strategies.

Potential Methods

- Sample scats or hairs and conduct genetics analysis on suspected routes to assess dispersal patterns.
- Satellite-collar cats of different age and sex and monitor their displacements on local and large scale.

Case Studies

Beier, P. 1995. **Dispersal of Juvenile Cougars in Fragmented Habitat.** Journal of Wildlife Management 59(2):228-237.

Pierce, B. M., V. C. Bleich, J. D. Wehausen, and R. T. Bowyer. 1999. **Migratory patterns of mountain lions: Implications for social regulation and conservation.** Journal of Mammalogy 80:986-992.

<u>R.3 Snow leopard population size:</u>

Past estimates of snow leopard numbers represent little more than a "best guess" and are based on very limited surveys, of which many are of questionable design, and have been conducted in a small fraction of the range. Trend data is even less available and also of questionable validity. It is necessary to know what baseline population levels are now, to gauge effectiveness of conservation actions.

Potential Methods

- Conduct photo-trap camera surveys to census snow leopards in multiple areas.
- Collect hair samples to use genetic methods of identifying individuals and estimating population size.
- Correlate SLIMS data with known population sizes to validate the technique as a predictive tool.

Case Studies

Jackson, R M. and J. Roe. 2002. P**reliminary observations on non-invasive techniques for identifying individual snow leopards and monitoring populations.** Pages 116-117 in T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

Spearing, A. 2002. **A note on the prospects for snow leopard census using photographic capture.** Pages 173 – 185 in T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

<u>R.4 Snow leopard population trends and factor responsible for changes:</u>

Across most of potential snow leopard range we are not even certain where the cats occur. In areas where occupancy by snow leopards has been confirmed, population trends have not been calculated. Sign density, such as pugmarks and scrapes, is currently the most common method used to estimate relative snow leopard density. In some areas where long-term studies have been accomplished, such as Mongolia, there are several years worth of sign density data to compare and arrive at a general population trend estimate. However, data from sign transects are fraught with potential biases. A reliable, and preferably simple and inexpensive, method for monitoring population changes over time is much needed, particularly to monitor impacts of human activities. This includes positive impacts of conservation programs, and negative impacts associated with other human activity.

Potential Methods

- Identify areas where data are available and calculate population trends.
- Develop new methods to monitor population changes (see R. 26).
- Use both old and new methods on areas where estimates are needed.

Case Studies

Harveson, L. A., B. Route, F. Armstrong, N. J. Silvy, and M. E. Tewes. 1999. **Trends in populations of mountain lion in Carlsbad Caverns and Guadalupe Mountains National Parks.** Southwestern Naturalist 44(4):490-494.

Smallwood, K. S. 1994. **Trends in California mountain lion populations.** Southwestern Naturalist 39(1):67-72.

<u>R.5 Protected Area coverage – extent and representation of habitats (gap analysis):</u>

A current analysis of the extent of protected area coverage of snow leopard habitat has not been attempted. Initially a Gap analysis of this type will have to look at "potential" snow leopard habitat because a clear and accurate depiction of snow leopard range extent is a long-term research task. To effectively plan conservation measures, there need to be a global understanding of the various ecological roles the snow leopard plays in Central Asia. A successful conservation strategy should ensure that this diversity of evolutionary processes is conserved – and so should be clearly identified on distribution maps.

Potential Methods

- Based on snow leopard distribution updates (R.1), include protected areas (with level of protection).
- Identify areas that should be considered as a priority for protection.
- Define Snow Leopard Conservation Units that encompass the various ecological processes in which the snow leopard is involved throughout its range.

Case Studies

Jennings, M. D. 2000. **Gap analysis: concepts, methods, and recent results.** Landscape Ecology 15(1): 5-20.

Kiester, A. R., J. M. Scott, B. Csuti, R. F. Noss, B. Butterfield, K. Sahr and D. White. 1996. **Conservation prioritization using GAP data.** Conservation Biology 10(5):1332-1342.

Sanderson, E.W., K.H. Redford, C.L.B. Chetkiewicz, R.A. Medellin, A.R. Rabinowitz, J.G. Robinson and A.B. Taber. 2002. **Planning to save a species: the jaguar as a model.** Conservation Biology 16(1):58-72.

Wikramanayake, E.D., E. Dinerstein, J.G. Robinson, U. Karanth, A. Rabinowitz, D. Olson, T. Mathew, P. Hedao, M. Conner, G. Hemley and D. Bolze. 1998. **An ecology-based method for defining priorities for large mammal conservation: The tiger as case study.** Conservation Biology 12:865-878.

R.6 Agents of habitat degradation and relative impacts:

Habitat loss and degradation in snow leopard range is most commonly attributed to grazing of domestic livestock. However, there has been no quantitative analysis of this and other agents of habitat impacts. If adequate habitat is to be conserved to support viable populations of leopards and their prey, these agents need to be listed and the severity of the impacts on habitat quantified. Other agents may include mining, roads, pipelines, trekking/eco-tourism, etc.

Potential Methods

- Review literature on habitat degradation in snow leopard range.
- Develop a standardized protocol to record habitat degradation and disturbance (various indexes).
- Assess habitat degradation in selected areas.
- Identify areas where habitat degradation is or has been particularly important.

Case Studies

Cote, S. D. 1996. **Mountain goat responses to helicopter disturbance.** Wildlife Society Bulletin 24(4): 681-685.

Cronin, M. A., H. A. Whitlaw and W. B. Ballard. 2000. **Northern Alaska oil fields and caribou.** Wildlife Society Bulletin 28(4):919-922.

Linnell, J. D. C., J. E. Swenson, R. Andersen and B. Barnes. 2000. **How vulnerable are denning bears to disturbance?** Wildlife Society Bulletin 28(2): 400-413.

Merrill, E. H., T. P.Hemker and K. P.Woodruff. 1994. **Impacts of mining facilities on fall migration of mule deer.** Wildlife Society Bulletin 22(1):68-73.

Schneider, R. R. and S. Wasel. 2000. **The effect of human settlement on the density of moose in northern Alberta.** Journal of Wildlife Management 64(2): 513-520.

Rempel, R. S., P. C. Elkie, A. R. Rodgers and M. J. Gluck. 1997. **Timber-management and natural-disturbance effects on moose habitat: Landscape evaluation.** Journal of Wildlife Management 61(2): 17-524.

R.7 Snow leopard – prey relationships:

Our understanding of snow leopard prey preference and use comes primarily from a few studies in India, Mongolia, and Nepal. There has been limited effort to look at predator-prey relationships and often we make estimates of prey needs based on studies of other carnivores. The capability of protected areas to support viable snow leopard populations, when based on non-snow leopard predator-prey data, is potentially faulty and misleading. In addition, snow leopard population may also put at risk some prey species under poaching. A thorough investigation of snow leopard-prey relationships is needed and should include food habits studies from various parts of the range.

Potential Methods

- Include prey research in snow leopard autoecological studies.
- Investigate how prey density affects snow leopard abundance.
- Assess impact of snow leopard predation on prey population dynamics.

Case Studies

Jobin, A., P. Molinari and U. Breitenmoser. 2000. **Prey spectrum, prey preference and consumption rates of Eurasian lynx in the Swiss Jura Mountains.** Acta Theriologica 45(2):243-252.

Karanth, K. U. and B. M. Stith. 1999. **Prey depletion as a critical determinant of tiger population viability.** Pages 100-113 in Seidensticker, J., S. Christie and P. Jackson, editors. Riding the tiger: Tiger conservation in human-dominated landscapes. Cambridge University Press, Cambridge, New York & Melbourne.

Molinari-Jobin, A., P. Molinari, C. Breitenmoser-Wursten and U. Breitenmoser. 2002. **Significance of lynx Lynx lynx predation for roe deer Capreolus capreolus and chamois Rupicapra rupicapra mortality in the Swiss Jura Mountains.** Wildlife Biology 8(2):109-115.

Oli, M.K. 1994. **Snow leopards and blue sheep in Nepal - densities and predator- prey ratio.** Journal of Mammalogy 75:998-1004.

Ramakrishnan, U., R. G. Coss and N. W. Pelkey. 1999. **Tiger decline caused by the reduction of large ungulate prey: evidence from a study of leopard diets in southern India.** Biological Conservation 89(2):113-120.

Ross, P. I., M. G. Jalkotzy and M. Festa-Bianchet.

1997. **Cougar predation on bighorn sheep in southwestern Alberta during winter.** Canadian Journal of Zoology 75(5):771-775.

Sunde, P. and T. Kvam. 1997. **Diet patterns of Eurasian lynx Lynx lynx: What causes sexually determined prey size segregation?** Acta Theriologica 42(2):189-201.

R.8 Prey species distribution and "hot spots":

As with snow leopards themselves, the distribution and abundance of the cat's primary prey is poorly documented over much of the range. Some records exist but have not been collected in a uniform fashion and reported in the literature. Historic and current records need to be retrieved and analyzed. This will allow surveys to be designed to fill in gaps or update our knowledge.

Potential Methods

- Review literature and develop an habitat model for each snow leopard preys species
- Use the standardized SLIMS protocol to collect data on prey sightings.
- Develop a prey distribution database (analogous to SLIMS) with a standardized way of recording data.

Case Studies

Anon. 1997. **Status and distributions of Caprinae by region: China, the Commonwealth of Independent States, and Mongolia.** Pages 148-203 in Shackleton, D. M. editor. Wild sheep and goats and their relatives. Status survey and conservation action plan for Caprinae. IUCN. Gland. Switzerland.

Anon. 1997. **Status and distributions of Caprinae by region: Indo-Himalayan Region.** Pages 204-263 in Shackleton, D. M. editor. Wild sheep and goats and their relatives. Status survey and conservation action plan for Caprinae. IUCN. Gland. Switzerland

R.9 Prey population baseline and trends:

As above (R.8), prey trends and causes of change must be determined. Baseline population estimates should immediately be gained for at least the most critical snow leopard areas and all snow leopard containing protected areas. This will allow long-term trend monitoring to begin.

Potential Methods

- Based on R.8 conduct surveys where information is lacking or unreliable.
- In key selected areas conduct regular surveys to monitor trends over years.

Case Studies

Fox, J. L. and R. M. Jackson. 2002. **Blue sheep and snow leopards in Bhutan and trans-Himalayan Nepal: recent status evaluations and their application to research and conservation.** Page 64 in T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

Harris, R. B., D. H. Pletscher, C. O. Loggers and D. J. Miller. 1999. **Status and trends of Tibetan plateau mammalian fauna, Yeniugou, China.** Biological Conservation 87(1): 13-19.

Reading, R. P., S. Amgalanbaatar, H. Mix and B. Lhagvasuren. 1997. **Argali Ovis ammon surveys in Mongolia's south Gobi.** Oryx 31(4): 285-294.

R.10 Dynamics of illegal ungulate hunting (sources, local need, uses, trade, etc.):

Wild ungulates are hunted both illegally and legally across much of snow leopard range. We lack a clear synopsis of the extent of both types of activities. Conservation planning for snow leopards and prey can not be accomplished without an understanding of the potential impacts of ungulate and small mammal (marmot) hunting on prey populations.

Potential Methods

- Record prey poaching events on a systematical basis, in parallel to snow leopard poaching investigation (use existing available bodies).
- Develop a standardized framework to document poaching cases (use specific data such as measurements to get information on prey population). Train people to record adequately.
- Incorporate poaching cases into national and range wide database to identify patterns of prey poaching.

Case Studies

IFAW and WTI. 2001. **Wrap up the trade: an international campaign to save the endangered Tibetan antelope.** International Fund for Animal Welfare, Yarmouth Port, MA, USA and Wildlife Trust of India, Delhi, India. 80 pp.

Milner-Gulland, E. J., M. V. Kholodova, A. Bekenov, O. M. Bukreeva, I. A. Grachev, L. Amgalan and A. A. Lushchekina. 2001. **Dramatic declines in saiga antelope populations.** Oryx 35(4): 340-345.

R.11 Dynamics of legal ungulate harvest and baseline statistics (sex/age, effort, trophy size, etc.):

In many cases where ungulate hunting is legal, limited records are kept, or potentially valuable data is not collected at the time of the hunt. Legal trophy and meat hunting is a valuable source of demographic data on ungulate populations, but is overlooked. Governments and resource managers need to be provided with examples of best methods for collecting, storing and analyzing these data. Historic records need to be collected and assessed.

Potential Methods

- Develop a standardized framework to document harvests and train people to record them adequately.
- Use all possible available biological information such as measurements, conditions, parasites, etc… to get information on prey population – use same or similar framework than the one for poaching.
- Record prey harvest on a systematical basis.
- Incorporate harvest information into national and range wide database to detect any collapse in prey population.

Case Studies

Chan, S., A.V. Maksimuk and L.V Zhirnov. 1995. **From steppe to store: the trade in saiga antelope horn. TRAFFIC Species in Danger report.** Compiled by Stephen Nash. TRAFFIC, Cambridge, UK.

Harris, R. B. 1994. **Wildlife conservation in Yeniugou, Qinghai Province, China.** Doctoral Dissertation. University of Montana. pp. 346.

Harris, R. B., W. A. Wall and F. W. Allendorf. 2002. **Genetic consequences of hunting: what do we know and what should we know?** Wildlife Society Bulletin 30(2):634-643.

Hofer, D. 2002. **The lion's share of the hunt: trophy hunting and conservation: a review of the legal eurasian tourist hunting market and trophy trade under CITES.** With contributions from Juan Carlos Blanco, Juan Herrero, Roland Melisch, Massimiliano Rocco, Alexey Vaisman and Ellen van Krunkelsveen. TRAFFIC Europe Report, Brussels, Belgium.

Reading, R. P., H. Mix, B. Lhagvasuren and N. Tseveenmyadag. 1998. **The commercial harvest of wildlife in Dornod Aimag, Mongolia.** Journal of Wildlife Management 62(1): 59-71.

Shackleton, D.M. 2001. **A Review of community-based trophy hunting programs in Pakistan.** IUCN/SSC Caprinae Specialist Group. Prepared for the Mountain Areas Conservancy Project. Available at: http://www.macp-pk.org/docs/trophyhunting_review.PDF

Wegge, P. 1997. **Preliminary guidelines for sustainable use of wild caprins.** Pages 365-372 in Shackleton, D. M. editor. Wild sheep and goats and their relatives. Status survey and conservation action plan for Caprinae. IUCN. Gland. Switzerland.

<u>R.12 Wild ungulate – livestock interactions (competition):</u>

In many parts of snow leopard range livestock husbandry is a primary human activity. Overgrazing is common, potentially reducing forage needed by wild ungulates. The extent and impacts are not well known or documented in most of the range.

Potential Methods

- Review literature on wild ungulate and livestock interactions, and develop a standardized framework to record them.
- Similarly to what has been done for snow leopard and prey distribution, develop a GIS database for livestock husbandry patterns throughout the snow leopard range. Incorporate interaction information into this database.
- Identify patterns of interaction, or identify areas where information is lacking and conduct necessary surveys. Monitor interaction over time.

Case Studies

Breebaart, L., R. Bhikraj, T. G. O'Connor. 2002. **Dietary overlap between Boer goats and indigenous browsers in a South African savanna.** African Journal of Range and Forage Science 19(1): 13-20.

Jenks, J. A., D. M. Leslie Jr., R. L. Lochmiller, M. A. Melchiors and F. T. McCollum. 1996. **Competition in sympatric white-tailed deer and cattle populations in southern pine forests of Oklahoma and Arkansas, USA.** Acta Theriologica 41(3):287-306.

Solanki, G. S. and R. M. Naik. 1998. **Grazing interactions between wild and domestic herbivores.** Small Ruminant Research 27(3): 231-235.

<u>R.13 Ungulate disease – type, areas of occurrence, prevalence, virulence, treatment:</u>

Diseases of ungulates are thought to be a limiting factor for some populations, thus reducing snow leopard prey availability. Investigations should focus on which diseases and what vectors (livestock?) are responsible, and what the level of impact is.

Potential Methods

- Review literature of ungulate diseases throughout snow leopard range.
- Connect this information into the prey distribution database developed under R.8.
- Develop a standardized framework to record disease outbreak.
- Conduct regular prey health assessment to monitor health status and identify any crisis.
- Consult with experts (IUCN Veterinary Specialist Group) for actions.

Case Studies

Bengis, R.G., R. A. Kock and J. Fischer. 2002. **Infectious animal diseases: the wildlife/livestock interface.** OIE Revue Scientifique et Technique 21(1): 53-65.

Gross, J. E., F. J. Singer and M. E. Moses. 2000. **Effects of disease, dispersal, and area on bighorn sheep restoration.** Restoration Ecology 8:25-37.

<u>R.14 Snow leopard poaching levels:</u>

Poaching of snow leopards is a known problem in some areas, while in others it may be very rare. To best address the issue at a local level, it is necessary to document the problem exists, the numbers of cats that are being killed each year, and reasons for killing (such as socio-economic factors in the area, depredation concerns, etc.).

Potential Methods

- Review cases to identify known poaching patterns.
- Develop a standardized framework to document poaching cases (use specific data such as measurements to get information on population).
- Build or enhance a vigilance network. Train people to record adequately.
- Incorporate poaching cases into national and range wide database to identify patterns of snow leopard poaching. Compare with prey poaching database.
- Share this information with enforcement officers or community workers to develop actions to better fight poaching.

Case Studies

Damania, R., R. Stringer, K. U. Karanth, B. Stith. 2003. **The economics of protecting tiger populations: linking household behaviour to poaching and prey depletion.** Land Economics (79)2:198-216.

Dexel, B. **Snow leopard conservation in Kyrgyzstan: enforcement, education and research activities by the German Society for Nature Conservation (NABU).** Pages 59 – 63 in T. M. McCarthy and J. Weltzin, editors. Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

Kumar, A. and B. Wright. 1999. **Combating tiger poaching and illegal wildlife trade in India.** Pages 243-251 in Seidensticker, J., S. Christie and P. Jackson, editors. Riding the tiger: Tiger conservation in human-dominated landscapes. Cambridge University Press, Cambridge, New York & Melbourne.

<u>R.15 Illegal trade in wildlife parts – market demand, sources and routes, value, etc.:</u>

A thorough investigation of trade in snow leopards and their prey should be undertaken where poaching for economic reasons is determined to be an issue, and in known black market centers.

Potential Methods

- Based on a review of existing cases of poaching (R.10 and R.14), identify sources, routes, nodes and destinations.
- Document how wildlife parts are used and valued by all stakeholders involved in illegal trade.
- Identify areas where further investigation is needed and conduct investigation.
- Use this analysis to identify key points where actions are likely to be more efficient.

Case Studies

Dexel, B. 2002. **The illegal trade in snow leopards : a global perspective.** Naturschutzbund Deutschland - German Society for Nature Conservation (NABU). Available at http://www.schneeleopard.de

Mills, J.A. and P. Jackson. 1994. **Killed for a cure: a review of the worldwide trade in tiger bone.** TRAFFIC Species in Danger report. TRAFFIC, Cambridge, UK.

Nowell, K. 2000. **Far from a cure: the tiger trade revisited.** TRAFFIC Species in danger report. TRAFFIC, Cambridge, UK.

Plowden, C. and D. Bowles. 1997. **The illegal market in tiger parts in northern Sumatra, Indonesia.** Oryx 31(1):59-66.

Roe, D., T. Mulliken, S. Milledge, J. Mremi, S. Mosha and M. Grieg-Gran. 2002. **Making a killing or making a living? Wildlife trade, trade controls and rural livelihoods.** Biodiversity and Livelihoods Issues No.6.

Theile, S. 2003. **Fading footsteps: the killing and trade of snow leopards.** TRAFFIC, Cambridge, United Kingdom.

<u>R.16 Livestock depredation rates:</u>

Livestock losses to predators may constitute a serious economic hardship for poor pastoralists living in snow leopard habitat. However, the loss rate can vary greatly and may influence what type of conservation remedy is appropriate in any given site. Any study of depredation should consider not only numbers of losses but type of livestock lost and situation under which losses occur (see R.17).

Potential Methods

- Review literature to have a broader view of existing knowledge on depredation.
- Develop a standardized framework to document depredation cases. Include various types of information and train people to record.
- Conduct deeper investigations on selected areas.

Case Studies

Mazzolli, M., M. E. Graipel and N. Dunstone. 2002. **Mountain lion depredation in southern Brazil.** Biological Conservation 105(1):43-51.

Meriggi, A. and S. Lovari. 1996. **A review of wolf predation in southern Europe: Does the wolf prefer wild prey to livestock?** Journal of Applied Ecology 33:1561-1571.

Odden, J., J.D.C. Linnell, P.F. Moa, I. Herfindal, T. Kvam, and R. Andersen. 2002. **Lynx depredation on domestic sheep in Norway.** Journal of Wildlife Management 66:98-105.

Pedersen, V.A., J.D.C. Linnell, R. Andersen, H. Andren, M. Linden and P. Segerstrom. 1999. **Winter lynx**

Lynx lynx predation on semi-domestic reindeer Rangifer tarandus in northern Sweden. Wildlife Biology 5:203-211.

Stahl, P., J.-M. Vandel, V. Herrenschmidt and P. Migot. 2001. **Predation on livestock by an expanding re-introduced lynx population: long-term trend and spatial variability.** Journal of Applied Ecology 38: 674-687.

R.17 Livestock depredation causes:

The root causes of depredation may include such factors as herding practices (closely guarded, use of dogs, corrals, etc.) and changes in natural prey availability. To provide effective remedial measures this must first be carefully studied.

Potential Methods

- Based on R.16, record patterns.
- Use this analysis to identify key factors critical for action efficiency.

Case Studies

Jackson, R. M., R. Wangchuk and D. Hillard. 2002. **Grassroots measures to protect the endangered snow leopard from herder retribution: lessons learned from predator-proofing corrals in Ladakh.** Pages 102-115 in T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

Linnell, J.D.C., J. Odden, M.E. Smith, R. Aanes and J.E. Swenson. 1999. **Large carnivores that kill livestock: do «problem individuals» really exist?** Wildlife Society Bulletin 27:698-705.

Mech, L.D., E.K. Harper, T.J. Meier and W.J. Paul. 2000. **Assessing factors that may predispose Minnesota farms to wolf depredations on cattle.** Wildlife Society Bulletin 28:623-629.

Patterson, B. D., E. J. Neiburger and S. M. Kasiki. 2003. **Tooth breakage and dental disease as causes of carnivore-human conflicts.** Journal of Mammalogy 84(1):190-196.

Stahl, P., J.-M. Vandel, V. Herrenschmidt and P. Migot. 2001. **The effect of removing lynx in reducing attacks on sheep in the French Jura Mountains.** Biological Conservation 101:15-22.

Zhang, E., G. B. Schaller, L. Zhi and H. Zhang. 2002. **Tiger predation on livestock in Gedang, Medog, Southeast Tibet, China.** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.

R.18 Grazing pressure and range conditions:

Stocking rates for domestic livestock and resultant range conditions vary greatly across the range and influence competition with wild ungulates. When stocking rates are high, more marginal range may be put into use by pastoralists, often meaning higher habitat where direct interaction with snow leopards is more likely. Grazing controls may be indicated, but such programs will benefit from a clear understanding of stocking rates and resultant range conditions (see R.12).

Potential Methods

- Develop a GIS database for grazing pressure and range conditions patterns throughout the snow leopard range.
- Incorporate interaction information into this database.
- Use this database to identify priority areas for action.

Case Studies

Bernardo, D. J., G. W. Boudreau and T. C. Bidwell. 1994. **Economic tradeoffs between livestock grazing and wildlife habitat: a ranch-level analysis.** Wildlife Society Bulletin 22(3):393-402.

Clark, P. E., W. C. Krueger, L. D. Bryant and D. R. Thomas. 2000. **Livestock grazing effects on forage quality of elk winter range.** Journal of Range Management 53(1):97-105.

Eccard, J. A., R. B. Walther, S. J. Milton. 2000. **How livestock grazing affects vegetation structures and small mammal distribution in the semi-arid Karoo.** Journal of Arid Environments 46(2):103-106.

Hayward, B., E. J. Heske, C. W. Painter. 1997. **Effects of livestock grazing on small mammals at a desert cienaga.** Journal of Wildlife Management 61(1):123-129.

Silori, C. S. and B. K. Mishra. 2001. **Assessment of livestock grazing pressure in and around the elephant corridors in Mudumalai Wildlife Sanctuary, south India.** Biodiversity and Conservation 10(12):2181-2195.

R.19 Snow leopard disease – type, areas of occurrence, prevalence, virulence, treatment:

There are relatively few reports of disease being a serious concern for snow leopard and losses are likely few. However, in a few cases skin diseases appear to be a factor in the death of several cats in an isolated area. The extent, prevalence and disease type should be investigated in any instance brought to light.

Potential Methods

- Review literature of snow leopard diseases throughout its range. Use also information from cases involving closely related species.
- Connect this information into the snow leopard distribution database developed under R.1.
- Incorporate information on a plausibility index of disease outbreak given by the presence of favorable factors in snow leopard population (such as previous cases, presence of domestic animals, etc…).
- Develop a standardized framework to record disease

outbreak.

- Conduct regular snow leopard health assessment to monitor health status and identify any crisis. This will be mainly based on health examination during captures and screening for parasites present in scats.
- Consult with experts (IUCN Veterinary Specialist Group) for actions.

Case Studies

Boomker, J. Penzhorm, B.L. and I.G. Horak. 2001. **Parasites of lions (Panthera leo) and leopards (Panthera pardus): a documentation.** Pages 131-142 in J. van Heerden, editor Proceedings of a Symposium on Lions and Leopards as Game Ranch Animals. Widlife Group, South African Veterinary Association, Onderstepoort, South Africa.

Deem, S.L., L.H. Spelman, R.A. Yates and R.J. Montali. 2000. **Canine distemper in terrestrial carnivores: A review.** Journal of Zoo and Wildlife Medicine 31: 441-451.

Degiorgis, M.P., C.H. Segerstad, B. Christensson and T. Morner. 2001. **Otodectic otoacariasis in free-ranging Eurasian lynx in Sweden.** Journal of Wildlife Diseases 37:626-629.

Funk, S. M. and C. V. Fiorello. 2001. **The role of disease in carnivore ecology and conservation.** Pages 443-466 in Gittleman, J. L., S. M. Funk, D. W. MacDonald and R. K. Wayne, editors. Carnivore Conservation. Cambridge University Press, Cambridge, New York & Melbourne.

Meltzer, D.G.A. 2001. **Disease overview of large felids.** Pages 143-150 in J. van Heerden, editor Proceedings of a Symposium on Lions and Leopards as Game Ranch Animals. Widlife Group, South African Veterinary Association, Onderstepoort, South Africa.

Murray, D. L., C. A. Kapke, J. F. Evermann and T. K. Fuller. 1999. **Infectious disease and the conservation of free-ranging large carnivores.** Animal Conservation 2:241-254.

Osofsky, S.A., K.J. Hirsch, E.E. Zuckerman and W.D. Hardy. 1996. **Feline lentivirus and feline oncovirus status of free-ranging lions (Panthera leo), leopards (Panthera pardus), and cheetahs (Acinonyx jubatus) in Botswana: A regional perspective.** Journal of Zoo and Wildlife Medicine 27:453-467.

Packer, C., S. Altizer, M. Appel, E. Brown, J. Martenson, S.J. O'Brien, M. Roelke-Parker, R. Hofmann-Lehmann and H. Lutz. 1999. **Viruses of the Serengeti: patterns of infection and mortality in African lions.** Journal of Animal Ecology 68:1161-1178.

Paul-Murphy, J., T. Work, D. Hunter, E. McFie and D. Fjelline. 1994. **Serologic survey and serum biochemical reference ranges of the free-ranging mountain lion (Felis concolor) in California.** Journal of Wildlife Diseases 30:205-215.

Steinel A., C.R. Parrish, M.E. Bloom and U. Truyen. 2001. **Parvovirus infections in wild carnivores.** Journal of Wildlife Diseases 37:594-607.

Roelke M.E., D.J. Forrester, E.R. Jacobson, G.V. Kollias, F.W. Scott, M.C. Barr, J.F. Evermann and E.C. Pirtle. 1933. **Seroprevalence of infectious disease agents in free-ranging Florida panthers (Felis concolor coryi).** Journal of Wildlife Diseases 29:36-49.

Rotstein, D. S., R. Thomas, K. Helmick, S. B. Citino, S. K. Taylor and M. R. Dunbar. 1999. **Dermatophyte infections in free-ranging Florida panthers (Felis concolor coryi).** Journal of Zoo and Wildlife Medicine 30(2):281-284.

Ryser-Degiorgis, M.P., A. Ryser, L.N. Bacciarini, C. Angst, B. Gottstein, M. Janovsky and U. Breitenmoser. 2002. **Notoedric and sarcoptic mange in free-ranging lynx from Switzerland.** Journal of Wildlife Diseases 38:228-232.

<u>R.20 Snow leopard home-range size and habitat use:</u>

A few notable studies of snow leopard range size and habitat use have been completed, however, the results indicate broad difference are likely across the range. Studies from several representative areas across the range are clearly needed to better understand these basic ecological parameters for the species.

Potential Methods

- Conduct radio-tracking studies in areas where snow leopards have different ecology.
- Some of these studies should be long term.

Case Studies

Sunde, P., T. Kvam, P. Moa, A. Negard and K. Overskaug. 2000. **Space use by Eurasian lynxes Lynx lynx in central Norway.** Acta Theriologica 45(4): 507-524.

Sunde, P., T. Kvam, J.P. Bolstad and M. Bronndal. 2000. **Foraging of lynxes in a managed boreal-alpine environment.** Ecography 23:291-298.

<u>R.21 Snow leopard social structure and behavior:</u>

As with home-range size and habitat use, social structure and behavior in the wild have been examined in few studies and are even more poorly understood.

Potential Methods

- Conduct radio-tracking studies in areas where snow leopards have different ecology.
- Some of these studies should be long term.

Case Studies

Ferreras, P., J. F. Beltran, J. J. Aldama and M. Delibes. 1997. **Spatial organization and land tenure system of the endangered Iberian lynx (Lynx pardinus).** Journal of Zoology 243:163-189.

Pierce, B.M., V.C. Bleich and R.T. Bowyer. 2000. **Social organization of mountain lions: Does a land-tenure system regulate population size?** Ecology 81:1533-1543.

Stander, P. E., P. J. Haden, Kaqece and Ghau. 1997. **The ecology of asociality in Namibian leopards.** Journal of Zoology 242:343-364.

R.22 Snow leopard population genetics:

There have been no attempts to look at population genetics for this species in the wild. Gene flow across their highly fragmented range should be examined. Population isolates are likely and their existence will be a factor in conservation planning. Sub-speciation may be a fact between northern and southern portions of the range, but has not been documented.

Potential Methods

- Gather all wild snow leopard genetic samples that may be available and conduct genetic analysis.
- Identify any inbreeding, deleterious effect or genetic structuration in the existing snow leopard population.
- Finer level of genetic structuration may also be investigated using snow leopard virus genetic structuration.

Case Studies

Biek, R and M. Poss. 2002. **Using phylogeography of a microparasite to assess spatial population structure in its mammalian carnivore host.** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.

Eizirik, E., J. H. Kim, M. Menotti-Raymond, P. G. Crawshaw, S. J. O'Brien and W. E. Johnson. 2001. **Phylogeography, population history and conservation genetics of jaguars (Panthera onca, Mammalia, Felidae).** Molecular Ecology 10(1):65-79.

Maehr, D. S. and G. B. Caddick. 1995. **Demographics and genetic introgression in the Florida panther.** Conservation Biology 9(5):1295-1298.

Spong, G., M. Johansson and M. Bjorklund. 2000. **High genetic variation in leopards indicates large and long- term stable effective population size.** Molecular Ecology 9:1773-1782.

Schwartz, M. K., L. S. Mills, Y. Ortega, L. F. Ruggiero and F. W. Allendorf. 2003. **Landscape location affects genetic variation of Canada lynx (Lynx canadensis).** Molecular Ecology (12)7:1807-1816

Uphyrkina, O., D. Miquelle, H. Quigley, C. Driscoll, and S. J. O'Brien. 2002. **Conservation genetics of the Far Eastern leopard (Panthera pardus orientalis).** Journal of Heredity 93(5):303-311.

R.23 Snow leopard food habits:

Snow leopard food habits are fairly well documented from various parts of their range, however, it is important that at least cursory studies of prey selection are conducted to help correctly focus conservation schemes aimed at stabilizing or increasing food availability for the cats.

Potential Methods

- Develop a standardized protocol to investigate snow leopard diet (mainly from scats and carcasses). This includes recording items in the field as well as identification in the laboratory.
- Analyze samples that may already be available and conduct surveys to assess prey use by snow leopard.

Case Studies

Cunningham, S. C., C. R. Gustavson and W. B. Ballard. 1999. **Diet selection of mountain lions in southeastern Arizona.** Journal of Range Management 52(3):202-207.

Johnson, K. G., W. Wang, D. G. Reid and J. C. Hu. 1993. **Food-habits of Asiatic leopards (Panthera pardus fusea) in Wolong Reserve, Sichuan, China.** Journal of Mammalogy 74(3):646-650.

Maehr, D. S. and C. T. Moore. 1992. **Models of mass growth for 3 North-American cougar populations.** Journal of Wildlife Management 56(4):700-707.

Oli, M. K. 1993. **A Key for the identification of the hair of mammals of a snow leopard (Panthera uncia) habitat in Nepal.** Journal of Zoology 231: 71-93.

Oli, M. K., I. R. Taylor and M. E. Rogers. 1993. **Diet of the snow leopard (Panthera uncia) in the Annapurna Conservation Area, Nepal.** Journal of Zoology 231(3):365-370.

R.24 Snow leopard relationship to other predators:

A broad suite of carnivores occur within snow leopard range and no studies have been undertaken to look at inter-specific relationships including competition for food or aggression. Another issue that could be of importance to conservation planning is misidentification of predators responsible for livestock depredation.

Potential Methods

- Review literature for sympatry or exclusion between snow leopards and other carnivores, and develop a standardized framework to record them.
- Develop specific tool to record other carnivore presence and differentiate it from snow leopard presence. Include all carnivores while surveying for snow leopards.
- Similarly to what has been done for snow leopard distribution, develop a GIS database for other carnivore species throughout the snow leopard range. Incorporate relationship information into this database.
- Identify patterns of relationship and how this is likely to affect snow leopard population, or identify areas where information is lacking.

Case Studies

Caro, T. and C. Stoner. 2003. **The potential for interspecific competition among African carnivores.** Biological Conservation 110(1):67-75

Creel, S., G. Spong and N. Creel. 2001. **Interspecific competition and the population biology of extinction-prone carnivores.** Pages 35-60 in Gittleman, J. L., S. M. Funk, D. W. MacDonald and R. K. Wayne, editors. Carnivore Conservation. Cambridge University Press, Cambridge, New York & Melbourne.

Karanth, K. U. and M. E. Sunquist. 2000. **Behavioural correlates of predation by tiger (Panthera tigris), leopard (Panthera pardus) and dhole (Cuon alpinus) in Nagarahole, India.** Journal of Zoology 250: 255-265.

Palomares, F. and T. M. Caro. 1999. **Interspecific killing among mammalian carnivores.** American Naturalist 153(5):492-508.

Taber, A. B., A. Novaro, N. Neris and F. H. Colman. 1997. **Food habits of sympatric jaguar and puma in the Paraguayan Chaco.** Biotropica 29(2):204-213.

R.25 Economic valuation of snow leopards:

To make a strong argument for conservation of snow leopards, it may be beneficial in many cases to be able to place an economic value on the species. This can be particularly important when resource development (mining, etc.) and depredation losses are being weighed against maintaining snow leopard numbers. Economic value of snow leopards will include intrinsic value and potential for generating eco-tourism in an area.

Potential Methods

- Review literature for economic valuations of snow leopards, and develop a standardized framework to record them.
- Identify patterns of economic valuations and how some of them can be used to benefit snow leopard conservation.
- Develop innovative schemes of wildlife valuation.

Case Studies

Cotterill, A. 2001. **The economic viability of lions (Panthera leo) on a commercial wildlife ranch: examples and management implications from a Zimbabwean case study.** Pages 189-197 in J. van Heerden, editor Proceedings of a Symposium on Lions and Leopards as Game Ranch Animals. Widlife Group, South African Veterinary Association, Onderstepoort, South Africa.

Daily, G. C. and K. Ellison. 2002. **The new economy of nature: the quest to make conservation profitable.** Island Press. Washington, DC.

Ellison, K. and G. C. Daily. 2003. **Making conservation profitable.** Conservation in Practice 4(2):13-19.

Hanssen, L. 2001. **Leopards and tourism in a commercial farming area of Namibia.** Pages 99-108 in Shackley, M. editor. Flagship Species: Case Studies in Wildlife Tourism Management. International Ecotourism Society.

Hussain, S. 2000. **Protecting the snow leopard and enhancing farmers' livelihoods: a pilot insurance scheme in Baltistan.** Moutain Research and Development 20(3):226-231.

Mishra1, C. and M. D. Madhusudan. 2002. **An incentive scheme for wildlife conservation in the Indian trans-Himalaya.** Pages 129-135 in T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

Mishra, C. and T. M. McCarthy. 2002. **The role of incentive schemes in conserving the snow leopard (Uncia uncia).** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.

Rasker, R. and A. Hackman. 1996. **Economic development and the conservation of large carnivores.** Conservation Biology 10:991-1002.

Stander, P. E., Kaqece, Nisa, T. Dabe and D. Dabe. 2001. **Non-consumptive utilisation of leopards: community conservation and ecotourism in practice.** Pages 50-57 in J. van Heerden, editor Proceedings of a Symposium on Lions and Leopards as Game Ranch Animals. Widlife Group, South African Veterinary Association, Onderstepoort, South Africa.

R.26 Snow leopard monitoring techniques development/improvement:

In the past 10 years the primary method for monitoring snow leopards has been sign transects. However, the method is fraught with possible errors and biases which have not been adequately investigated. Other methodologies are now coming on-line that hold much potential to improve, or enhance sign surveys. These include several non-invasive techniques such as camera-trapping and genetic. Much effort should be placed into development and validation of these and other methods for monitoring population changes. This will be critical for evaluating the effectiveness of conservation programs as efforts to save the species are increased.

Potential Methods

- Use new methods developed on well studied big carnivores and try to adapt them to snow leopard specific cases. Have non snow leopard specialist involved into that exercise.
- Test and improve these methods by using them as well as old ones under various snow leopard ecological conditions.

Case Studies

General review

Karanth, K. U. 1999. **Counting tigers with confidence.** Pages 360-353 in Seidensticker, J., S. Christie and P. Jackson, editors. Riding the tiger: Tiger conservation in human-dominated landscapes. Cambridge University Press, Cambridge, New York & Melbourne.

Karanth, U. K. and J. Nichols. 2002. **Monitoring tigers and their prey: A manual for researchers, managers and conservationists in Tropical Asia.** Centre for Wildlife Studies, Bangalore, India. pp. 193

Silveira, L., A. T.A. Jacomo and J. A. F. Diniz-Filho. 2003. **Camera trap, line transect census and track surveys: a comparative evaluation.** Biological Conservation 114(3):351-355.

Wilson, G. J. and R. J. Delahay. 2001. **A review of methods to estimate the abundance of terrestrial carnivores using field signs and observation.** Wildlife Research 28(2):151-164.

Interviews

Gros, P. M., M. J. Kelly and T. M. Caro. 1996. **Estimating carnivore densities for conservation purposes: indirect methods compared to baseline demographic data.** Oikos 77(2):197-206.

Camera-traps

Carbone, C., S. Christie, K. Conforti, T. Coulson, N. Franklin, J. R. Ginsberg, M. Griffiths, J. Holden, K. Kawanishi, M. Kinnaird, R. Laidlaw, A. Lynam, D. W. Macdonald, D. Martyr, C. McDougal, L. Nath, T. O'Brien, J. Seidensticker, D. J. L. Smith, M. Sunquist, R. Tilson and W. N. Wan Shahruddin. 2001. **The use of photographic rates to estimate densities of tigers and other cryptic mammals.** Animal Conservation 4:75–79.

Karanth, K. U. and J. D. Nichols. 1998. **Estimation of tiger densities in India using photographic captures and recaptures.** Ecology 79(8):2852-2862.

Silver, S. C., L. E. T. Ostro and L. K. Marsh. 2002. **The use of camera traps to estimate jaguar populations.** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.

Trolle, M. and M. Kéry. 2003. **Estimation of ocelot density in the Pantanal using capture-recapture analysis of camera-trapping data.** Journal of Mammalogy 84(2):607-614.

Genetics

Mowat, G. and C. Strobeck. 2000. **Estimating population size of grizzly bears using hair capture, DNA profiling, and mark-recapture analysis.** Journal of Wildlife Management 64:183-193.

Poole, K. G., G. Mowat and D. A. Fear. 2001. **DNA-based population estimate for grizzly bears Ursus arctos in northeastern British Columbia, Canada.** Wildlife Biology 7(2):105-115.

Hormone analysis

Czekala, N. M., B. S. Durrant, L. Callison, M. Williams and S. Millard. 1994. **Fecal steroid-hormone analysis as an indicator of reproductive function in the cheetah.** Zoo Biology 13(2):119-128.

Others

McDaniel, G. W., K. S. McKelvey, J. R. Squires and L. F. Ruggiero. 2000. **Efficacy of lures and hair snares to detect lynx.** Wildlife Society Bulletin 28(1):119-123.

Riordan, P. 1998. **Unsupervised recognition of individual tigers and snow leopards from their footprints.** Animal Conservation 1:253-262.

R.27 Socio-economic profiling of herder communities in snow leopard habitat:

Snow leopard conservation is intricately tied to the people that share the mountains with the cats. The motivations of those people, to conserve or "use" snow leopards and other resources, can only be understood if their economic situation is adequately elaborated.

Potential Methods

- Review literature for socio-economic profiling of herder communities, and develop a standardized framework to record them.
- Develop a GIS database for socio-economic profiling of herder communities throughout the snow leopard range.
- Identify patterns of socio-economic profiling of herder communities and if some of them are critical for snow leopard conservation. Connect this database to previous ones and seek for correlation between poaching, livestock encroachment, etc…

Case Studies

Jackson, R. and R. Wangchuk. 2001. **Linking snow leopard conservation and people-wildlife conflict resolution: grassroots measures to protect the endangered snow leopard from herder retribution.** Endangered Species Update. 18(4):138-141.

Hussain, S. 2000. **Protecting the snow leopard and enhancing the farmers' livelihoods: a pilot insurance scheme in Baltistan.** Mountain Research and Development 20:224–229.

Mishra, C. 1997. **Livestock depredation by large carnivores in the Indian trans-Himalaya: Conflict perceptions and conservation prospects.** Environmental Conservation 24(4):338-343.

Inayat, S. 2002. **Role of women in conservation of snow leopard in Pakistan.** Pages 73-76 in T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

R.28 Methods to alleviate impacts of war:

The impacts of war are only now being looked at in terms of wildlife losses and snow leopards in particular. These can be direct losses during conflict, and indirect losses due to economic hardship, displaced human populace, misguided post-conflict aid that fails to consider the environment, etc. Both the causes and potential solutions need to be investigated, as war continues to be a prospect for parts of snow leopard range.

Potential Methods

- Review literature for impact of war on wildlife in Central Asia, and develop a standardized framework to record them.
- Develop communication and negotiation approach aiming at having parties in conflict stating they won't use wildlife as a resource for war, therefore appearing as potential respectable leaders.
- Because, conservationists are most likely to intervene into post-war situations, develop guidelines for actions for these situations, targeting all stakeholders (parties in conflict, refugees, UN troops and humanitarian sectors).
- Build a database of past, present and possible conflicts and identify if some snow leopard populations are at risk.

Case Studies

Appleton, M. and J. Morris. 1997. **Conservation in a conflict area.** Oryx 31(3):153-155.

Draulans, D. and E. Van Krunkelsven. 2002. **The impact of war on forest areas in the Democratic Republic of Congo.** Oryx 36(1):35-40.

Plumptre, A. J., J. B. Bizumuremyi, F. Uwimana, J. D. Ndaruhebeye. 1997. **The effects of the Rwandan civil war on poaching of ungulates in the Parc National des Volcans.** Oryx 31(4):265-273.

Zahler, P. and P. Graham. 2001. **War and wildlife: The Afghanistan conflict and its effects on the environment.** International Snow Leopard Trust Special Report: 1-13.

<u>R.29 Livestock and human population status and trends:</u>

Human and livestock population density in snow leopard range is far from static and has recently undergone dramatic fluctuations stemming from the collapse of the Soviet system, and more recently armed conflict in various parts of the range. Conservation measures can not rely on out-dated information on human and livestock trends.

Potential Methods

- Identify where political changes have occurred throughout the snow leopard range and incorporate them into a database.
- Assess how this has affected previously mentioned factors (poaching, economic valuation, livestock, socio-economic profiling).
- Identify political changes have put some snow leopard population at risks.

Case Studies

Miller, D. J. and G. B. Schaller. 1997. **Conservation threats to the Chang Tang Wildlife Reserve, Tibet.** Ambio 26(3):185-186.

Sharma, U. R.. 1992. **Park-people interactions in Royal Chitwan National Park, Nepal.** Doctoral Dissertation. University of Arizona. 275 pp.

Wambuguh O. 1998. **Local communities and wildlife: a spatial analysis of human-wildlife interactions in Laikipia district, Kenya.** Doctoral dissertation. University of California, Berkeley.

<u>R.30 Analysis of existing policies and laws:</u>

Conservation will often best be accomplished through the establishment and enforcement of sound environmental laws. This can only be accomplished after a careful and thorough review of the current legal framework at the international, national, and local level.

Potential Methods

- Review legislation structure of snow leopards countries (legal system, who does what, overall efficiency, not snow leopard specific).
- Based on the previous step, record protection laws (international, national and local level) and policies and incorporate them into a database, in standardized way.
- Identify if (i) some populations are particularly at risk in a legal point of view, (ii) some patterns have been particularly successful in protecting snow leopards and could be duplicated in other places.

Case Studies

Keiter, R. B. and H. Locke. 1996. **Law and large carnivore conservation in the Rocky Mountains of the US and Canada.** Conservation Biology 10: 1003-1012.

Porter, J. C. 2002. **Finding teeth for Russian Federation tiger protection laws: using United States gray wolf populations as an inspiration, and United States endangered species legislation as a model for Russian Federation endangered species legal reform.** Penn State Environmental Law Review 10(2).

Singh, J. 2002. **Transboundary stakeholders: developing cross-border conservation linkages for the snow leopard.** Pages 159-169 in T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

<u>R.31 Human attitudes to snow leopards:</u>

Ultimately, conservation of snow leopards can not be accomplished without the cooperation of the people who live in snow leopard habitat, nor without the encouragement and support of resource managers and government officials. It will be necessary to change human attitudes toward this predator at a number of levels if conservation is to be effective. A baseline of human attitudes is establish against which to measure effectiveness of educational programs aimed at improving those attitudes

Potential Methods

- Review literature for human attitudes to snow leopards, and develop a standardized framework to record them.
- Similarly to what has been done for socio-economic profiling, develop a GIS database for human attitudes to snow leopards throughout its range.
- Identify patterns of human attitudes to snow leopards and if some of them are (positively or negatively) critical for snow leopard conservation. Connect this database to previous ones and seek for correlation between poaching, livestock encroachment, etc…

Case Studies

Conforti, V. A. and F. C. Cascelli de Azevedoa. 2003. **Local perceptions of jaguars (Panthera onca) and pumas (Puma concolor) in the Iguaçu National Park area, South Brazil.** Biological Conservation 111(2):215-221.

Hussain, S. 2002. **Nature and human nature: conservation, values and snow leopard.** Pages 65-72 in T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

Hussain, S. 2003. **The status of the snow leopard in Pakistan and its conflict with local farmers.** Oryx, 37(1): 26–33.

Manfredo, M.J., H.C. Zinn, L. Sikorowski and J. Jones. 1998. **Public acceptance of mountain lion management: a case study of Denver, Colorado, and nearby foothills areas.** Wildlife Society Bulletin 26: 964-970.

Oli, M.K., I.R. Taylor and M.E. Rogers. 1994. **Snow leopard Panthera uncia predation of livestock - an assessment of local perceptions in the Annapurna Conservation Area, Nepal.** Biological Conservation 68:63-68.

Patterson, D. K. 2002. **Evaluating tiger conservation: what social conditions allow for success in conservation?** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.

Zimmermann, A. 2002. **Attitudes of ranchers in brazil's pantanal to conflicts with jaguars.** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.

4. Country Action Planning

A. The SLSS as an Action Planning Tool

One of the logical primary uses of this Snow Leopard Survival Strategy is to aid in the development of country-specific Action Plans. There are various sources for guidance in development of Action Plans for endangered species, including the Council of Europe document "Guidelines for Action Plans for Animal Species" (T-PVS-(ACPLANS) (97) 8).

We have not reprinted or paraphrased these guidelines again here. However, in general Action Planning leaders should:

- Analyze the problems and choose the proper scale,
- Identify the key stakeholders and integrate them into the planning process at the beginning, (i.e. ensure a broadly participatory process)
- Choose a multi-level approach if the problems and stakeholders are particularly diverse
- Seek to identify achievable and appropriate actions
- Build monitoring of results into the Plan

To elaborate on the above points:

- Analyze the problems and choose the proper scale – In many, if not most cases, the appropriate scale for snow leopard action plans will be the country level. However, where areas are large and the conservation issues differ dramatically across state, regional or provincial plans may be required. This is quite likely the case for China and perhaps India. Action Planners must carefully consider the diversity of issues and conditions to select a scale. An exceedingly complex plan that attempts to address a broad array of problems will not be useful and difficult to implement.

- Identify the key stakeholders and integrate them into the planning process at the beginning – Top-down plans are rarely successful because they fail to bring in all of the grass-roots stakeholders at the outset. A thorough analysis must be conducted very early in the process to ensure it is a participatory one. Examples of stakeholder groups that should be consulted include; 1) local people whose lives will be directly impacted by the plan, 2) local community governments and citizen groups, 3) resource users such as hunters and subsistence gatherers, 4) local, national and international NGO's, 5) Protected Area administrations, 6) law enforcement agencies, and 7) policy makers at all levels of government. This is NOT an exhaustive list, and it is incumbent on the planners to identify all stakeholders.

- Choose a multi-level approach if the problems and stakeholders are particularly diverse – It may not be possible to interact with all stakeholders at the same level or using the same methodology. At the community level planners may need to employ Participatory Rural Assessment (PRA) tools. Other potentially more literate and/or mobile stakeholder's input may be solicited through well-devised surveys and questionnaires, or they me be asked to participate in workshops and other planning meetings. Drafts of the plan should be reviewed by the broadest audience possible at various stages of preparation to ensure that the plan has accurately captured the input from all contributors.

- Seek to identify achievable and appropriate actions – This Survival Strategy provides a broad list of potential actions to address common and serious threats. However, planners must seriously consider which of these and other actions could be best employed to meet the specific conservation issues they are faced with. There are no "silver bullets" in conservation, and any action must be tailored to meet the specific conditions of the country, region or site. Further, only actions that can reasonably be accomplished with available resources should be included in the Plan. An Action Plan must also identify who will undertake each activity. A Plan that identifies actions but has no available resources to implement them, nor a responsible entity to lead them, is doomed to failure.

- Build monitoring of results into the Plan – A plan that has no mechanism built in to monitor progress and results has a much reduced chance of attaining the desired results. Milestones and timeframes should be identified to gauge progress. The Plan should specify review dates and allow for revisions of actions should they be found to fall short of goals. An Action Plan in that sense should be a living document that can be modified over time to meet changing conditions and address shortcomings.

With these in mind we can say that Good Action Plans:

- Have the proper scale and address problems at a level where they can be solved,
- Are put to use,
- Are broadly accepted by all stakeholders,
- Have a high likelihood of producing measurable improvement of a problem if employed,
- Integrate monitoring and follow-up into the plan.

B. Action Planning Assistance

The Action Planning process need not be done in a vacuum. The Snow Leopard Network (SLN), a group of specialist and relevant organizations, can provide much needed assistance in terms of expertise and advice during the planning process. Collectively, the SLN membership has experience in nearly every area of snow leopard related conservation, research, education, and policy. They can be approached for assistance through the International Snow Leopard Trust, 4649 Sunnyside Ave. N., Suite 325, Seattle, Washington, 98103, USA, on their website http://www.snowleopard.org/sln/ or via email at info@snowleopard.org.

© Dennis Conner

5. Taking the SLSS forward

A key outcome of the SLSS Workshop was the creation of the Snow Leopard Network (SLN). The SLN is a partnership of organizations and individuals from government and private sector who work together for the effective conservation of the snow leopard, its prey, and their natural habitat to the benefit of people and biodiversity. The initial members of the SLN are the specialist who worked together on the SLSS. Carrying the SLSS forward was the impetus for developing the Network. To that end, the SLN has articulated the following mission statement, goal, and objectives.

Mission Statement:

To promote sound scientifically-based conservation of the endangered snow leopard through networking and collaboration between individuals, organizations, and governments.

Goal:

Establish and strengthen professional linkages for addressing the crucial issues affecting the survival of snow leopards and their prey species, and the livelihood opportunities of local people.

Objectives:

- Establish the SLN as lead coordinator for promoting snow leopard research and conservation
- Facilitate the implementation of the SLSS, and relevant aspects of CMS, CITES, CBD etc
- Promote development and implementation of country action plans for snow leopards
- Promote scientific management and conservation of snow leopard, natural prey and their mountain ecosystem
- Build and strengthen capacity in range states for snow leopard conservation
- Formulate position statements on snow leopard related issues drawing on the combined knowledge and expertise of the SLN members

Literature cited

Adil, A.W. 1997. Status and conservation of snow leopard in Afghanistan. Pages 35-38 in: R. Jackson and A. Ahmad (editors). Proceedings of the 8th International Snow Leopard Symposium, Islamabad, November 1995. International Snow Leopard Trust, Seattle and WWF-Pakistan, Lahore

Annenkov, B.P. 1990. The snow leopard in the Dzungarsky Plateau. International Pedigree Book of Snow Leopards 6:21-24.

Anon. 2001. Der Schneeleopard in Kirgistan. www.nabu.de/leopard/leo.htm.

Anon. 2002a. National laws for implementation of the Convention. Document Doc. 28 at the twelfth meeting of the Conference of the Parties to CITES, Santiago, Chile, 3-14 November 2002.

Anon. 2002b. Strategy for conservation of the Snow Leopard in the Russian Federation. WWF Russia. Moscow.

Anon. 2003. Interpretation and implementation of the Convention. Asian big cats. Document SC49 Doc. 10. Forty-ninth meeting of the Standing Committee, Geneva (Switzerland), 22-25 April 2003.

Baker, M. 2002. Afghanistan: UN To Survey Effects of War, Drought On Environment. www.rferl.org/nca/features/2002/09/13092002175831.asp. Date: 16.10.2002

Bannikov, A.G. 1984. Red Data Book of the USSR. Lesnaya Promyshlenhost Publishers, Moscow (In Russian).

Bhatnagar, Y.V., V.B. Mathur and T.M. McCarthy. 2001. A regional perspective for snow leopard conservation in the Indian Trans-Himalaya. Unpublished workshop paper.

Blomqvist, L. 1978. Distribution and status of the snow leopard, Panthera uncia. International Pedigree Book of Snow Leopards 1:6-21

Blower, J. H. 1986. Nature conservation in Bhutan: project findings and recommendations. UNDP/FAO Project BHU/83/022, Field Document. 55 p

Bold, A. and S. Dorzhunduy. 1976. Report on snow leopards in the southern spurs of the Gobi Altai. Proc. Institute of General and Experimental Biology, Ulaanbaatar 11:27-43 (in Russian).

Braden, K.E. 1982. The geographic distribution of snow leopards in the USSR: maps of areas of snow leopard habitation in the USSR. International Pedigree Book of Snow Leopards 3:25-39.

Braden, K.E. 1984. Nature reserves of the Soviet Union. International Pedigree Book of Snow Leopards 4:11-14.

Butler, J., P. Achuff, and J. Johnston. 1986. Arjin Mountains Nature Reserve, Xinjiange, People's Republic of China: management recommendations and resource summary. IUCN-WWF. NTIS, 56 pages.

Buzurukov, A. and R. Muratov. 1994. Snow leopards in Tajikistan. Pages 29-32 in: J. L., Fox and Du Jizeng (editors). Proceedings of the Seventh International Snow Leopard Symposium (Xining, Qinghai, China, July 25-30, 1992). International Snow Leopard Trust, Seattle, Washington.

Bykova, E., B. Grebot and E. Kreuzberg-Mukhina. 2002. Assessment of the Snow Leopard in Central Asian region. Unpublished report.

Chundawat, R.S. and R.S. Rawat. 1994. Food habits of snow leopard in Ladakh, India. Pages 127-132 in: J. L., Fox and Du Jizeng (editors). Proceedings of the Seventh International Snow Leopard Symposium (Xining, Qinghai, China, July 25-30, 1992). International Snow Leopard Trust, Seattle, Washington

Chundawat, R.S., W.A. Rodgers and H.S. Panwar. 1988. Status report on snow leopard in India. Pages 113-120 in H. Freeman, editor. Proceedings of the Fifth International Snow Leopard Symposium. International Snow Leopard Trust and Wildlife Institute of India, Seattle, Washington.

CMS. 2002. Report supporting concerted co-operative action under CMS to conserve the Snow Leopard (Uncia uncia). CMS/ScC.11/Doc.15. 30 August 2002. Presented at the eleventh meeting of the CMS Scientific Council, Bonn, 14-17 September 2002.

Council of Europe. 1997. Guidelines for Action Plans for Animal Species" (T-PVS-(ACPLANS) (97) 8). Nature and Environment No. 92.

Dexel, B. 2002. The illegal trade in snow leopards – A global perspective. Naturschutzbund Deutschland (NABU).

Dhungel, S. K. 1994. Conservation of the snow leopard in Nepal. Pages 47-50 in: J. L., Fox and Du Jizeng (editors). Proceedings of the Seventh International Snow Leopard Symposium (Xining, Qinghai, China, July 25-30, 1992). International Snow Leopard Trust, Seattle, Washington.

Fox, J.L. 1989. A review of the status and ecology of the snow leopard (Panthera uncia). Unpublished Report. International Snow Leopard Trust, Seattle, Washington, 40 pages.

Fox, J.L. 1994. Snow leopard conservation in the wild - a comprehensive perspective on a low density and highly fragmented population. Pages 3-15 in: J. L., Fox and Du Jizeng (editors). Proceedings of the Seventh International Snow Leopard Symposium (Xining, Qinghai, China, July 25-30, 1992). International Snow Leopard Trust, Seattle, Washington.

Fox, J.L. and R. S. Chundawat. 1988. Observations of snow leopard stalking, killing, and feeding behavior. Mammalia 52(1): 137-140

Fox, J.L. and R.S. Chundawat. 1991. The mountain ungulates of Ladakh, India. Biological Conservation 58:167-190.

Fox, J.L. and J. Du Jizeng. 1994. Proceedings of the

Seventh International Snow Leopard Symposium (Xining, Qinghai, China, July 25-30, 1992). International Snow Leopard Trust, Seattle, Washington.

Fox, J.L. and R. Jackson. 2002. Blue sheep and snow leopards in Bhutan and trans-Himalayan Nepal: recent status evaluation and their application to research and conservation Page 64 in T. M. McCarthy and J. Weltzin, (editors) Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

Fox. J.L. and C. Nurbu. 1990. Hemis, a national park for snow leopard in India's trans-Himalaya. International Pedigree Book of Snow Leopards 6:71-84.

Fox, J.L., S. P Sinha, R.S. Chundawat, and P. K Das. 1988. A field survey of snow leopard presence and habitat use in north western India. Pages 99-111 in H. Freeman, editor. Proceedings of the Fifth International Snow Leopard Symposium. International Snow Leopard Trust and Wildlife Institute of India, Seattle, Washington.

Fox, J.L., S.P. Sinha, R.S. Chundawat and P.K. Das. 1991. Status of the snow leopard Panthera uncia in North-west India. Biological Conservation 55:283-298.

Fuller, S. and J. Ahmed. 1997. Opportunities for transfrontier protected areas in Pakistan. Pages 204-215 in: R. Jackson and A. Ahmad (editors). Proceedings of the 8th International Snow Leopard Symposium, Islamabad, November 1995. International Snow Leopard Trust, Seattle and WWF-Pakistan, Lahore.

Government of India. 1988. The Snow Leopard Conservation Scheme. Ministry of Environment and Forests, New Delhi. 27 pages.

Green, M.J.B. 1988. Protected areas and snow leopards: their distribution and status. Pages 3-19 in H. Freeman, editor. Proceedings of the Fifth International Snow Leopard Symposium. International Snow Leopard Trust and Wildlife Institute of India, Seattle, Washington.

Green, M.J.B. 1992. Nature Reserves of the Himalaya and the Mountains of Central Asia. New Delhi: IUCN, Cambridge and Oxford University Press.

Green, M.J.B. 1994. Protecting the mountains of Central Asia and their snow leopard populations. Pages 223-237 in: J. L., Fox and Du Jizeng (editors). Proceedings of the Seventh International Snow Leopard Symposium (Xining, Qinghai, China, July 25-30, 1992). International Snow Leopard Trust, Seattle, Washington.

Green, M.J.B. and B. Zhimbiev. 1997. Transboundary protected areas and snow leopard conservation. Pages 194-203 in: R. Jackson and A. Ahmad (editors). Proceedings of the 8th International Snow Leopard Symposium, Islamabad, November 1995. International Snow Leopard Trust, Seattle and WWF-Pakistan, Lahore.

Gripenberg, U., Soderlund, C. Wahlber, and L. Blomqvist. 1982. International Pedigree Book of Snow Leopards 3:135-138.

Hast, M.H. 1989. The larynx of roaring and non-roaring cats. Journal of Anatomy 163:173-121.

Hemmer, H. 1967. Panthera Oken, 1816 (Mammalia, Carnivora): Further comment on the proposed preservation and renewed application. Buletin Zoologique Nomenclature 24:259-261.

Hemmer, H. 1972. Uncia uncia. Mammalian Species 20:1-5.

Heptner, V. and A.A. Sludskii. 1992. Mammals of the Soviet Union, Volume II, Part 2 Carnivora (Hyaenas and Cats). Smithsonian Institution Libraries and National Science Foundation, Washington DC. 748 pages.

Hunter, D.O. and R. Jackson. 1997. A range-wide model of potential snow leopard habitat. Pages 51-56 in: R. Jackson and A. Ahmad (editors). Proceedings of the 8th International Snow Leopard Symposium, Islamabad, November 1995. International Snow Leopard Trust, Seattle and WWF-Pakistan, Lahore.

Hussain, S. 2003. The status of the snow leopard in Pakistan and its conflict with local farmers. Oryx 37(1):26-33.

IUCN. 2002. IUCN red List of Threatened Species. IUCN, Gland, Switzerland. http://www.redlist.org.

Jackson, R. 1979. Snow leopards in Nepal. Oryx (15)2: 191-195.

Jackson, R. 1991. A wildlife survey of the Qomolangma Nature Preserve, Tibet Autonomous Regions, People's Republic of China. Unpub. Rept., Woodlands Mountain Institute, Franklin, West Virginia. 61 pages.

Jackson, R. 1992. Snow leopard. Unpubl. data sheet, IUCN/SSC/Cat Specialist Group, Bougy-Villars, Switzerland

Jackson, R. 2002. Snow Leopard Status, Distribution and Protected Area Coverage. Pages 77-101 in T. M. McCarthy and J. Weltzin, (editors) Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

Jackson, R. and G.G. Ahlborn. 1984. Preliminary habitat suitability model for the snow leopard Panthera uncia in west Nepal. International Pedigree Book of Snow Leopards 4:43-52.

Jackson, R. and G.G. Ahlborn. 1988. Observation on the ecology of snow leopard (Panthera uncia) in west Nepal. Pages 65-87. in H. Freeman, editor. Proceedings of the Fifth International Snow Leopard Symposium. International Snow Leopard Trust and Wildlife Institute of India, Seattle, Washington.

Jackson, R. and G. G. Ahlborn. 1989. Snow leopards (Panthera uncia) in Nepal: home range and movements. National Geographic Research 5(2):161-175.

Jackson, R. and G. G. Ahlborn. 1990. The role of protected areas in Nepal in maintaining viable populations of snow leopards. International Pedigree Book of Snow Leopards 6:51-69.

Jackson, R., G.G. Ahlborn, S. Ale, D. Gurung, M. Gurung and U.R. Yadav. 1994b. Reducing livestock depredation in the Nepalese Himalaya: case of the Annapurna Conservation Area. Unpublished report prepared for U.S. Agency of International Development by BioSystems Analysis, Inc., Tiburon California.

Jackson, R. and A. Ahmad (editors). Proceedings of the 8th International Snow Leopard Symposium, Islamabad, November 1995. International Snow Leopard Trust, Seattle and WWF-Pakistan, Lahore

Jackson, R. and D.O. Hunter. 1996. Snow leopard survey and conservation handbook. International Snow Leopard Trust, Seattle, Washington.

Jackson, R. and J.L. Fox. 1997a. Snow leopard conservation: accomplishments and research priorities. Pages 128-145 in: R. Jackson and A. Ahmad (editors). Proceedings of the 8th International Snow Leopard Symposium, Islamabad, November 1995. International Snow Leopard Trust, Seattle and WWF-Pakistan, Lahore.

Jackson, R. and J.L Fox. 1997b. Snow leopard and prey species workshop in Bhutan. Cat News 27:18-19.

Jackson, R., Wang, Zongyi, Lu, Xuedong, and Chen Yun. 1994a. Snow leopards in the Qomolangma Nature Preserve of the Tibet Autonomous region. Pages 85-95 in: J. L., Fox and Du Jizeng (editors). Proceedings of the Seventh International Snow Leopard Symposium (Xining, Qinghai, China, July 25-30, 1992). International Snow Leopard Trust, Seattle, Washington.

Jackson, R., Wangchuk, Pema, T. Namgyal, and E. Kumar. 2000. Report on the second Bhutan SLIMS training workshop. Unpub. Report, International Snow Leopard Trust, Seattle.

Jiang, Q.M. and W.V. Bleisch. 1996. Preliminary assessment of large mammals in the Namcha Barwa region of south-eastern Tibet. Oryx 30(1):37-44.

Kattel, B. and Bajimaya, S.S. 1997. Status and Conservation of Snow Leopard in Nepal. In: R. Jackson and A. Ahmad (Eds.) Pages 28-34. in: R. Jackson and A. Ahmad (editors). Proceedings of the 8th International Snow Leopard Symposium, Islamabad, November 1995. International Snow Leopard Trust, Seattle and WWF-Pakistan, Lahore.

Kattel, B. and S.S. Bajimaya. 1997. Status and Conservation of Snow Leopard in Nepal. Pages 28-34 in: R. Jackson and A. Ahmad (editors). Proceedings of the 8th International Snow Leopard Symposium, Islamabad, November 1995. International Snow Leopard Trust, Seattle and WWF-Pakistan, Lahore.

Khan, J. 2002. Report on snow leopard pelt trade survey. TRAFFIC Europe unpublished report.

Koshkarev, E.P. 1989. The Snow Leopard in Kirgizia. Ilim Publishers, Frunze, Kirgizia, USSR. 98 pages. (In Russian).

Koshkarev, E.P. 1990. On the environment-related stability of snow leopard (Uncia uncia) populations in connection with their distribution in the natural habitats and chances fro spread within the USSR. International Pedigree Book of Snow Leopards 6:37-50.

Koshkarev, E.P.1996 The snow leopard in its northeastern range. Cat News 25:10.

Koshkarev, E.P. 1998. Snow leopard along the border of Russia and Mongolia. Cat News 28:12-14.

Koshkarev, E.P. 2000. What has happened to the snow leopard after the break-up of Soviet Union? Snow Line. XVI.

Koshkarev, E. P. and V. Vyrypaev. 2000. The snow leopard after the break-up of the Soviet Union. Cat News 32:9-11.

Kreuzberg-Mukhina, E., A Esipov, B. Aromov, E. Bykova, and E. Vashetko. 2002. Snow leopard and its protection in Uzbekistan. Pages 134-135 in T. M. McCarthy and J. Weltzin, (editors) Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

Liao, Y.1994. Snow leopard distribution, purchase locations and conservation in Qinghai Province, China. Pages 65-72 in: J. L., Fox and Du Jizeng (editors). Proceedings of the Seventh International Snow Leopard Symposium (Xining, Qinghai, China, July 25-30, 1992). International Snow Leopard Trust, Seattle, Washington.

Liao, Y. and B. Tan. 1988. A preliminary study of the geographic distribution of snow leopards in China. Pages 51-63 in H. Freeman, editor. Proceedings of the Fifth International Snow Leopard Symposium. International Snow Leopard Trust and Wildlife Institute of India, Seattle, Washington.

MACP (Mountain Areas Conservancy Project). 2001. Annual Report for 2000. PAK/98/G31 -PAK/98/014, UNDP, IUCN and WWF-Pakistan. Islamabad, Pakistan.

Malik, M.M. 1997. Status and conservation of snow leopard in Pakistan. Pages 11-20 in: R. Jackson and A. Ahmad (editors). Proceedings of the 8th International Snow Leopard Symposium, Islamabad, November 1995. International Snow Leopard Trust, Seattle and WWF-Pakistan, Lahore.

Mallon, D. 1985. The mammals of the Mongolian People's Republic. Mammal Review 15:71-102.

Mallon, D. 1984a. The snow leopard in Ladakh. International Pedigree Book of Snow Leopards. 4:23-37.

Mallon, D. 1984b. The snow leopard, Panthera uncia, in Mongolia. International Pedigree Book of Snow Leopards 4:3-10.

Mallon, D.P. & M.S. Bacha 1989 Ecology and management of the Hemis National Park. Report to the Department of Wildlife Protection, Jamnu and Kashmir Government

McCarthy, T.M. 2000. Ecology and conservation of snow leopards, Gobi brown bears and wild Bactrian camels in Mongolia. Ph.D. Dissertation, University of Massachusetts, Amherst. 133 pages.

Medvedev, D.G. 1990. The snow leopard in the eastern Sayan Mountains. International Pedigree Book of

Snow Leopards 6:17-19.
Nowak, R.M., and J.L. Paradiso. 1983. Walker's mammals of the world. Fourth ed. Vol. II. Johns Hopkins Univ. Press, Baltimore, Maryland. 1362 pages.
Nowell, K. and P. Jackson. 1996. Wild Cats: Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland.
O'Connell-Rodwell, C and R. Parry-Jones. 2002. An Assessment of China's Management of Trade in Elephants and Elephants products. TRAFFIC Online Report Series, No. 3. TRAFFIC East Asia, Hong Kong, China. Available at http://www.traffic.org/publications/china_report.pdf
Oli, M.K. 1991. The ecology and conservation of the snow leopard (Panthera uncia) in the Annapurna Conservation Area, Nepal. University of Edinburgh, Scotland. Phil. Thesis.
Oli, M.K. 1994. Snow leopards and blue sheep in Nepal: densities and predator-prey ratio. Journal of Mammalogy 75(4):998-1004.
Oli, M. K. 1995. The snow leopard dilemma: will they persist? American Zoo and Aquarium Association Regional Conference Proceedings: 433-442
Panjwani, R. 1997. Ban on Ivory, Fur and Snake Skin Trade in India. TRAFFIC India/WWF India.
Peters, G. 1980. The vocal repertoire of the snow leopard (Uncia uncia, Schreber 1775). International Pedigree Book of Snow Leopards 2:137-158.
Petocz, R.G. 1978. Report on the Afghan Pamir, Part I. Ecological reconnaissance. UNDP/FAO Project AFG/74/016. Field Document No. 6.
Pocock, R.I. 1917. The classification of existing Felidae. Ann. Mag. Nat. Hist., Ser. 8, 20:329-350.
Poyarkov, A.D. and A.E. Subbotin. 2002. The snow leopard status in Russia. Pages 139-141 in T. M. McCarthy and J. Weltzin, (Eds.) Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/
Poyarkov, A.D., G.S. Samoylova and A.E. Subbotin. 2002. Evaluation of potential habitats of snow leopard (Uncia uncia, Schreb.) in Altay-Khangay-Sayan region and in the territory of Russian Federation: GIS approach. Pages 148-158 in T. M. McCarthy and J. Weltzin, (Eds.) Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/
Reading, R.P. 1995. Biological Assessment of Three Beauties of the Gobi National Conservation Park With Recommendations for Special Zone (Core Area) Locations, Tourist Routes, and Park Management. Northern Rockies Conservation Cooperative & Nature Conservation International, Jackson, Wyoming. Unpublished Report.
Reiger, I. 1980. Some aspects of the history of ounce knowledge. International Pedigree Book of Snow Leopards 2:1-36
Roberts, T.J. 1977. The mammals of Pakistan. Ernest Benn, London and Tonbridge. 361 pages.
Rodgers, W. A. and H. S. Panwar. 1988. Planning a wildlife protected area network in India. FAO Field Document 1(9):1-341.
Sayer, J.A. 1980. The conservation of the snow leopard (Uncia uncia) in Afghanistan. International. Pedigree Book of Snow Leopards 2:55-61.
Schaller, G.B. 1976. Mountain mammals in Pakistan. Oryx 13:351-356.
Schaller, G.B. 1977. Mountain Monarchs: Wild Sheep and Goats of the Himalaya. University Chicago Press, Chicago. 426 pages.
Schaller, G.B. 1990. Saving China's wildlife. International Wildlife 20(1):30-40
Schaller, G.B. 1998. Wildlife of the Tibetan Steppe. University Chicago Press, Chicago. 373 pages.
Schaller, G.B., Li Hong, Lu Hua, Ren Junrang, Qiu Mingjiang, and Wang Haibin. 1987. Status of large mammals in the Taxkorgan Reserve, Xinjiang, China. Biological Conservation 42:53-71.
Schaller, G.B., Li Hong, Talipu, Junrang Ren, and Mingjiang Qiu. 1988a. The snow leopard in Xinjiang. Oryx 22(4):197-204.
Schaller, G.B., J. Tserendeleg, and G. Amarsanaa. 1994. Pages 33-42 in: J. L., Fox and Du Jizeng (editors). Proceedings of the Seventh International Snow Leopard Symposium (Xining, Qinghai, China, July 25-30, 1992). International Snow Leopard Trust, Seattle, Washington.
Schaller, G.B., Ren Junrang, and Qiu Mingjiang. 1988b. Status of snow leopard (Panthera uncia) in Qinghai and Gansu provinces, China. Biological Conservation 45:179-194.
Singh, J. and R. Jackson. 1995. Transfrontier conservation areas: creating opportunities for conservation, peace, and the snow leopard in Central Asia. International Journal of Wilderness 5(3):7-12.
Singh, S., A. Kothari, and P. Pande. 1990. Directory of National Parks and Sanctuaries in Himachal Pradesh: management status and profiles. Indian Institute of Public Administration, New Delhi, India. 158 pages.
SLSS. 2002. Draft Outline for Snow Leopard Survival Strategy. Unpublished report, International Snow Leopard Trust, Seattle.
Sludskiy, A. A. 1973. The snow leopard or irbis- Panthera (Uncia) uncia Schreber (1976). Pages 74-83 in The distribution and population of wild cats in the USSR Works of the Institute of Zoology, Kazakh Academy of Sciences, Vol. 34. (Russian, English transl., K.E. Braden).
Smirnov, M.N., G.A. Sokolov and A.N. Zyryanov. 1990. The snow leopard (Uncia uncia Schreber 1776) in Siberia. International Pedigree Book of Snow Leopards 6:9-15.
Soderlund, V., U. Gripenberg, C. Wahlberg, and L. Blomqvist. 1980. Chromosome studies in the snow leopard (Panthera uncia): preliminary report. International Pedigree Book of Snow Leopards 2:168-182.
Sokov, A.I. 1990 The present status of snow leopard

(Uncia uncia) population in the south-western Pamir-Altai Mountains (Tadzhistan). International Pedigree Book of Snow Leopards 6:33-36.

Sopin, L. V. 1977. The snow leopard in the Altai. Pages 143-144 in V. E. Sokolov, ed., Rare species of mammals and their conservation. Materials of the Second All-Union Conference. Nauka, Moscow. (Russian).

Stroganov, S. U. 1962. Carnivorous mammals of Siberia. Bio. Inst., Acad. Sci. USSR, Siberian Branch. (Eng. Transl., 1969, Israel Program for Scientific Translations. 522pages).

Theile, S. 2003. Fading Footsteps: the killing and trade of Snow leopards. TRAFFIC, Cambridge, United Kingdom

Thornback, J. and C. W. Holloway. 1976. Snow Leopard. Red Data Book, Volume 1: Mammalia. IUCN, Morges, Switzerland.

UNEP. 2003. Post-Conflict environmental assessment Afghanistan. United Nations Environment Programme, Switzerland. Available at http://postconflict.unep.ch/afghanistan/report afghanistanpcajanuary20003.pdf

Wang, X. and G.B. Schaller. 1996. Status of large mammals in western Inner Mongolia, China. Journal of East China Normal University, Natural Science (Special Issue of Zoology) 12:93-104.

Wegge, P. 1988. Assessment of Khunjerab National Park and environs, Pakistan. Unpub. Report, IUCN, Gland. 25 pages + appendices.

Wikramanayake, E.D., C. Carpenter, H. Strand and M. McKnight. 2001. Ecoregion-based conservation in the Eastern Himalaya: identifying important areas for biodiversity conservation. WWF-US and ICIMOD. 178 pages.

Wikramanayake, E.D., E. Dinerstein, T. Allnut, C. Loucks and W. Wettengel. 1998. A biodiversity assessment and gap analysis of the Himalayas. World Wildlife Fund - US/ UNDP report, Washington DC.

Wildt, D. E., J. D. Mellen, and U. S. Seal. 1992. Felid action plan, 1991 and 1992: AAZPA Felid Taxon Advisory Group regional collection plan and IUCN Captive Breeding Specialist Group global felid action plan. CBSG, Species Survival Commission: 1-205.

Yang, Q. 1994. Further study on the geographical distribution and conservation of snow leopard in Qinghai Province, China. Pages 73-77 in: J. L., Fox and Du Jizeng (editors). Proceedings of the Seventh International Snow Leopard Symposium (Xining, Qinghai, China, July 25-30, 1992). International Snow Leopard Trust, Seattle, Washington.

Zahler, P. and P. Graham. 2001. War and wildlife: The Afghanistan conflict and its effects on the environment. International Snow Leopard Trust Special Report: 1-13.

Zavatsky, B.P. 1988 Present distribution and population of snow leopard in Sayan. Shushensky Biosphere Reserve. Rare terrestrial vertebrates of Siberia: 82-87. Novosibirsk. Nauka.

Zhirjakov, V.A. 1990. On the ecology of snow leopard in the Zailisky-Alatau (northern Tien Shan). International Pedigree Book of Snow Leopards 6:25-30.

Appendix I. List of SLSS Participants

The following people have played a role in the development of the Snow Leopard Survival Strategy. Not all participants attended the Summit Workshop in Seattle in May 2002, however, all of these individuals took part either through internet-based information exchange, reviewing draft documents, or participating in surveys. Those who attended the Summit are denoted by an asterisk (*) next to their name.

Name	Country	Organization
*Ale, Som	Nepal	ACAP
*Allen, Priscilla	UK	ISLT
*Ashiq Ahmad Khan	Pakistan	WWF-Pakistan
*Bayarjargal, A.	Mongolia	Irbis Mongolia/ISLT
*Bhatnagar, Yash Veer	India	Wildlife Institute of India
*Braden, Kathleen	USA	Seattle Pacific Univ.
*Breitenmoser, Christine	Switzerland	IUCN Cat Specialist Group Co-chair
*Breitenmoser, Urs	Switzerland	IUCN Cat Specialist Group Co-chair
Chapron, Guillaume	France	CNRS, Ecole Normale Supérieure
*Chundawat, Raghu	India	Wildlife Institute of India
*Dexel, Birga	Germany	NABU Snow Leopard Project
*Emmerich, Chris	USA	USGS – MESC
*Esipov, A.	Uzbekistan	Chatkal Nature Reserve
*Fox, Joe	Norway	Univ. Tromso
*Frazier, Harmony	USA	Woodland Park Zoo
*Freeman, Helen	USA	ISLT Founder
*Gurung, Chanrda	Nepal	WWF-Nepal
Harris, Rich	USA	Montana State University
*Hillard, Darla	USA	Snow Leopard Conservancy
*Hongfei, Zou	China	Harbin Univ / ISLT
*Hu Kanping	China	State Forestry Administration
*Hunter, Don	USA	USGS
*Inayat, Saeeda	Pakistan	ISLT / WWF-Pakistan
*Jackson, Rod	USA	Snow Leopard Conservancy
*Kadamshoev, M.	Tajikistan	Pamir Biol Institute
*Khan, Amad	Pakistan	NWFP Wildlife Department
*Khan, Javed	Pakistan	ISLT / WWF-Pakistan
*Koshkarev, Zhenya	Russia	Independent

Lu Zhi	China	Yale Univ. School of Forestry
*Malik, Mohammad Mumtaz	Pakistan	NWFP Wildlife Department
*Malikya, Ghulam	Afhganistan	Save the Env – Afghanistan
*Mallon, David	UK	Zoo UK
*McCarthy, Tom	USA	ISLT
Miquelle, Dale	Russia/USA	WCS - Russia Tiger Program
*Mishra, Charu	India	Nature Cons. Foundation / ISLT
*Mukhina, Elena	Uzbekistan	Institute of Zool, Acad of Sciences
*Munkhstog, B.	Mongolia	IRBIS Mongolia / ISLT
*Nowell, Kristin	USA	Cat Action Treasury
*Poyarkov , Andrew	Russia	Acad of Science
*Rankin, Callum	UK	WWF-UK
*Rutherford, Brad	USA	ISLT
*Shafqat, Hussain	Pakistan	Project Snow Leopard
Schaller, George	USA	WCS
Shukarev, Emil	Kyrgystan	Central Asia Transboundary GEF Project
*Singh, Jay	USA	Univ. of Washington
*Subbotin, Andrey	Russia	WWF Altai Snow Leop. Proj. (former)
*Sumiya, G.	Mongolia	WWF-Mongolia
*Thiele, Stephanie	UK	TRAFFIC
*Toropova, Valentina	Kyrgystan	Asia Irbis
*Wangchuck, Tshewang	Bhutan	Jigme Dorji National Park
*Wasser, Sam	USA	Univ. of Washington
*Wen Bo	China	Independent
*Wharton, Dan	USA	Wildlife Conservation Society
*Yuchenkov, Y.	Kazakhstan	Katon-Karagay State National Park
*Zinchenko, Yuri	Kazakhstan	Katon-Karagay State National Park

Appendix II: Abstracts of Case Studies presented in Section on Information Needs

References without abstract are not included in this appendix.

Appleton, M. and J. Morris. 1997. **Conservation in a conflict area**. Oryx 31(3):153-155.
Liberia is slowly recovering from a 7-year civil war that devastated the country's infrastructure. Timber needed for reconstruction is being illegally exported to benefit faction leaders and foreigners. Despite unimaginable disorder, the Liberian Society for the Conservation of Nature is eager to resume its conservation activities. Sapo, Liberia's first National Park, was a focal point of fighting during the war, but the wildlife in the park seems to have fared well and possibly even benefited from the dispersal of humans from the area. However, illegal logging is now taking place near the park and multi-lateral Peacekeeping forces have turned a blind eye to the situation. EC ad workers hope to install several bridges in the area to facilitate humanitarian relief efforts, but that may exacerbate the environmental destruction. Until political stability returns, there is little hope of halting the theft of resources that could otherwise be supplying sustainable and desperately needed income for the country.

Beier, P. 1995. **Dispersal of Juvenile Cougars in Fragmented Habitat**. Journal of Wildlife Management 59(2):228-237.
There is little information on the spatiotemporal pattern of dispersal of juvenile cougars (Felis concolor) and no data on disperser use of habitat corridors. I investigated dispersal of radio-tagged juvenile cougars (8 M, 1 F) in a California landscape containing 3 corridors (1.5, 4.0, and 6.0 km long) and several habitat peninsulas created by urban growth. Dispersal was usually initiated by the mother abandoning the cub near an edge of her home range. The cub stayed within 300 m of that site for 13-19 days and then dispersed in the direction opposite that taken by the mother. Mean age at dispersal was 18 months (range 13-21 months). Each disperser travelled from its natal range to the farthest part of the urban-wildland edge. Dispersing males occupied a series of small (<30% the area used by ad M in the same time span), temporary (10-298 days) home ranges, usually near the urban- wildland interface, and often with its longest border along that edge. Each of the 3 corridors was used by 1-3 dispersers, 5 of the 9 dispersers found and successfully used corridors, and 2 dispersers entered but failed to traverse corridors. Dispersing cougars will use corridors that are located along natural travel routes, have ample woody cover, include an underpass integrated with roadside fencing at high-speed road crossings, lack artificial outdoor lighting, and have <1 dwelling unit/16 ha.

Bengis, R.G., R. A. Kock and J. Fischer. 2002. **Infectious animal diseases: the wildlife/livestock interface**. O I E Revue Scientifique et Technique 21(1):53-65.
The long-standing conflict between livestock owners and animal health authorities on the one hand, and wildlife conservationists on the other, is largely based on differing attitudes to controlling diseases of livestock which are associated with wildlife. The authors have attempted to highlight the fact that these disease problems are frequently bi-directional at the wildlife/livestock interface. The different categories of diseases involved are presented. A new dimension being faced by veterinary regulatory authorities is the spectre of emerging sylvatic foci of diseases, such as bovine tuberculosis, bovine brucellosis and possibly rinderpest; these diseases threaten to undermine national and international eradication schemes, which have been implemented and executed with significant success, and at great cost. Conversely, wildlife-based ecotourism world-wide has expanded rapidly over the past decade and is the source of lacking foreign revenue for many developing countries. Traditional subsistence farming is still the largest source of much-needed protein on some continents and this, together with the growth and hunger of historically disadvantaged communities for land, is forcing enterprises and communities with markedly different objectives and land-use practices to operate effectively in close proximity. Some land-users rely exclusively on wildlife, others on livestock and/or agronomy, while yet others need to combine these activities. The net result may be an expansion or intensification of the interface between wildlife and domestic livestock, which will require innovative control strategies that permit differing types of wildlife/livestock interaction, and that do not threaten the land-use options of neighbours or the ability of a country to market animals and animal products profitably.

Bernardo, D. J., G. W. Boudreau and T. C. Bidwell. 1994. **Economic tradeoffs between livestock grazing and wildlife habitat: a ranch-level analysis**. Wildlife Society Bulletin 22(3):393-402.
The authors develop and apply a mathematical model to evaluate the economic trade-off between livestock grazing and wildlife habitat. The model incorporates habitat appraisal criteria into an optimization model to allow livestock production to be maximized while meeting wildlife habitat constraints.

Biek, R and M. Poss. 2002. **Using phylogeography of a microparasite to assess spatial population structure in its mammalian carnivore host.** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.
Molecular approaches are widely used to infer spatial population structure in conservation. However, the genetic population structure of a species may reflect processes on temporal scales much larger than those of specific conservation interest, for example if populations became fragmented relatively recently. In this study we demonstrate that phylogenetic data of an endemic, rapidly-evolving, and non-pathogenic retrovirus commonly found in Rocky Mountain populations of cougars, Puma concolor, can provide recent information on population subdivision and movement of its host. Based on sequence data from two viral genes, we show that most infected cats within an area carry closely related viruses and our data indicates that many such regional virus variants circulate in Rocky Mountain cougars. Further, using serial sampling of infected individuals we estimated that the virus genes examined evolve at rates of 0.1-0.5% per year, suggesting that virus transmission that occurred among cougar populations within the last few decades should be detectable. This molecular technique thus holds the promise to provide current information about population connectivity, an issue of much interest to conservation.

Breebaart, L., R. Bhikraj, T. G. O'Connor. 2002. **Dietary overlap between Boer goats and indigenous browsers in a South African savanna.** African Journal of Range and Forage Science 19(1): 13-20.
The winter diet of free ranging Boer goats in Valley Bushveld, KwaZulu-Natal, was determined by direct observations and compared with the diet of indigenous browsers (kudu, eland, giraffe, black rhinoceros) in order to determine which browsers are most compatible with goats for ensuring more efficient use of savanna vegetation. Goats were predominantly browsers during winter, spending 73% of their time eating woody plant forage. Principal woody plant species in the diet included Rhus pentheri. Acacia nilotica, Acacia karroo, Euclea crispa and Ziziphus mucronata. Succulents (Aloe ferox and Aloe maculata) were also readily eaten. Highly preferred species were Capparis sepiaria, Phyllanthus verrucosus and Scolopia zeyheri, while Rhoicissus tridentata, Calpurnia urea, Acacia ataxacantha, Euclea natalensis, Clerodendrum glabrum, Zanthoxylum capense and Hippobromus paucifolia were strongly avoided. Goats fed between ground level and 1m, with an average feeding height of 0.67m. The diet and feeding height of kudu and goats and of black rhinoceros and goats overlapped to a large extent suggesting that they are potential competitors for food resources. Similarly, overlap in diet between giraffes and goats was extensive, but overlap in feeding height was small. The potential for competition appeared to be the least between goats and eland because, despite feeding at similar heights, they generally consumed different species. A mixed farming system which includes goats, eland and giraffe is proposed as a useful management tool for using savanna vegetation more efficiently.

Carbone, C., S. Christie, K. Conforti, T. Coulson, N. Franklin, J. R. Ginsberg, M. Griffiths, J. Holden, K. Kawanishi, M. Kinnaird, R. Laidlaw, A. Lynam, D. W. Macdonald, D. Martyr, C. McDougal, L. Nath, T. O'Brien, J. Seidensticker, D. J. L. Smith, M. Sunquist, R. Tilson and W. N. Wan Shahruddin. 2001. **The use of photographic rates to estimate densities of tigers and other cryptic mammals**. Animal Conservation 4:75–79
The monitoring and management of species depends on reliable population estimates, and this can be both difficult and very costly for cryptic large vertebrates that live in forested habitats. Recently developed camera trapping techniques have already been shown to be an effective means of making mark–recapture estimates of individually identifiable animals (e.g. tigers). Camera traps also provide a new method for surveying animal abundance. Through computer simulations, and an analysis of the rates of camera trap capture from 19 studies of tigers across the species' range, we show that the number of camera days/tiger photograph correlates with independent estimates of tiger density. This statistic does not rely on individual identity and is particularly useful for estimating the population density of species that are not individually identifiable. Finally, we used the comparison between observed trapping rates and the computer simulations to estimate the minimum effort required to determine that tigers, or other species, do not exist in an area, a measure that is critical for conservation planning.

Caro, T. and C. Stoner. 2003. **The potential for interspecific competition among African carnivores.** Biological Conservation 110(1):67-75
The general importance of interspecific competition as an ecological factor for carnivores is unknown and its conservation significance may have been inflated by intensive research conducted on a few vulnerable species. We therefore examined the potential for interspecific competition across carnivores on one continent, Africa, by calculating, for each of 70 carnivore species, the number of other carnivore species that overlapped it in geographic range, habitat, and diet, and that could potentially kill the species in question. The average carnivore in Africa shares some of its geographic range and habitat with 26 other species suggesting competition could be pervasive. More specifically, carnivores may have to share food resources with 22 other carnivore species, on average, although the potential for food stealing is far lower. The average African carnivore may be vulnerable to predation by 15 other species although it is unlikely to be eaten by other carnivores. These analyses

indicate that exploitative competition and interspecific killing are of potential widespread importance for a large number of carnivores in Africa, rather than being restricted to a few selected carnivores highlighted in the current literature.

Chan, S., A.V. Maksimuk and L.V Zhirnov. 1995. **From steppe to store: the trade in saiga antelope horn**. TRAFFIC Species in Danger report. Compiled by Stephen Nash. TRAFFIC, Cambridge, UK.
This report examines the history and present use of Saiga Antelope horn in Chinese medicine, status and commercial harvesting of the antelope in its range states and the trade in Saiga horn in East and Southeast Asia.

Clark, P. E., W. C. Krueger, L. D. Bryant and D. R. Thomas. 2000. **Livestock grazing effects on forage quality of elk winter range**. Journal of Range Management 53(1):97-105.
Carefully-managed livestock grazing has been offered as a tool to improve the forage quality of graminoids on big game winter range. Formal testing of this theory has thus far been done using hand clippers rather than livestock grazing. We report winter standing reproductive culm, crude protein, in vitro dry matter digestibility, and standing crop responses of bluebunch wheatgrass (*Agropyron spicatum* [Pursh] Scribn. & Smith), Idaho fescue (*Festuca idahoensis* Elmer), and elk sedge (*Carex geyeri* Boott) to late-spring domestic sheep grazing. The study was conducted in 1993 and 1994 on a big game winter range in the Blue Mountains of northeastern Oregon. Sheep grazing and exclusion treatments were applied to 20-ha plots at 3 sites on the study area. Targeted utilization for grazed plots was 50% graminoid standing crop removal during the boot stage of bluebunch wheatgrass. Grazing did not influence the number of standing reproductive culms per plant in bluebunch wheatgrass. Crude protein and in vitro dry matter digestibility of bluebunch wheatgrass in grazed plots increased by 1.0 and 4.3 percentage points, respectively, over ungrazed plots. Grazing reduced the standing crop of bluebunch wheatgrass by 116.9 kg ha-1 DM. Standing Idaho fescue reproductive culms decreased by 0.7 culms plant-1 under grazing. Crude protein of Idaho fescue in grazed plots was 1.3 percentage points greater than in ungrazed plots. Crude protein and in vitro dry matter digestibility responses of elk sedge were inconsistent between years and may be related to utilization or growth differences between years. The levels of forage quality improvement in bluebunch wheatgrass and Idaho fescue obtained in this study could benefit the nutritional status of wintering Rocky Mountain elk (*Cervus elaphus nelsoni* Bailey). More research is needed regarding the effects of grazing on the winter forage quality of elk sedge.

Conforti, V. A. and F. C. Cascelli de Azevedoa**.** 2003. **Local perceptions of jaguars (Panthera onca) and pumas (Puma concolor) in the Iguaçu National Park area, South Brazil.** Biological Conservation 111(2): 215-221.
Jaguars (Panthera onca) have been killed by local residents within the boundaries and lands surrounding Iguaçu National Park (INP), Brazil. Both jaguars and pumas (Puma concolor) occur in the region, however, livestock predation by pumas has rarely been reported. Our objective was to assess the local perceptions about jaguars and pumas. We identified two major factors that distinguished the perceptions towards the two species: less people feared the puma than the jaguar; and most people believed that jaguars, but not pumas, were released into INP by local authorities. Interestingly, despite those major differences in these perceptions, feelings towards the two species tended to be the same. Perceptions towards jaguars were not influenced by the predation history of the properties, suggesting that the predation impact was not remarkable enough to influence local perceptions towards carnivores. This is apparently the first study on local perceptions towards large carnivores in Brazil.

Cote, S. D. 1996. **Mountain goat responses to helicopter disturbance**. Wildlife Society Bulletin 24(4): 681-685.
Mountain goat (Oreamnos americanus) responses to helicopter traffic were investigated at Caw Ridge (Alberta) from June to August 1995. A population of 109 marked individuals inhabited the ridge during the study. As measured by their overt responses, mountain goats were disturbed by 58% of the flights and were more adversely affected when helicopters flew within 500 m. Eighty-five percent of flights within 500 m caused the goats to move >100 m; 9% of the flights >1,500 m away caused the goats to move similar distances. Helicopter visibility and height above ground, number of goats in the group, group type (bachelor or nursery), and behavior of groups just prior to helicopter flights did not appear to influence reactions of goats to helicopters. Helicopter flights caused the disintegration of social groups on greater than or equal to 5 occasions and resulted in 1 case of severe injury to an adult female. Based on these observations, restriction of helicopter flights within 2 km of alpine areas and cliffs that support mountain goat populations is recommended.

Cronin, M. A., H. A. Whitlaw and W. B. Ballard. 2000. Northern **Alaska oil fields and caribou**. Wildlife Society Bulletin 28(4):919-922.
Caribou (Rangifer tarandus) are a prominent factor in regulating and managing oil and gas exploration and development in Alaska. Concerns that the oil fields in the Prudhoe Bay region of northern Alaska have negatively affected the distribution and productivity of the Central

Arctic caribou herd (CAH) have been expressed in scientific literature and management documents such as environmental impact statements. The number of CAH caribou in the western summer range that includes the oil fields declined by more than 50% between 1992 and 1995 but then almost doubled between 1995 and 1997. Numbers of caribou in the eastern portion of the range, without oil fields, showed opposite trends during these time intervals. The changes in numbers of caribou in areas with and without oil fields are probably due to movements between summer ranges rather than oil-field impacts. Although there may be some disturbance of animals in the oil fields, population-level impacts apparently have not occurred. The number of caribou in the CAH has increased from approximately 5,000 to approximately 20,000 since oil-field development began, and the management objectives for the CAH have been met despite development of the largest oil and gas fields in the United States. Managers and regulators should acknowledge that coexistence of caribou with oil and gas development demonstrates the success of mitigation, regulation, and management efforts, These successes should be cited and incorporated in planning efforts for future oil development and in public management documents such as environmental impact statements (EIS), Management documents can be considered as scientific and objective only if all available information is included, regardless of whether the information has negative or positive connotations for developments.

Cunningham, S. C., C. R. Gustavson and W. B. Ballard. 1999. **Diet selection of mountain lions in southeastern Arizona**. Journal of Range Management 52(3):202-207.
Prey selection by mountain lions (Puma concolor) in the Aravaipa-Klondyke area in southeastern Arizona was studied from February 1991 to September 1993. Overall diet as determined from frequency of occurrence in 370 seats was 48% deer (Odocoileus virginianus cousi and O. hemionus combined), 34% cattle, 17% javelina (Tayassu tajacu), 6% rabbit (Sylvilagus spp. and Lepus californicus combined), 4% rodent, and 2% desert bighorn sheep (Ovis canadensis mexicanus). With respect to biomass consumed, cattle composed 44%, deer 40%, javelina 10.9%, rabbits 2.9%, and rodents 0.02%. Based on mean weights of prey consumed, the proportion of individuals killed and eaten changed to rabbits 52.7%, deer 16.3%, rodents 12%, javelina 10%, cattle 8%, and desert bighorn sheep 0.5%. Mountain lions selected deer less frequently than their availability would suggest, selected calves slightly more than their availability, and javelina as expected. We speculated that lions selected calves because they were more vulnerable to predation than deer.

Czekala, N. M., B. S. Durrant, L. Callison, M. Williams and S. Millard. 1994. **Fecal steroid-hormone analysis as an indicator of reproductive function in the cheetah.** Zoo Biology 13(2):119-128.
Techniques were developed and validated to measure fecal estrogen and progesterone concentrations of the female cheetah. Fecal samples were collected from seven mature females. Cheetahs were monitored before mating and continued until parturition. Four females had normal pregnancies, one conceived but the pregnancy resulted in spontaneous abortion, one was mated but apparently did not conceive and one was treated with gonadotropin-releasing hormone (GnRH) and human chorionic gonadotropin (hCG) to induce follicular growth and ovulation. Vaginal superficial cells increased with increasing estrogen concentrations. Peak estrogen occurred one day postcopulation. Increases in fecal progesterone concentrations, indicative of ovulation, occurred after copulation and hormonally induced ovulation. For the first time reproductive function can be monitored in the cheetah using non-invasive sample collection.

Damania, R., R. Stringer, K. U. Karanth, B. Stith. 2003. **The economics of protecting tiger populations: linking household behaviour to poaching and prey depletion.** Land Economics (79)2:198-216.
The tiger (Panthera tigris) is classified as endangered and populations continue to decline. This paper presents a formal economic analysis of the two most imminent threats to the survival of wild tigers: poaching of tigers and hunting their prey. A model is developed to examine the interactions between tigers and farm households living in and around tiger habitats. The analysis extends the model of tiger demography to incorporate predator-prey interactions and explore the sensitivity of tiger populations to key economic parameters. To our knowledge, this is the first formal investigation into the economic causes of declining tiger populations. The analysis aims to contribute to policy debates on how best to protect one of the world's most endangered wild cats.

Deem, S.L., L.H. Spelman, R.A. Yates and R.J. Montali. 2000. **Canine distemper in terrestrial carnivores: A review**. Journal of Zoo and Wildlife Medicine 31:441-451.
Canine distemper virus is a member of the genus Morbillivirus in the family Paramyxoviridae. Canine distemper has been recorded in domestic dogs for centuries. It is now recognized as a worldwide problem of carnivores and has the second highest fatality rate of any infectious disease, after rabies, in domestic dogs. The importance of this disease in nondomestic animals has become evident with vaccine-induced infections in a variety of species and large-scale epidemics in captive and free-ranging felids. To date, canine distemper has been reported in all families of terrestrial carnivores: Canidae, Felidae, Hyaenidae, Mustelidae, Procyonidae, Ursidae, and Viverridae. Veterinarians, including those working with nondomestic carnivores, should be

familiar with the clinical signs, diagnosis, and clinical management of this disease.

Degiorgis, M.P., C.H. Segerstad, B. Christensson and T. Morner. 2001. **Otodectic otoacariasis in free-ranging Eurasian lynx in Sweden.** Journal of Wildlife Diseases 37:626-629.
An infestation with Otodectes cynotis, the ear mite of cats and dogs, was observed in three free-ranging Eurasian lynx (Lynx lynx) killed in Sweden. The ear canals were obstructed by waxy secretions and exfoliated epithelium. Histologically, there were hyperkeratosis and acanthosis, and the epithelial surface was overlained by hyperkeratotic and parakeratotic crusts with mites, mite detritus and cerumen. In the subcutis there was a slight to moderate infiltration of lymphocytes and macrophages. The ceruminous glands were hypertrophic and hyperplastic, and there was also an hyperplasia of the sebaceous glands. The lesions seemed to correlate with the degree of infestation. To our knowledge, this is the first report of otoacariasis in free-ranging lynx.

Dexel, B. **Snow leopard conservation in Kyrgyzstan: enforcement, education and research activities by the German Society for Nature Conservation (NABU).** Pages 59 – 63 *in* T. M. McCarthy and J. Weltzin, editors. Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA.
NABU has been active in nature conservation in Kyrgyzstan since 1993 and helped develop a snow leopard conservation strategy for the country in 1998 with the aim of stemming poaching which supplies the illegal bone and hide markets. NABU established a 5 member team known as Gruppa Bars (bars meaning snow leopard in Kyrgyz) to seek out and undermine illegal trade. Through the terms of a bilateral agreement with the Kyrgyz Ministry of Environment, the team conducts undercover operations and maintains a country-wide network of informants. Between 1999 and 2002 the team dealt with 178 wildlife offenses and confiscated 14 snow leopard skins, 1 live snow leopard, 162 firearms, and more than 300 traps and snares. An education component was added to the project in 2000 with a traveling exhibition that visits communities in snow leopard habitat. Educational activities are aimed at both adults and children. More than 10,000 children and 2,000 adults have been reached in the years 2000-2001 alone. The proximity to markets for skin, live specimens, and bones in China makes enforcement of trade and poaching laws a key issue for Kyrgyzstan and other Central Asian states in the coming years.

Draulans, D. and E. Van Krunkelsven. 2002. **The impact of war on forest areas in the Democratic Republic of Congo.** Oryx 36(1):35-40.
This paper provides a review of data on the effects of the civil war on forest areas in the Democratic Republic of Congo. Only a few of these effects were beneficial, the most important being the collapse of the wood industry. However, the war has increased the number of people that rely on wood for fuel and bush-meat for protein. The presence of soldiers and refugees aggravates this pressure. When people hide they do not necessarily refrain from hunting, because goods, including ivory, can be stocked to be traded when the situation improves. War seems beneficial to the environment only if it keeps people out of large areas. It could be useful to extend the concept of peace parks to war zones. The idea of an international 'green force' to protect biodiversity hotspots should be given serious consideration. Awareness is growing that political instability should not preclude conservation efforts from being continued.

Ferreras, P., J. F. Beltran, J. J. Aldama and M. Delibes. 1997. **Spatial organization and land tenure system of the endangered Iberian lynx (Lynx pardinus).** Journal of Zoology 243:163-189.
The spatial organization of the endangered Iberian lynx, Lynx pardinus (Temminck, 1827), was studied in Doaana National Park, south-western Spain, between 1983 and 1992. Thirty-six individuals (19 males and 17 females), including 24 adults (13 males and 11 females) were radio-tracked, providing 13,950 locations during 17,111 radio-tracking days. Iberian lynxes were essentially solitary (95.9% of simultaneous locations apart) and interactions were restricted to rearing activities by females. Adult associations were uncommon. Seasonal (four months) home ranges were larger for adult resident males (10.3 +/- 1.9 km^2; n = 5) than for females (8.7 +/- 2.4 km^2; n = 5). Lynxes used a central portion of the home range intensively ('core area', 50% Harmonic Mean) with similar size for males (3.7 +/- 0.7 km^2) and females (3.2 +/- 0.8 km^2), representing, on average, a 37.6 +/- 1.5% and 36.6 +/- 4.5% of male and female home ranges, respectively. Intrasexual home- range overlap was usually low between same-sex neighbours (15.1 +/- 6.6% males and 22.1 +/- 3.3% for females), but some instances of high overlap (>25%), both among males and females, were recorded, corresponding to spatial interactions between neighbours which usually ended with the displacement of one of the contenders. Core areas were mainly exclusive except during these spatial interactions. Actual fights resulting from these interactions seem more frequent than previously reported for other medium-sized solitary felids, likely promoted by high competition for optimum territories due to saturation of the population. The Iberian lynx spatial organization in Doaana works as a land tenure system, as described for other solitary felids. Although the mating system tends to monogamy, with male home range overlapping mainly that of one female, individual variations to polygyny were also found.

Fox, J. L. and R. M. Jackson. 2002. **Blue sheep and snow leopards in Bhutan and trans-Himalayan Nepal: recent status evaluations and their application to research and conservation.** Page 64 *in* T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

As part of the SLIMS (Snow Leopard Information Management System) workshops designed to train in-country nationals in wildlife survey techniques, wild sheep and snow leopard population indices were estimated in areas of northeastern Bhutan and northwestern Nepal. The Bhutan site consisted of open moist grasslands above timberline on the southern side of the Himalaya, whereas the Nepal site comprised dry steppe mountains to the north of the main Himalaya. Blue sheep counts indicated densities of 2-4/km^2 in the Nepal sites and 4-6/km^2 in the Bhutan sites. Other differences, such as blue sheep sexual segregation in Nepal but not in Bhutan, emphasize varied ecological conditions in the two sites, and suggest directions for future predator-prey research. In contrast to blue sheep results, the snow leopard sign indices were higher, average 2.8 sign items per 100 m of sign transect, in Nepal than the 1.2 items per 100 m of sign transect found in Bhutan, thus suggesting a questionable inverse relationship between snow leopard density and that of its major prey. Factors such as the relatively open terrain and moist climate (e.g., heavy winter snow) appear to reduce habitat quality for snow leopard in Bhutan, so that in spite of the higher blue sheep density there are perhaps only 1-2 snow leopards per 100 km^2 on average at the Bhutan site compared to 4-5 or more per 100 km^2 in over as much as 40-50% of the Nepal site. One must also consider that different topography, primarily differential presence of valley bottom cliffs and ridge top outcrops (marking sites), can affect sign density, and general topography as well as livestock density probably influences snow leopard hunting success. These results point up some of the problems in comparing density indices of such predators and prey in different sites, but used as tools in repeated same-site/season monitoring, the survey methods can provide reasonable assessments of change given sufficient sampling effort. Incorporation of such simple monitoring as part of protected area management in the Himalaya can be instrumental in the design and assessment of conservation programs as well as providing a basis for further research.

Eccard, J. A., R. B. Walther, S. J. Milton. 2000. **How livestock grazing affects vegetation structures and small mammal distribution in the semi-arid Karoo**. Journal of Arid Environments 46(2):103-106.

In this study we investigated vegetation changes superimposed by grazing and their effect on small mammals in the Karoo (South Africa) on grazed farmland and an adjacent, 10-year livestock enclosure. Plains and drainage line habitats were compared by monitoring vegetation height and cover, and small mammal species composition and abundance along transects. Animals were captured by live trapping. Vegetation cover was low on the grazed compared to the ungrazed study site, but vegetation height did not differ. The number of small mammal individuals and the number of species captured was higher at the ungrazed study site. Two species of climbing rodents captured in the ungrazed drainage line were absent from the grazed drainage line. Numbers of small mammals captured on the plains were similar for grazed and ungrazed land, but grazed plains were dominated by a single species of gerbil.

Eizirik, E., J. H. Kim, M. Menotti-Raymond, P. G. Crawshaw, S. J. O'Brien and W. E. Johnson. 2001. **Phylogeography, population history and conservation genetics of jaguars (Panthera onca, Mammalia, Felidae).** Molecular Ecology 10(1):65-79.

The jaguar (Panthera onca), the largest felid in the American Continent, is currently threatened by habitat loss, fragmentation and human persecution. We have investigated the genetic diversity, population structure and demographic history of jaguars across their geographical range by analysing 715 base pairs of the mitochondrial DNA (mtDNA) control region and 29 microsatellite loci in approximate to 40 individuals sampled from Mexico to southern Brazil. Jaguars display low to moderate levels of mtDNA diversity and medium to high levels of microsatellite size variation, and show evidence of a recent demographic expansion. We estimate that extant jaguar mtDNA lineages arose 280 000-510 000 years ago (95% CI 137 000-830 000 years ago), a younger date than suggested by available fossil data. No strong geographical structure was observed, in contrast to previously proposed subspecific partitions. However, major geographical barriers such as the Amazon river and the Darien straits between northern South America and Central America appear to have restricted historical gene flow in this species, producing measurable genetic differentiation. Jaguars could be divided into four incompletely isolated phylogeographic groups, and further sampling may reveal a finer pattern of subdivision or isolation by distance on a regional level. Operational conservation units for this species can be defined on a biome or ecosystem scale, but should take into account the historical barriers to dispersal identified here. Conservation strategies for jaguars should aim to maintain high levels of gene flow over broad geographical areas, possibly through active management of disconnected populations on a regional scale.

Gros, P. M., M. J. Kelly and T. M. Caro. 1996. **Estimating carnivore densities for conservation purposes: indirect methods compared to baseline demographic data.** Oikos 77(2):197-206.

Using the cheetah Acinonyx jubatus as a model, we compared predictions from four indirect methods of estimating carnivore densities to estimates of density derived from baseline demographic data collected during behavioural ecological studies in three national parks of East Africa. Interviewing people locally was the most accurate indirect method and produced estimates representing 75 to 100% of reference densities. Regressing cheetah biomass against prey biomass further underestimated reference densities. Using an average cheetah density derived from reported densities in 13 African protected areas, and modeling cheetah densities from home range and demographic data were the least accurate approaches. When indirect methods' results were compared across ten study areas in East Africa, we found that log-transformed interview and prey biomass methods' estimates were significantly correlated, and that prey biomass and home range models produced significantly different outcomes. After discussing strengths and weaknesses of the methods, we outline the conditions under which each may provide valid results. Our findings highlight the importance of calibrating indirect methods of estimating carnivore densities, and demonstrate the difficulties that conservation planners face in integrating density estimates derived from different methods when devising conservation strategies.

Gross, J. E., F. J. Singer and M. E. Moses. 2000. **Effects of disease, dispersal, and area on bighorn sheep restoration**. Restoration Ecology 8:25-37.
We simulated population dynamics of bighorn sheep (Ovis canadensis) inhabiting six discrete habitat patches in the Badlands ecosystem, South Dakota. Modeled populations were subjected to a range of potential management actions and rates of disease-causing infection. Simulated disease varied in severity from mild ([approximately] 12% mortality) to severe ([approximately] 67% mortality), with infections imposed once, at regular intervals, or with a fixed probability each year. In the absence of disease, 200-year extinction rates were uniformly low and insensitive to changes in colonization rate or area of suitable habitat. A single infection, accompanied by change in the area of suitable habitat or colonization rate, resulted in extinction rates of up to 40%, and large changes in average population size (up to 10-fold with changes in area; 4-fold with changes in colonization rate). Simulations with multiple infections, which are probably most realistic, generally resulted in extinction rates that exceeded 20% over a 200-year period. Model results clearly showed that efforts directed toward reducing the frequency or severity of disease are of highest priority for improving the success of attempts to restore bighorn sheep populations. Increases in areas of suitable habitat or improvements to corridors between existing habitat patches were far less likely to improve persistence of simulated sheep populations than reductions in the impact of disease. Although theory predicts that enhanced movements may exacerbate effects of disease, increased colonization rates resulted in relatively small but consistent increases in persistence and average population size for all combinations of parameters we examined.

Harris, R. B. 1994. **Wildlife conservation in Yeniugou, Qinghai Province, China**. Doctoral Dissertation. University of Montana. pp. 346.
Conservation prospects for large mammals in Yeniugou, an unprotected region of approx 3900 km^2 in Qinghai Province, China, were investigated. Mortality from poaching activities was identified as the greatest threat subject to management intervention. Failing implementation of effective conservation systems, it was concluded that large mammal fauna in Yeniugou will become reduced and possibly extirpated. The potential of using foreign currency as an incentive in a management structure was explored through questionnaire surveys. Wild ungulate population sizes were estimated with randomly-placed line transects supplemented by total counts; and by delineating discrete groups, and estimating the probability that group observations represented duplicate counts. Estimated numbers and 95% CIs were: Tibetan gazelle (Procapra picticaudata) 1,511 (1,037-1,985), Tibetan antelope (Pantholops hodgsoni) 2,076 (927-3,247), Tibetan wild ass (Equus hemionus) 843 (618-1,052), wild yak (Poephagus mutus) 1,223 (1,014-1,494), blue sheep (Pseudois nayaur) 1,200 (1,150-1,261), and argali (Ovis ammon) 245 (238-256). Results of surveys mailed to Asian ecotour and trophy-hunting operators suggested that both endeavors remained problematic in western China. Ecotour operators were less satisfied with services in China than elsewhere in Asia, and most used cultural attractions in preference to wildlife; few were comfortable using horses or requiring clients to hike at high elevations. Available revenues for conservation projects were 5-15% total ecotour fees. Interest and potential revenues from trophy hunters were high. Trophy hunting appeared able to provide higher revenues for conservation in Yeniugou with less development than ecotourism. I proposed that a Yeniugou Wildlife Management Area (YWMA) be established. YWMA relies on a dynamic incentive structure to reward actions that conserve, and punish actions that waste, wildlife resources. Elements of YWMA include definition of residents and exclusion of outsiders, financial and in-kind benefits, limitations on development activities incompatible with conserving natural habitat, biennial wildlife monitoring, linking benefits to the results of biennial surveys, employment of full-time enforcement personnel, maintenance of a livestock economy, and participation of local people in administration of the program. Problems identified with YWMA include legal barriers to importation of trophies from rare species, heavy reliance on the precision of biennial wildlife population estimates, and difficulties of creating and maintaining an effective management structure that adequately represents all the stake-holding parties.

Harris, R. B., D. H. Pletscher, C. O. Loggers and D. J. Miller. 1999. **Status and trends of Tibetan plateau mammalian fauna, Yeniugou, China**. Biological Conservation 87(1): 13-19.
We conducted surveys focusing on the unique and vulnerable ungulate species in Yeniugou, Qinghai province, China, during September 1997 to compare population estimates with those from the early 1990s. The status of two ungulate species appeared essentially unchanged since 1990-1992: wild yak Bos grunniens (about 1200 to 1300 animals) and Tibetan gazelle Procapra picticaudata. The status of one ungulate species, the white-lipped deer Cervus albirostris, appeared to improve, from a very few to close to 100. We are unsure how the status of the Tibetan wild ass Equus kiang compares with that of the early 1990s. The status of three species declined during the period: blue sheep Pseudois nayaur and argali Ovis ammon declined slightly (possibly due to a weather event), and the Tibetan antelope Pantholops hodgsoni declined dramatically (probably due primarily to poaching), from over 2000 estimated in 1991 to only two seen during 1997. Poaching of antelope has become a serious problem throughout the Tibetan plateau in recent years, and this survey provides evidence that an entire subpopulation can disappear (either through mortality, movement away from human disturbance or a combination) within a relatively short time-frame. That some species (e.g. wild yak, white-lipped deer) continue to thrive in Yeniugou is heartening, but even they remain vulnerable to market-driven poaching.

Harris, R. B., W. A. Wall and F. W. Allendorf. 2002. **Genetic consequences of hunting: what do we know and what should we know?** Wildlife Society Bulletin 30(2):634-643.
Possible evolutionary consequences of sport hunting have received relatively little consideration by wildlife managers. We reviewed the literature on genetic implications of sport hunting of terrestrial vertebrates and recommend research directions to address current uncertainties. Four potential effects can be ascribed to sport hunting: 1) it may alter the rate of gene flow among neighboring demes, 2) it may alter the rate of genetic drift through its effect on genetically effective population size, 3) it may decrease fitness by deliberately culling individuals with traits deemed undesirable by hunters or managers, and 4) it may inadvertently decrease fitness by selectively removing individuals with traits desired by hunters. Which, if any, of these effects are serious concerns depends on the nature and intensity of harvest as well as the demographic characteristics and breeding system of the species at issue. Undesirable genetic consequences from hunting have been documented in only a few cases, and we see no urgency. However, studies specifically investigating these issues have been rare, and such consequences require careful analysis and long time periods to detect. Existing information is sufficient to suggest that hunting regimes producing sex- and age-specific mortality patterns similar to those occurring naturally, or which maintain demographic structures conducive to natural breeding patterns, will have fewer long-term evolutionary consequences than those producing highly uncharacteristic mortality patterns.

Harveson, L. A., B. Route, F. Armstrong, N. J. Silvy, and M. E. Tewes. 1999. **Trends in populations of mountain lion in Carlsbad Caverns and Guadalupe Mountains National Parks**. Southwestern Naturalist 44(4):490-494.
In the United States, the mountain lion (Puma concolor) is limited to the western states and an isolated population in Florida. Recent reports suggest that numbers of mountain lions in the west are increasing; however, most estimates are based on biased harvest records, mortality reports, or sightings. Our purpose was to assess trends in mountain lion populations in two areas within the Chihuahuan Desert by use of multiple-sign surveys. Transects were monitored in spring and fall 1987 to 1996 in Carlsbad Caverns (CCNP) and Guadalupe Mountains National Parks (GMNP). Amount and type of mountain lion sign in each park differed and was likely related to the dominant substrate. A decreasing trend in mountain lion sign was observed on GMNP from fall 1987 to fall 1991 and an increasing trend in mountain lion sign was observed from Spring 1992 to Spring 1996. No trend was observed on CCNP from fall 1987 to spring 1996. Mortalities on adjacent lands may have reduced numbers of mountain lions at GMNP. Multiple-sign transects may provide a useful tool for monitoring populations of mountain lions in other regions of the Southwest.

Hayward, B., E. J. Heske, C. W. Painter. 1997. **Effects of livestock grazing on small mammals at a desert cienaga.** Journal of Wildlife Management 61(1):123-129.
Livestock in arid regions often concentrate their grazing in riparian areas, and this activity can have strong effects on native vegetation and wildlife. Small mammals at a desert wetland (cienaga) in southwestern New Mexico were more abundant on 2 l-ha plots from which livestock were excluded over a 10-year period than on 2 similar grazed plots ($P = 0.025$). However, species of small mammals differed in the direction and degree of their responses to livestock exclusion. Differences in mean abundance between grazed versus ungrazed plots could not be demonstrated for any species of small mammal individually because of strong annual variation in abundance and low statistical power of tests. However, the cumulative effect was that small mammals were 50% more abundant on plots from which livestock were excluded. Because small mammals provide an important resource base for many animals at higher trophic levels, even a few livestock enclosures of moderate size could benefit a variety of species of wildlife in desert

wetlands.

Hofer, D. 2002. **The Lion's share of the hunt: trophy hunting and conservation: a review of the legal eurasian tourist hunting market and trophy trade under CITES.** With contributions from Juan Carlos Blanco, Juan Herrero, Roland Melisch, Massimiliano Rocco, Alexey Vaisman and Ellen van Krunkelsveen. TRAFFIC Europe Report, Brussels, Belgium.
This report on European sport hunting of wildlife reveals that increasing number of European sport hunters hunt in the Eastern Europe and Central Asia region since the collapse of the state-regulated markets in the early 1990s. The study shows that trophy hunters from Europe spend some EUR120 – 180 million on hunting related costs each year in the region, but only a third of the income remains in the supply countries generating very little towards the gross national products (GNP) of the region.

Hunter, D. O. and R. J. Jackson. 1997. **A range-wide model of potential snow leopard habitat.** Pages 51-56. *in* R. Jackson and A. Ahmad, editors Proceedings of the Eighth International Snow Leopard Symposium, Islamabad, Pakistan. International Snow Leopard Trust, Seattle, WA.
A range-wide model of potential snow leopard habitat was produced based on the Digital Chart of the World (DCW) 1:1,000,000 series, the digital equivalent of the United States Defense Mapping Agencies Operational Navigation Chart series. Using paper maps, polygons were drawn around estimated elevation limits for snow leopard range. Likewise the boundaries for protected areas were drawn in. These polygons were digitized and combined with the DCW country borders to create an initial range map with permanent snow fields and water bodies excluded. The resultant map of potential habitat was categorized as "fair" for areas of slope less than 30 degrees or within designated buffer limits of human habitation, and as "good" for areas with greater than 30 degrees slope. Standard GIS tools were used to extract potential habitat tables for snow leopard range countries. This table provides estimates of total habitat, good habitat, fair habitat, and the percent of habitat within protected areas.

Hussain, S. 2000. **Protecting the snow leopard and enhancing farmers' livelihoods: a pilot insurance scheme in Baltistan.** Moutain Research and Development 20(3):226-231.
Snow leopards that prey on poor farmers' livestock pose a twofold problem: they endanger farmers' precarious mountain livelihoods as well as the survival of the snow leopard as a unique species since farmers engage in retaliatory killings. Project Snow Leopard (PSL), a recent pilot initiative in Baltistan, involves a partnership between local farmers and private enterprise in the form of an insurance scheme combined with ecotourism activities. Farmers jointly finance the insurance scheme through the payment of premiums per head of livestock they own, while the remaining funds are provided by profits from trekking expeditions focusing on the snow leopard. The insurance scheme is jointly managed by a village management committee and PSL staff. The scheme is structured in such a way that villagers monitor each other and have incentives to avoid cheating the system.

Hussain, S. 2003. **The status of the snow leopard in Pakistan and its conflict with local farmers**. Oryx, 37(1): 26–33.
Between 1998 and 2001 I carried out surveys in four areas in the Baltistan district of the Northern Areas of Pakistan to estimate the population of the snow leopard and to examine the threats to its future conservation. I estimate that a total of 36–50 snow leopards are present in the areas surveyed. Based on the availability of suitable snow leopard habitat and of its prey species, I estimate that 90–120 snow leopards are potentially present in Baltistan and 300–420 throughout its range within Pakistan's borders. Although this estimate is higher than extrapolations based on earlier surveys, the long-term future of the snow leopard is under threat. This is mainly due to retaliatory killings by farmers, and poaching for pelts and other body parts. Species-focused conservation policies, particularly those targeting ungulates for the promotion of trophy hunting, may constitute an additional threat to snow leopard conservation in the region. However, all forms of threats to the snow leopard in Baltistan appear to emanate from the relatively poor economic conditions of the local people.

IFAW and WTI. 2001. **Wrap up the trade: an international campaign to save the endangered Tibetan antelope**. International Fund for Animal Welfare, Yarmouth Port, MA, USA and Wildlife Trust of India, Delhi, India. 80 pp.
In summer 2000, IFAW and WTI assembled a team of seven investigators who divided into three pairs and assigned themselves to specific localities in the Kashmir Valley. Their primary objective was to identify and speak with shahtoosh weavers. In each locality they identified a senior shahtoosh worker, who then took them to others involved in the shahtoosh trade. Being a small place, this technique, though time consuming, was very productive in revealing the mechanics of the shahtoosh shawl production process. The investigators then went from house to house collecting data. A written survey of 1,210 interviews were conducted in order to determine the impact, if any at all, of a ban on shahtoosh weaving in the Indian state of Jammu and Kashmir. This chapter discusses what the investigators found during their travels.

Jackson, R M. and J. Roe. 2002. **Preliminary observations on non-invasive techniques for identifying individual snow leopards and monitoring populations.** Pages 116-117 *in* T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/

We are experimenting with video and infrared 35 mm camera traps, hair carpets and playback vocalizations to determine which combination of techniques would maximize data while minimizing the amount of effort required, cost involved and disturbance to wild snow leopards. To date, video and infrared camera traps have proven the most successful methodology for generating the necessary level of information for high precision population estimates. Preliminary results indicate that strategic positioning of camera traps along travel corridors and active scent rocks greatly enhances capture rates. Video performs better than still cameras in terms of reducing loss of information due to asymmetry bias. Other problematic factors in obtaining camera trap data within Hemis National Park include human disturbance, domestic livestock movement, and weather and solar interference. We also employed hair carpets as a means of non-invasively collecting snow leopard hair. Carpet nails and industrial staples were embedded in sections of carpet approximately 8 inches by 8 inches in size. The hair carpets were glued to heavily utilized rock scents and sprayed with a scent in hopes of snagging individual hairs with attached follicles. By linking the DNA "fingerprint" of a leopard with simultaneous camera trap information, we will be in a better position to identify, catalog and track individual leopards and monitor population trends over time. Finally, we experimented with pre-recorded playback vocalizations of captive snow leopard mating calls as a way of detecting the species within a given area during the breeding season, and possibly also for encouraging visitation to camera trap or hair carpet sampling stations.

Jackson, R. and R. Wangchuk. 2001. **Linking snow leopard conservation and people-wildlife conflict resolution: grassroots measures to protect the endangered snow leopard from herder retribution**. Endangered Species Update. 18(4):138-141.

Livestock depredation has become a significant problem across the snow leopard's (Panthera uncia) range in Central Asia, being most severe in and near protected areas. Such predation, especially incidents of "surplus killing," in which five to 100 or more sheep and goats are lost in as ingle night, almost inevitably leads herders to retaliate by killing rare or endangered carnivores like snow leopard, wolf, and lynx. Ironically, such loss can be avoided by making the night-time enclosures predator-proof, improving animal husbandry techniques, educating herders on wildlife conservation and the importance of protecting the natural prey base, and by providing economic incentives like handicrafts skills training and marketing, along with carefully planned ecotourism trekking and guiding. The author explores innovative conservation initiatives in the Himalaya (Ladakh and Tibet) and Mongolia, which also build local capacity, self-reliance, and stewardship for nature using Appreciative Participatory Planning and Action, or APPA, techniques. The most sound conservation investments are those contingent upon establishing direct linkages with biodiversity protection, ensuring co-financing and reciprocal responsibility for project activities, encouraging the full participation of all stakeholders, and assuring regular monitoring and evaluation of the village-based agreements (embodied in Action Plans).

Jenks, J. A., D. M. Leslie Jr., R. L. Lochmiller, M. A. Melchiors and F. T. McCollum. 1996. **Competition in sympatric white-tailed deer and cattle populations in southern pine forests of Oklahoma and Arkansas, USA**. Acta Theriologica 41(3):287-306.

Inferences on competitive interactions between white-tailed deer Odocoileus virginianus (Zimmermann, 1780) and cattle were made using information on diet composition and quality. We hypothesized that dietary overlap between deer and cattle would increase with cattle density and that quality of deer diets would be higher in areas not exposed to cattle than in areas that were stocked with moderate to high cattle densities. Three treatments were delineated in McCurtain County, Oklahoma (heavy cattle stocking), and Howard (moderate to light cattle stocking) and Pike (no cattle stocking) counties, Arkansas. Treatments were similar with respect to soils and vegetation but differed with respect to cattle stocking rate (i.e. number of cattle/ha). Deer and cattle diets and concentrations of fecal nitrogen (FN) (an index to dietary quality) were determined from feces that were obtained from 12 randomly selected collection areas (4/treatment) from October 1986 to October 1988. Dietary overlap of deer and cattle was highest in winter and lowest in summer. Dietary overlap of deer populations was lowest for populations exposed to heavy cattle stocking and no cattle stocking which suggested that competition between the deer and cattle occurred in winter. Fecal nitrogen was lowest in deer feces collected from treatments with cattle stocking in Febraury but higher in August and October. Both dietary quality and dietary overlap suggested possible competitive interactions between deer and cattle in winter. However, higher dietary forb and dietary quality for deer in summer exposed to cattle suggested that cattle can facilitate growth of early successional plant species in pine habitats.

Jennings, M. D. 2000. **Gap analysis: concepts, methods, and recent results**. Landscape Ecology 15(1): 5-20.

Rapid progress is being made in the conceptual, technical,

and organizational requirements for generating synoptic multi-scale views of the earth's surface and its biological content. Using the spatially comprehensive data that are now available, researchers, land managers, and land-use planners can, for the first time, quantitatively place landscape units - from general categories such as `Forests' or `Cold-Deciduous Shrubland Formation' to more categories such as `Picea glauca-Abies balsamea-Populus spp. Forest Alliance' - in their large-area contexts. The National Gap Analysis Program (GAP) has developed the technical and organizational capabilities necessary for the regular production and analysis of such information. This paper provides a brief overview of concepts and methods as well as some recent results from the GAP projects. Clearly, new frameworks for biogeographic information and organizational cooperation are needed if we are to have any hope of documenting the full range of species occurrences and ecological processes in ways meaningful to their management. The GAP experience provides one model for achieving these new frameworks.

Jobin, A., P. Molinari and U. Breitenmoser. 2000. **Prey spectrum, prey preference and consumption rates of Eurasian lynx in the Swiss Jura Mountains.** Acta Theriologica 45(2):243-252.
We examined 617 kills made by radio-tracked Eurasian lynx Lynx lynx (Linnaeus, 1758) from March 1988 to May 1998 to assess prey spectrum, preference, and food consumption rates in the Swiss Jura Mountains. Roe deer Capreolus capreolus and chamois Rupicapra rupicapra were the main prey (69 and 22%, respectively), followed by red fox Vulpes vulpes, brown hare Lepus europaeus, domestic cat Felis catus, wild cat Felis sylvestris, marmot Marmota marmota, pine marten Martes martes, capercaillie Tetrao urogallus, and badger Meles meles. Lynx fed on an ungulate prey from 1 to 7 days, depending on the prey category. The consumption rates of males, of females alone, and of females with kittens varied from 3.2 to 4.9 kg per night, with an increasing trend as the kittens grew older. Including the days when lynx had no kill (searching time) lynx consumed 2 +/- 0.9 kg per night. The mean searching time was 1.5-2 days for females, depending on the season and the number of kittens, and 2.5 days for males. The mean interval between consecutive kills was 5.9 for males and 5.2 days for females, respectively. At 38% of carcasses the presence of one or several scavengers (red fox, raven Corvus corax or both) was detected. Although 69% of the kills were roe deer and only 22% chamois, we hypothesise that in the forests of the Jura Mountains chamois are more vulnerable to lynx predation than roe deer, as chamois had a slightly higher preference index (0.59) than roe deer (0.41), based on rough estimates of the two ungulate populations in the study area.

Johnson, K. G., W. Wang, D. G. Reid and J. C. Hu. 1993. **Food-habits of Asiatic leopards (Panthera pardus fusea) in Wolong Reserve, Sichuan, China.** Journal of Mammalogy 74(3):646-650.
Analysis of feces showed Asiatic leopards (Panthera pardus fusea) to consume a varied diet over a 7-year period. Tufted deer (Elaphodus cephalophus) was replaced as the most frequent prey by bamboo rats (Rhizomys sinense). Fifteen species of large and medium-sized mammals composed the majority of the diet with pheasants, livestock, grass, and soil being eaten occasionally. Reasons for dietary shifts were unclear and may reflect leopards hunting for any readily captured prey by opportunistic encounter and perhaps by changes in hunting behavior, prey availability, or prey vulnerability associated with a bamboo die-off.

Karanth, K. U. and J. D. Nichols. 1998. **Estimation of tiger densities in India using photographic captures and recaptures.** Ecology 79(8):2852-2862.
The tiger (Panthera tigris) is an endangered, large felid whose demographic status is poorly known across its distributional range in Asia. Previously applied methods for estimating tiger abundance, using total counts based on tracks, have proved unreliable. Lack of reliable data on tiger densities not only has constrained our ability to understand the ecological factors shaping communities of large, solitary felids, but also has undermined the effective conservation of these animals. In this paper, we describe the use of a field method proposed by Karanth (1995), which combines camera-trap photography, to identify individual tigers, with theoretically well-founded capture-recapture models. We developed a sampling design for camera-trapping and used the approach to estimate tiger population size and density in four representative tiger habitats indifferent parts of India. The field method worked well and provided data suitable for analysis using closed capture-recapture models. The results suggest the potential for applying this methodology to rigorously estimate abundances, survival rates, and other population parameters for tigers and other low-density, secretive animal species in which individuals can be identified based on natural markings. Estimated probabilities of photo-capturing tigers present in the study sites ranged from 0.75 to 1.00. Estimated densities of tigers > 1 yr old ranged from 4.1 +/- 1.31 to 16.8 +/- 2.96 tigers/100 km^2 (mean +/- 1 se). Simultaneously, we used line- transect sampling to determine that mean densities of principal tiger prey at these sites ranged from 56.1 to 63.8 ungulates/ km^2. Tiger densities appear to be positively associated with prey densities, except at one site influenced by tiger poaching. Our results generally support the prediction that relative abundances of large felid species may be governed primarily by the abundance and structure of their prey communities.

Karanth, K. U. and M. E. Sunquist. 2000. **Behavioural correlates of predation by tiger (Panthera tigris), leopard (Panthera pardus) and dhole (Cuon alpinus) in Nagarahole, India.** Journal of Zoology 250:255-265.
Behavioural factors that are likely to contribute to the coexistence of tiger Panthera tigris, leopard P. pardus and dhole Cuon alpinus, were investigated in the tropical forests of Nagarahole, southern India, during 1986-1992. Examination of predator seats and kills were combined with radiotracking of four tigers, three leopards, and visual observations of a pack of dhole. The three predators selectively killed different prey types in terms of species, size and age-sex classes, facilitating their coexistence through ecological separation. There was no temporal separation of predatory activities between tigers and leopards. Hunting activities of dholes were temporally separated from those of the two felids to some extent. Rate of movement per unit time was higher for leopards compared to tigers during day and night. In general, the activity patterns of predators appeared to be largely related to the activities of their principal prey, rather than to mutual avoidance. The three predator species used the same areas and hunted in similar habitats, although tigers attacked their prey in slightly denser cover than leopards. Both cats attacked their prey close to habitat features that attracted ungulates. There was no evidence for interspecific spatial exclusion among predators, resulting either from habitat specificity or social dominance behaviours. Our results suggest that ecological factors, such as adequate availability of appropriate-sized prey, dense cover and high tree densities may be the primary factors in structuring the predator communities of tropical forests. Behavioural factors such as differential habitat selection or inter-specific social dominance, which are of crucial importance in savanna habitats, might play a relatively minor role in shaping the predator communities of tropical forests.

Keiter, R. B. and H. Locke. 1996. **Law and large carnivore conservation in the Rocky Mountains of the US and Canada.** Conservation Biology 10:1003-1012.
The law governing large carnivores in the western U.S. and western Canada abounds in jurisdictional complexity. In the U.S., different federal and state laws govern large carnivore conservation efforts; species listed under the Endangered Species Act are generally protected, whereas those subject to state regulation can be hunted, trapped, or otherwise taken. Neither federal nor state environmental or land management laws specifically protect large carnivores, though these laws can be used to protect habitat. A similar situation prevails in Canada. Canadian federal law does not address large carnivore conservation, although the national parks provide some secure habitat. Provincial laws vary widely; none of these laws specifically protect large carnivores, but some provisions can be involved to protect habitat. Although the two nations have not entered any bilateral treaties to protect large carnivores, several species receive limited protection under multilateral treaty obligations. Despite these jurisdictional complexities, the existing legal framework can be built upon to promote large carnivore conservation efforts, primarily through a legally protected reserve system. Whether the political will exists to utilize fully the available legal authorities remains to be seen.

Kiester, A. R., J. M. Scott, B. Csuti, R. F. Noss, B. Butterfield, K. Sahr and D. White. 1996. **Conservation prioritization using GAP data.** Conservation Biology 10(5):1332-1342.
Data collected by the Gap Analysis Program in the state of Idaho (U.S.A.) are used to prioritize the selection of locations for conservation action and research. Set coverage and integer programming algorithms provide a sequence of localities that maximize the number of species or vegetation classes represented at each step. Richness maps of vegetation cover class diversity, terrestrial vertebrate species diversity ("hot spot analysis"), endangered, threatened, and candidate species diversity, and unprotected vertebrate species diversity ("gap analysis"), when prioritized, show a rapid accumulation of species as more localities are chosen for terrestrial vertebrates and unprotected vertebrates. Gap analysis identifies four target areas ("gaps") that include 79 of the 83 vertebrate species not currently protected. Accumulation of vegetation cover classes and endangered, threatened, and candidate species is much slower. Sweep analysis is used to determine how well prioritizing on one component of diversity accumulates other components. Endangered, threatened, and candidate species do not sweep total vertebrates as well as unprotected vertebrates do, but are better than vegetation classes. Total vertebrates sweep endangered, threatened, and candidate species better than unprotected vertebrates do, which in turn are better than vegetation classes. We emphasize that prioritization must be part of conservation efforts at multiple scales and that prioritization points out important localities where more detailed work must be undertaken.

Kobler, A. and M. Adamic. 2000. **Identifying brown bear habitat by a combined GIS and machine learning method.** Ecological Modelling 135:291-300 (2000).
In this paper we attempt to identify brown bear (Ursus arctos) habitat in south-western part of Slovenia, a country lying on the north-western-most edge of the continuous Dinaric-Eastern Alps brown bear population. The knowledge base (in the form of a decision tree) for the expert system for identifying the suitable habitat, was induced by automated machine learning from recorded bear sightings, and then linked to the GIS thematic layers for subsequent habitat/non-habitat classification of the entire study area. The accuracy of the decision tree classifier was 87% (KHAT 73%). The decision tree mostly agreed with the existing domain knowledge. For the study area the main factors considered by the expert

system to be important for brown bear habitat were the percentage of forest (positive), proximity to settlements (negative) and elevation above see (positive), however the decision tree did not account for habitat patch size. After filtering out habitat patches smaller than 5000 ha in GIS, the accuracy increased to 89% (KHAT 77%). Whereas 88% of the habitat was within forests, only 33% of all forests were considered suitable as habitat.

Linnell, J.D.C., J. Odden, M.E. Smith, R. Aanes and J.E. Swenson. 1999. **Large carnivores that kill livestock: do "problem individuals" really exist?** Wildlife Society Bulletin 27:698-705.
Recovery of large carnivore populations often leads to conflicts with livestock. As an alternative to widespread control, there has been much focus on selective removal of problem individuals. However, it is not always clear if problem individuals really exist. Through a review of the literature we examine the conceptual nature of problem individuals, and the evidence for and against their existence. The potential for individual and gender specific differences in livestock killing behavior exists among carnivores. In contrast to expectations, it does not appear that inexperienced juveniles and infirm adults are often involved in excessive depredation, while it does appear that adult males are responsible for a disproportionate amount of livestock depredation. The form of husbandry in use is hypothesized to be an important factor in the development of problem individuals. Much more research on individual predation behavior is urgently required.

Linnell, J. D. C., J. E. Swenson, R. Andersen and B. Barnes. 2000. **How vulnerable are denning bears to disturbance?** Wildlife Society Bulletin 28(2):400-413.
When exposed to human disturbance, most large carnivores are able to move away from the source with little energetic cost. Bears represent an exception in that during winter, most individuals spend several months in an energy-saving state of hibernation in a den. This implies that disturbance of denning bears has the potential to have a large energetic cost, although data on the subject are rather diffuse. We reviewed the literature on densite selection, denning physiology, and responses to disturbance for the brown bear (Ursus arctos), black bear (U. americanus), and polar bear (U. maritimus). Generally, bears select dens one to 2 km from human activity (roads, habitation, industrial activity) and seemed to tolerate most activities that occurred more than one km from the den. Activity closer than one km and especially within 200 m caused variable responses. Some bears tolerate disturbance even inside the den, but bears will abandon dens in response to activity within this zone, especially early in the denning period. Den abandonment by brown and black bear females with cubs of the year can lead to increased cub mortality. Specific excavated or ground dens are rarely reused, whereas natural caves or hollow trees are reused with varying frequency. There is often some distance between an individual bear's consecutive dens. This indicates that loss of a single denning area following human disturbance will not always lead to deleterious effects, if alternative denning areas are available within the home range.

Maehr, D. S. and G. B. Caddick. 1995. **Demographics and genetic introgression in the Florida panther.** Conservation Biology 9(5):1295-1298.
With the release of eight female Texas cougars (Felis concolor stanleyana) into south Florida between March and July 1995, natural resource agencies have embarked on a task that is intended to restore the genetic integrity of the Florida panther (F. c. coryi). Although this intentional genetic introgression may, if successful, eliminate phenotypic characters that are presumed to derive from inbreeding, there is insufficient evidence to support the contention that such drastic management is currently necessary. Early panther research (1981-1985) resulted in the impression that a remnant population of panthers in south Florida was composed of old, nonreproductive individuals suffering from heavy parasitism, malnutrition, maladaptive phenotypic characters, and a high rate of road mortality (Alvarez 1993; Meffe & Carroll 1994: 229; Foster & Humphrey 1995; but see Maehr et al. 1991a). More recently, cardiac and male-reproductive anomalies have been cited as evidence of inbreeding and as immediate threats to the survival of the subspecies (Roelke & Glass 1992; Roelke et al. 1993a). No male reproductive failures have been observed in the population, however, and cardiac problems were involved in only two known deaths that were confounded by captive management of those individuals. One of these occurred after a "rehabilitated," road-injured adult male was returned to the wild with severely worn canines resulting from his efforts to escape captivity. The other was a young adult female that died immediately after surgery to correct a heart abnormality. The notions of genetic and demographic collapse endure to this day despite data that suggest otherwise.

Maehr, D. S. and J. A. Cox. 1995. **Landscape features and panthers in Florida.** Conservation Biology 9(5): 1008-1019.
We used a geographic information system (GIS) to document spatial associations of Florida panthers, land cover, and other geographical features. Panther radio locations (n = 14,548) occurred in hardwood hammock: mixed hardwood swamp, and cypress swamp in greater proportion than in randomly positioned points (n = 8500). Panther radio locations occurred less frequently in agricultural, barren, and shrub and brush land cover. Panther home ranges consisted of a combination of preferred and avoided cover types, including freshwater marsh, cypress swamp, hardwood swamp, and agricultural land. These cover types accounted

for 62% of the area in panther home ranges. We used correlation and discriminant function analyses to assess the potential importance of 20 landscape features. These panther locations were effectively distinguished from random points using four landscape variables: (1) the size of a contiguous patch of preferred land cover; (2) the proximity to preferred land cover; (3) the diversity of three preferred cover types within a window 120 x 120 m, and (4) the matrix within which preferred cover types occurred 83% of the panther locations and 81.9% of the random points were correctly classified based on a linear model constructed using these four variables. Large, contiguous areas of preferred land-cover types were especially important because 96% of all panther locations occurred within 90 m of preferred land cover. The average preferred forest patch size that was used by these panthers was 20,816 ha, and a regression equation suggests that patches larger than 500 ha are important. Maps of panther habitat suitability were developed using coefficients derived from discriminant analysis. Large areas of suitable land cover that are heavily used by panthers occur on private ranches covering 3606 km^2. Conservation of preferred habitat on these private lands is essential to maintaining a free-ranging population of panthers in southwest Florida.

Maehr, D. S. and C. T. Moore. 1992. **Models of mass growth for 3 North-American cougar populations**. Journal of Wildlife Management 56(4):700-707.
Previous studies of cougar (Felis concolor) physiology and population dynamics relied on growth curves of cougars obtained from diverse locations and under various rearing conditions. We were concerned about potential biases in studies that make but do not test the implicit assumption of homogeneity of growth characteristics among collection sites. Thus, we compared body masses of wild cougars from populations in Florida (F. c. coryi), Nevada (F. c. kaibabensis), and California (F. c. californica). We modeled mass as a nonlinear Richards function of age for each sex and population demographic group. Groups were consistent with respect to estimated birth mass and location of the inflection point of the growth curve. Adult mass was greater ($P < 0.001$) in males than females in all populations, and the size of the difference was similar among populations. Estimated adult masses of Florida and California cougars were not different ($P = 0.381$) from each other but were less ($P < 0.001$) than that of adult Nevada cougars. Growth rate varied by population but not by sex; Nevada cougars grew fastest to adult mass. Cougar mass is too variable to serve alone as an indicator of age beyond 24 months. Failure to control for population-specific influences on growth may bias inferences about growth.

Manfredo, M.J., H.C. Zinn, L. Sikorowski and J. Jones. 1998. **Public acceptance of mountain lion management: a case study of Denver, Colorado, and nearby foothills areas** Wildlife Society Bulletin 26: 964-970.
We propose that information about public attitudes toward mountain lion (*Puma concolor*) management practices is most useful when it accounts for the specific context of human- mountain lion encounter situations. A mail survey was used to assess public acceptance of 4 management actions involving mountain lions in 4 encounter situations occurring at 2 types of locations. Results showed strong support for the hypothesis that acceptance of management actions depends on the specific circumstances of the situations. We suggest that mountain lion management policies should account for a range of contingencies and that future studies of attitudes toward management actions should consider the importance of attitude specificity.

Mazzolli, M., M. E. Graipel and N. Dunstone. 2002. **Mountain lion depredation in southern Brazil**. Biological Conservation 105(1):43-51.
Mountain lion (Puma concolor) depredation incidents on livestock herds were recorded at 15 ranches in southern Brazil from 1993 to 1995. Maximum losses to mountain lions were 78% for goats, 84% for sheep, and 16% for cattle. Cattle mortality arising from causes other than depredation assumed a greater importance in herd productivity. In contrast, attacks on sheep and goats were more frequent than losses to other causes, but could be reduced to acceptable levels when Rocks were corralled at night. Most depredation incidents occurred when weather and light conditions were unfavorable to human activity. We explain these patterns and inter-ranch variation in depredation rates on the basis of a risk-avoidance strategy by the mountain lions. Stock losses can be minimized by understanding these patterns and by applying appropriate herd husbandry, thus reducing the urge to persecute this protected species.

McCarthy, T. M. 2000. **Ecology and conservation of snow leopards, Gobi brown bears, and wild Bactrian camels in Mongolia .** Ph.D. Dissertation. Univ. of Massachusetts, Amherst, MA. 133 pp.
A GIS map of snow leopard range in Mongolia was produced using extensive sign data collected using the SLIMS methodology. This was combined with information gained through extensive interviews with local people and historic data from Russian and Mongolian expeditions. The map did not rely on digital imagery, but on polygons hand-drawn on 1:500,000 basemaps using elevation as the sole habitat parameter of interest. In this regard the map is better ground-truthed than the Hunter-Jackson model, but less well supported by habitat parameter data.

McDaniel, G. W., K. S. McKelvey, J. R. Squires and L. F. Ruggiero. 2000. **Efficacy of lures and hair snares to**

detect lynx. Wildlife Society Bulletin 28(1):119-123.
Resource managers lack an inexpensive and quantifiable method to detect lynx presence across large landscapes. We tested efficacy of a protocol based on hair snagging to detect presence of lynx (Lynx canadensis). We tested 2 key elements of the protocol: 1) a hair-snaring device and 2) commercial lures used to attract and elicit rubbing behavior in lynx. The commercial lures we tested included: 1) beaver (Castor canadensis) castoreum and catnip oil, 2) Cat Passion(TM): 3) Pacific Call(TM) 4) Hawbacker's Cat lure #1(TM) and 5) BB1(TM) To compare detection rates among lures, we randomly placed lures at scent stations along 78 transects; each transect contained all 5 lures. We detected lynx at 45% of transects, and detections varied significantly among lures (chi^2 = 13.4, P = 0.009). Hair snares baited with castoreum and catnip oil were used significantly more than expected (P = 0.002). The relatively high overall detection rate demonstrated that deploying an effective lure along transects is an effective method to detect presence or absence.

Mech, L.D., E.K. Harper, T.J. Meier and W.J. Paul. 2000. **Assessing factors that may predispose Minnesota farms to wolf depredations on cattle.** Wildlife Society Bulletin 28:623-629.
Wolf (Canis lupus) depredations on livestock cause considerable conflict and expense in Minnesota. Furthermore, claims are made that such depredations are fostered by the type of animal husbandry practiced. Thus, we tried to detect factors that might predispose farms in Minnesota to wolf depredations. We compared results of interviews with 41 cattle farmers experiencing chronic cattle losses to wolves (chronic farms) with results from 41 nearby "matched" farms with no wolf losses to determine farm characteristics or husbandry practices that differed and that therefore might have affected wolf depredations. We also used a Geographic information System (GIS) to detect any habitat differences between the 2 types of farms. We found no differences between chronic and matched farms in the 11 farm characteristics and management practices that we surveyed, except that farms with chronic losses were larger, had more cattle, and had herds farther from human dwellings. Habitat types were the same around farms with and without losses. The role of proper carcass disposal as a possible factor predisposing farms to wolf depredations remains unclear.

Meegan, R. P. and D. S. Maehr. 2002. **Landscape conservation and regional planning for the Florida panther.** Southeastern Naturalist 1(3): 217-232.
The need for regional planning is increasingly important for effective Florida panther (Puma concolor coryi) (Bangs 1898) conservation and is essential for protecting enough habitat in South Florida to ensure a viable population. We used two decades of radio telemetry data and geographic information system (GIS) software to develop a regional blueprint for landscape restoration that enhances dispersal, facilitates population colonization, and could be the basis for future land use decisions in the range of the endangered Florida panther. We identified 923,576 ha of forests in an 18-county study area that is a barrier-rich patchwork of land uses. A least cost path analysis simulated natural colonization events and can be used to identify landscape linkages and conservation networks for the panther. Our analysis of planned development permits suggests that large-scale land protection must happen quickly. The alternatives are managing an isolated, heavily managed population or large-scale landscape restoration that is probably economically unfeasible.

Meriggi, A. and S. Lovari. 1996. **A review of wolf predation in southern Europe: Does the wolf prefer wild prey to livestock?** Journal of Applied Ecology 33: 1561-1571.
The recent recovery of the wolf in southern Europe has not yet removed the risk of local extinction. Wolf populations are fragmented and often comprise fewer than 500 individuals. In North America, northern and eastern Europe, wolves feed mainly on wild herbivores. In southern Europe, this canid has apparently adapted to feed also on fruit, rubbish, livestock, small and medium-size mammals. The main conservation problem lies with predation on domestic ungulates, which leads to extensive killing of wolves. The reintroduction of wild large herbivores has been advocated as a means of reducing attacks on livestock, but predation on the latter may remain high if domestic ungulates are locally abundant. Our synthesis of 15 studies, published in the last 15 years, on food habits of the wolf in southern Europe, has shown that ungulates have been the main diet component overall. A significant inverse correlation was found between the occurrence (%) of wild and domestic ungulates in the diet. The presence of relatively few wild ungulate species was necessary to reduce predation on livestock. Selection of wild and domestic ungulate prey was influenced mainly by their local abundance, but also by their accessibility. Feeding dependence on rubbish was local and rare. In Italy, the consumption of rubbish/fruit and that of ungulates was significantly negatively correlated. Diet breadth increased as the presence of large prey in the diet decreased. The simultaneous reintroduction of several wild ungulate species is likely to reduce predation on livestock and may prove to be one of the most effective conservation measures.

Merrill, E. H., T. P.Hemker and K. P.Woodruff. 1994. **Impacts of mining facilities on fall migration of mule deer.** Wildlife Society Bulletin 22(1):68-73.
Track counts and movements of radio-collared deer were monitored near a mine and phosphate processing plant in Idaho for 5 years to determine if the facilities hindered

deer migration. Observations of deer movements near the mine support previous findings that corridors through human built obstacles facilitate migration of ungulates. In areas of high snow accumulation, placement of travel corridors should take into account factors affecting snow distribution such as slope, aspect, and wind.

Miller, D. J. and G. B. Schaller. 1997. **Conservation threats to the Chang Tang Wildlife Reserve, Tibet**. Ambio 26(3):185-186.
The authors describe the wildlife and ecosystems found within the Chang Tang Wildlife Reserve, Tibet. The Reserve is the second largest protected area in the world and offers protection to a largely undisturbed rangeland ecosystem. Threats to this region and its wildlife are detailed.

Mills, J.A. and P. Jackson. 1994. **Killed for a cure: a review of the worldwide trade in tiger bone.** TRAFFIC Species in Danger report. TRAFFIC, Cambridge, UK.
A focus on the use of Tiger bone as a medicinal, this review compiles what is known of the status of Tiger populations, the uses and value of Tiger bone, the extent to which it is traded globally, and offers recommendations for Tiger conservation.

Milner-Gulland, E. J., M. V. Kholodova, A. Bekenov, O. M. Bukreeva, I. A. Grachev, L. Amgalan and A. A. Lushchekina. 2001. **Dramatic declines in saiga antelope populations**. Oryx 35(4): 340-345.
We present new data on the size of all the saiga antelope populations; three populations of the subspecies Saiga tatarica tatarica in Kazakhstan, one of S. t. tatarica in Kalmykia, Russia, and two of S. t. mongolica in Mongolia. The data suggest that three populations are under severe threat from poaching and have been declining at an increasing rate for the last 2-3 years. The Ustiurt population in Kazakhstan was relatively secure but is now also under threat. There is evidence of much reduced conception rates in Kalmykia, probably because of selective hunting of adult males. The Mongolian subspecies shows no evidence of recent decline, but is of concern because of the population's small size. The cause of the population declines appears to be poaching for meat and horns, which is a result of economic collapse in the rural areas of Kazakhstan and Kalmykia. We suggest that full aerial surveys be carried out oil the Betpak-dala (Kazakhstan) and Mongolian populations, and that funding is urgently required for the control of poaching in all parts of the saiga range.

Mishra, C. 1997. **Livestock depredation by large carnivores in the Indian trans-Himalaya: Conflict perceptions and conservation prospects.** Environmental Conservation 24(4):338-343.
Livestock depredation by the snow leopard, Uncia uncia, and the wolf, Canis lupus, has resulted in a human-wildlife conflict that hinders the conservation of these globally-threatened species throughout their range. This paper analyses the alleged economic loss due to livestock depredation by these carnivores, and the retaliatory responses of an agro-pastoral community around Kibber Wildlife Sanctuary in the Indian trans-Himalaya. The three villages studied (80 households) attributed a total of 189 livestock deaths (18% of the livestock holding) over a period of 18 months to wild predators, and this would amount to a loss per household equivalent to half the average annual per capita income. The financial compensation received by the villagers from the Government amounted to 3% of the perceived annual loss. Recent intensification of the conflict seems related to a 37.7% increase in livestock holding in the last decade. Villagers have been killing the wolf, though apparently not the snow leopard. A self-financed compensation scheme, and modification of existing livestock pens are suggested as area-specific short-term measures to reduce the conflict. The need to address the problem of increasing livestock holding in the long run is emphasized.

Mishra, C. and M. D. Madhusudan. 2002. **An incentive scheme for wildlife conservation in the Indian trans-Himalaya.** Pages 129-135 *in* T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA. Available at http://www.snowleopard.org/sln/
The habitat of the snow leopard Uncia uncia across South and Central Asia is subject to extensive pastoral use. Levels of livestock depredation by the snow leopard and other carnivores in the region are high, and often provokes retaliatory killing by the herders. This direct threat to large carnivores is further aggravated by a depletion of wild prey due to poaching and out-competition by livestock. In this paper, we describe a pilot project in the Indian Trans-Himalaya, which uses an incentive scheme to create areas free from livestock grazing on community-owned land, thereby fostering conservation commitment among local pastoralists, as well as contributing directly to an enhancement of wild prey density.

Mishra, C. and T. M. McCarthy. 2002. **The role of incentive schemes in conserving the snow leopard (Uncia uncia).** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.
Pastoralists and their livestock share much of the habitat of the snow leopard Uncia uncia across South and Central Asia. The levels of livestock predation by the snow leopard and other carnivores are high, and retaliatory killing by the herders is a direct threat to carnivore populations. Depletion of wild prey by poaching and out-competition by livestock also poses an indirect threat to

the region's carnivores. Conservationists working in these underdeveloped areas that face serious economic impacts from livestock losses have turned to incentive schemes to motivate local communities to protect carnivores. We describe a pilot incentive experiment in India that aims at enhancing wild prey density by creating livestock-free areas on common land. We also describe how income generation from handicrafts and tourism in Mongolia is helping to curtail poaching and retaliatory killing of snow leopards. However, initiatives that have tried to offset the costs of living with carnivores and to make conservation beneficial to the affected people have thus far been small, isolated, and heavily subsidized. Making these initiatives more comprehensive, expanding their coverage, and internalizing their costs are future challenges for conserving large carnivores like the snow leopard.

Molinari-Jobin, A., P. Molinari, C. Breitenmoser-Wursten and U. Breitenmoser. 2002. **Significance of lynx Lynx lynx predation for roe deer Capreolus capreolus and chamois Rupicapra rupicapra mortality in the Swiss Jura Mountains.** Wildlife Biology 8(2):109-115.
Prey class selection and kill rates by lynx Lynx lynx were studied in the Swiss Jura Mountains from March 1988 until May 1998 to evaluate the significance of lynx predation for roe deer Capreolus capreolus and chamois Rupicapra rupicapra. We found clear differences in the kill rates and prey class selection between lynx of different age, sex and breeding status. Male lynx killed more chamois than female lynx, and chamois was never found in kill series of subadult lynx. Family groups had the highest kill rate. They killed an ungulate every 5.0 days, compared to an average of 6.2-6.6 days for single lynx. During our 10-year study, the density of independent lynx was rather stable, ranging within 0.94-1.01 individuals/100 km^2. Based on the observed kill rates and the estimated lynx population structure we calculated that lynx killed 354 +/-13 roe deer and 8713 chamois annually in the 710 km^2 study area. The magnitude of lynx predation on roe deer and chamois was primarily shaped by the lynx population structure. A decline in the number of resident male lynx reduced the number of chamois killed in the study area by 1/4 of the previous number due to the difference in prey selection of male and female lynx. There was a difference in the most frequently killed age and sex classes between roe deer and chamois: lynx killed more male chamois (39%) than females or fawns, whereas in roe deer, does (38%) were most often killed. By altering adult survival, lynx predation has a significant impact on prey population dynamics. Lynx killed a maximum of 9% of the roe deer and 11% of the chamois spring population. Considering the differences in the recruitment potential of the two prey species, lynx has a greater impact on chamois than on roe deer.

Mowat, G. and C. Strobeck. 2000. **Estimating population size of grizzly bears using hair capture, DNA profiling, and mark-recapture analysis.** Journal of Wildlife Management 64:183-193.
We used. DNA analysis to estimate grizzly bear (Ursus arctos) population size in a 9,866 km^2 area in southeast British Columbia and a 5,030 km^2 area in southwest Alberta. We sampled bears by removing hair at bait sites surrounded by a single strand of barbed, wire. DNA profiling with microsatellites of the root portion of the hair was used to identify individuals. We collected hair from 109 different bears and had 25 recaptures in 5 10-day trapping sessions in British Columbia. In Alberta we collected hair from 37 bears and had 9 recaptures in 4 14-day sessions. A model in program CAPTURE (M-h) that accommodates heterogeneity in individual capture probabilities estimated the population size in British Columbia as 262 (95% CI = 224-313) and in Alberta as 74 (60- 100). We believe that hair capture combined, with DNA profiling is a promising technique for estimating distribution and abundance of bears and potentially many other species. This approach is of special interest to management biologists because it can be applied at the scale conservation and management decisions are made.

Murray, D. L., C. A. Kapke, J. F. Evermann and T. K. Fuller. 1999. **Infectious disease and the conservation of free-ranging large carnivores**. Animal Conservation 2:241-254.
Large carnivores are of vital importance to the stability and integrity of most ecosystems, but recent declines in free-ranging populations have highlighted the potentially devastating effect of infectious diseases on their conservation. We reviewed the literature on infectious diseases of 34 large (maximum body mass of adults >20 kg) terrestrial carnivore species, 18 of which are considered to be threatened in the wild, and examined reports of antibody prevalence (seroprevalence) and cases of infection, mortality and population decline. Of 52 diseases examined, 44% were viral, 31% bacterial and the remainder were protozoal or fungal. Many infections were endemic in carnivores and/or infected multiple taxonomic families, with the majority probably occurring via inhalation or ingestion. Most disease studies consisted of serological surveys for disease antibodies, and antibody detection tended to be widespread implying that exposure to micro-organisms was common. Seroprevalence was higher in tropical than temperate areas, and marginally higher for infections known to occur in multiple carnivore groups. Confirmation of active infection via micro-organism recovery was less common for ursids than other taxonomic groups. Published descriptions of disease-induced population decline or extinction were rare, and most outbreaks were allegedly the result of direct transmission of rabies or canine distemper virus (CDV) from abundant carnivore species to less-common large carnivores. We conclude that the threat of disease epidemics in large carnivores may be serious if otherwise lethal infections are endemic in reservoir hosts and transmitted horizontally among

taxa. To prevent or mitigate future population declines, research efforts should be aimed at identifying both the diseases of potential importance to large carnivores and the ecological conditions associated with their spread and severity.

Nowell, K. 2000. **Far from a cure: the tiger trade revisited. Species in Danger report.** TRAFFIC, Cambridge, UK.
This report examines the tiger trade in the late 1990s. In particular, it looks at the extent illegal trade in tiger bone can still be considered the leading threat to the tiger's survival in addition to the trade in skins and other tiger parts. The report urges range states to enforce trade bans and improve anti-poaching measures among other recommendations.

Odden, J., J.D.C. Linnell, P.F. Moa, I. Herfindal, T. Kvam, and R. Andersen. 2002. **Lynx depredation on domestic sheep in Norway.** Journal of Wildlife Management 66: 98-105.
We studied depredation rates on free-ranging domestic sheep (Ovis aries) bv Eurasian lynx (Lynx lynx) in 2 areas in Norway to test whether selected individuals or a demographic group within a lynx population kill a disproportionate share of livestock. During 6 grazing seasons from 1994 to 1999, we monitored 34 radio collared lynx during 641 tracking periods (either all night or during a full 24-hr period). Sixty-three domestic sheep and 3 domestic goats were killed by radio collared lynx during these periods. All of the radiocollared lynx had access to free-ranging domestic sheep within their annual home ranges. Male lynx killed sheep more frequently than females and were responsible for 12 out of 13 cases of surplus killing. After adjusting for number of nights monitored, sheep-killing rates among males differed slightly, whereas the differences between individual females were correlated with the number of sheep available. There were no indications of any special "problem individuals," but rather a "problem sex." There fore, it seems to be intrinsic in their behavior that males are likely to kill domestic animals more frequently than females. The lack of specific problem individuals in this study might depend on the livestock-herding technique used in Norway, where sheep generally are free- ranging and unattended throughout a lynx's home range. Selective removal of depredating males requires that the gap in the social mosaic either remains unfilled or is filled by an individual that causes less damage to livestock. The effects of such removal on sheep depredation are likely to be only temporary since all adult and yearling male lynx appear to kill sheep.

Oli, M. K. 1993. **A Key for the identification of the hair of mammals of a snow leopard (Panthera uncia) habitat in Nepal.** Journal of Zoology 231: 71-93.
Analysis of prey remains in scats, particularly hairs, is widely used to study diet of mammalian predators, but identification of hair is often difficult because hair structures vary considerably both within and between species. Use of photographic reference of diagnostically important hair structures from mammals occurring in a predator's habitat has been found to be convenient for routine identification. A photographic reference key was developed for the identification of hairs of the mammals known to occur in a snow leopard (Panthera uncia) habitat in the Annapurna Conservation Area, Nepal. The key included a photographic reference of the diagnostic hair structures of nine species of wild and five species of domestic mammals. The cross-sectional appearance, shape and arrangement of medulla, the ratio of cortex to medulla, and the form and distribution of pigment in medulla and cortex were important diagnostic aids in the identification of hairs.

Oli, M.K. 1994. **Snow leopards and blue sheep in Nepal - densities and predator- prey ratio**. Journal of Mammalogy 75:998-1004.
I studied snow leopards (Panthera uncia) and blue sheep (Pseudois nayaur) in Manang District, Annapurna Conservation Area, Nepal, to estimate numbers and analyze predator-prey interactions. Five to seven adult leopards used the 105- km^2 study area, a density of 4.8 to 6.7 leopards/100 km^2. Density of blue sheep was 6.6-10.2 sheep/ km^2, and biomass density was 304 kg/ km^2. Estimated relative biomass consumed by snow leopards suggested that blue sheep were the most important prey; marmots (Marmota himalayana) also contributed significantly to the diet of snow leopards. Snow leopards in Manang were estimated to harvest 9-20% of total biomass and 11- 24% of total number of blue sheep annually. Snow leopard: blue sheep ratio was 1:114-1: 159 on a weight basis, which was considered sustainable given the importance of small mammals in the leopard's diet and the absence of other competing predators.

Oli, M. K., I. R. Taylor and M. E. Rogers. 1993. **Diet of the snow leopard (Panthera uncia) in the Annapurna Conservation Area, Nepal.** Journal of Zoology 231(3): 365-370.
The diet of the snow leopard (Panthera uncia) was studied from 213 scats collected between April 1990 and February 1991 in the Annapurna Conservation Area, Nepal. Seven species of wild and five species of domestic mammals were taken, as well as an unidentified mammal and birds. Blue sheep (Pseudois nayaur) were the most frequently eaten prey. Himalayan marmots (Marmota himalayana) were also important, except in winter when they were hibernating. During winter, snow leopards ate more Toyle's pika (Ochotonoa roylei) and domestic livestock. Yaks were eaten more frequently than other livestock types.

Oli, M.K., I.R. Taylor and M.E. Rogers. 1994. **Snow leopard Panthera uncia predation of livestock - an assessment of local perceptions in the Annapurna Conservation Area, Nepal.** Biological Conservation 68:63-68.

Public attitudes towards snow leopard Panthera uncia predation of domestic livestock were investigated by a questionnaire survey of four villages in snow leopard habitat within the Annapurna Conservation Area, Nepal. Most local inhabitants were subsistence farmers, many dependent upon yaks, oxen, horses and goats, with an average livestock holding of 26.6 animals per household. Reported losses to snow leopards averaged 0.6 and 0.7 animals per household in two years of study, constituting 2.6% of total stockholding but representing in monetary terms almost a quarter of the average annual Nepali national per capita income. Local people held strongly negative attitudes towards snow leopards and most suggested that total extermination of leopards was the only acceptable solution to the predation problem. Snow leopards were reported to be killed by herdsmen in defence of their livestock. The long-term success of snow leopard conservation programmes may depend upon the satisfactory resolution of the predation conflict. Some possible ways of reducing predation losses are also discussed.

Ortega-Huerta, A. M. and K. E Medley. 1999. **Landscape analysis of jaguar (Panthera onca) habitat using sighting records in the Sierra de Tamaulipas, Mexico**. Environmental Conservation. 26(4):257-269.

The Sierra de Tamaulipas is a biogeographically isolated mountain system in Northern Mexico, where habitat fragmentation by land-management practices is a possible threat to wildlife conservation. As a case example, we used GIS analyses to evaluate how human activities influence the landscape structure of jaguar (Panthera onca) habitat in the region. The study: (1) ranked potential habitat based on associations between environmental attributes (topography, streams and vegetation) and the frequency distribution of jaguar sighting records; (2) classified current land cover from a 1990 Landsat-TM image and mapped the landscape structure of high potential habitat; and (3) compared the degree to which mature natural vegetation is fragmented by different types of owners. Jaguar sites showed significant associations with tropical deciduous and oak forests, and low, west or south-east slopes, between 400 and 900 m. About 52% of the high potential habitat was mapped as mature natural vegetation, which was distributed as two large patches (28% of the land area) and many small forest patches (98% at < 80 ha). The number and size-class distribution of high-potential habitat patches varied little amongst four ownership types, but the dispersed distribution of more subsistence and commercial-based owners across the landscape suggests the need for collaborative participation in a conservation plan. From our study the need to scale up from managing individual land parcels is substantiated and areas that promote regional contiguity of jaguar habitat in the Sierra de Tamaulipas are identified.

Osofsky, S.A., K.J. Hirsch, E.E. Zuckerman and W.D. Hardy. 1996. **Feline lentivirus and feline oncovirus status of free-ranging lions (Panthera leo), leopards (Panthera pardus), and cheetahs (Acinonyx jubatus) in Botswana: A regional perspective.** Journal of Zoo and Wildlife Medicine 27:453-467.

Subpopulations of large fields in southern Africa exhibit a range of lentivirus prevalence, with some subpopulations showing no evidence of infection. Botswana lions (Panthera lee), leopards (Panthera pardus), and cheetahs (Acinonyx jubatus) were evaluated for evidence of feline lentivirus infection by assaying for antibodies against test antigens derived from a puma lentivirus isolate (PLV(CGZ)) and a domestic cat feline immunodeficiency virus (FIV) and for oncovirus (feline leukemia virus [FeLV]) infection using an enzyme-linked immunosorbent assay (ELISA) for detection of antigen. Blood collection filter paper kits were distributed countrywide to safari hunters and Department of Wildlife and National Parks field officers involved in problem predator management. All sampling (n = 53) was opportunistic; no cats were captured, anaesthetized, or killed for this project. Five different assays for antibodies to lentivirus were utilized on most samples: PLV(CGZ) indirect immunofluorescence assay (IFA), PLV(CGZ) western immunoblot (WE), FIV ELISA, FIV IFA, and FIV WE. One test was used for detection of oncovirus antigen: domestic cat FeLV ELISA. None of the cats tested positive for FeLV infection. There are different specificities and sensitivities among the lentivirus assays being applied to nondomestic fields, suggesting that assay choice is important and that caution is warranted in interpreting data. Evidence of current lentivirus infection (defined as a positive result on at least the PLV(CGZ) WB) was found in all three species: eight of 31 Lions (25.8%), three of 18 leopards (16.7%), and one of four cheetahs (25%). In domestic cats and other mammals so far investigated, lentivirus seropositivity is strongly correlated with lentivirus infection. Seropositive cats were found in geographically diverse parts of the country. Although this study is not a comprehensive virologic evaluation of the lion, leopard, and cheetah populations of Botswana, it does reveal wild felid lentivirus infection in a previously unexamined portion of sub-Saharan Africa. With more information on PLV- like lentivirus and FeLV, scientists and managers in southern Africa can make more informed decisions regarding the movement of large cats locally or internationally for research, management, or commercial purposes.

Packer, C., S. Altizer, M. Appel, E. Brown, J. Martenson, S.J. O'Brien, M. Roelke-Parker, R. Hofmann-Lehmann and H. Lutz. 1999. **Viruses of the Serengeti: patterns**

of infection and mortality in African lions. Journal of Animal Ecology 68:1161-1178.
We present data on the temporal dynamics of six viruses that infect lions (Panthera lee) in the Serengeti National Park and Ngorongoro Crater, Tanzania, These populations have been studied continuously for the past 30 years, and previous research has documented their seroprevalence for feline herpesvirus, feline immunodeficiency virus (FIV), feline calicivirus, feline parvovirus, feline coronavirus and canine distemper virus (CDV), A seventh virus, feline leukaemia virus (FeLV), was absent from these animals, Comprehensive analysis reveals that feline herpesvirus and FIV were consistently prevalent at high levels, indicating that they were endemic in the host populations. Feline calici-, parvo- and coronavirus, and CDV repeatedly showed a pattern of seroprevalence that was indicative of discrete disease epidemics: a brief period of high exposure for each virus was followed by declining seroprevalence. The timing of viral invasion suggests that different epidemic viruses are associated with different minimum threshold densities of susceptible hosts, Furthermore, the proportion of susceptibles that became infected during disease outbreaks was positively correlated with the number of susceptible hosts at the beginning of each outbreak. Examination of the relationship between disease outbreaks and host fitness suggest that these viruses do not affect birth and death rates in lions, with the exception of the 1994 outbreak of canine distemper virus. Although the endemic viruses (FHV and FIV) were too prevalent to measure precise health effects, there was no evidence that FIV infection reduced host longevity.

Palomares, F. and T. M. Caro. 1999. **Interspecific killing among mammalian carnivores.** American Naturalist 153(5):492-508.
Interspecific killing among mammalian carnivores is common in nature and accounts for up to 68% of known mortalities in some species. Interactions may be symmetrical (both species kill each other) or asymmetrical (one species kills the other), and in some interactions adults of one species kill young but not adults of the other. There is a positive significant relationship between the body masses of solitary killer species and body masses of their victim species, and grouping species kill larger victims than solitary species. Interactions and consumption of the victim appear more common when food is scarce or disputed. In response to killers, victim species may alter their use of space, activity patterns, and form groups. Consequences of interspecific killing include population reduction or even extinction, and reduction and enhancement of prey populations, and may therefore have important implications for conservation and management of carnivores and their prey.

Patterson, B. D., E. J. Neiburger and S. M. Kasiki. 2003. **Tooth breakage and dental disease as causes of carnivore-human conflicts.** Journal of Mammalogy 84(1):190-196.
Large carnivores that become marauders and man-eaters are frequently thought to be old or infirm, apparently incapable of normal predatory behavior. To evaluate whether this "infirmity theory" offers a general explanation for animal–human conflicts, we examined teeth and jaws of lions (Panthera leo) in museum collections. Although tooth wear and breakage are normal in lions, they are rarely accompanied by severe pathologies. Although the infirmity theory may explain specific instances of carnivore–human conflict, including the infamous case of Tsavo's man-eating lions, most other conflicts can be linked to alternative explanations, especially prey depletion in human-dominated areas, which trigger the opportunity and necessity of exploiting people or livestock (or both) as prey.

Patterson, D. K. 2002. **Evaluating tiger conservation: what social conditions allow for success in conservation?** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.
While tigers receive considerable research attention and substantial funding is directed toward their conservation, their populations continue to decline. The results of preliminary doctoral research are discussed here, followed by future research plans. To identify possible causes for this seeming disconnect, a literature review of social conditions in conservation was conducted, followed by preliminary evaluations of in situ case projects in Cambodia. The preliminary evaluation was conducted through literature review, project document review, and correspondence with project contacts. The results of the literature review suggest that there are four major social conditions involved in effective conservation: positive government involvement, effective interagency cooperation, community involvement, and cultural appropriateness of the conservation methods. Preliminary evaluation results suggest that the first three conditions are essential in successful conservation. Next, extensive field evaluation of the case projects will allow for verification of and expansion upon these findings, and will also illuminate the role of culture in conservation. After these data are analyzed, a written survey of tiger projects across Asia will be conducted to determine whether the results are generalizable across tiger conservation. In the future it is hoped that this theoretical model will contribute to the success of future conservation initiatives.

Paul-Murphy, J., T. Work, D. Hunter, E. McFie and D. Fjelline. 1994. **Serologic survey and serum biochemical reference ranges of the free-ranging mountain lion (Felis concolor) in California**. Journal of Wildlife Diseases 30:205-215.
Serum samples from 58 mountain lions (Felis concolor) in California (USA) were collected between April 1987 and February 1990. Nineteen serum samples were used

for serum biochemistry determinations; the ranges were similar to reference values in domestic cats, captive exotic felidae and free-ranging mountain lions. A serological survey was conducted to determine whether antibodies were present against selected infectious agents. Fifty-four (93%) of 58 sera had antibodies against feline panleukopenia virus. Fifteen (68%) of 22, 16 (28%) of 58, 11 (19%) of 58, and 10 (17%) of 58 had serum antibodies against feline reovirus, feline coronavirus, feline herpes virus, and feline calicivirus, respectively. Twenty-three (40%) of 58 and 21 (58%) of 36 had serum antibodies against Yersinia pestis and Toxoplasma gondii, respectively. Only one of 22 sera had antibodies against the somatic antigen of Dirofilaria immitis. Feline leukemia virus and feline immunodeficiency virus antigens were not detected in any mountain lion's sera. All 58 sera samples were negative for antibodies to feline immunodeficiency virus and Chlamydia psittaci.

Pedersen, V.A., J.D.C. Linnell, R. Andersen, H. Andren, M. Linden and P. Segerstrom. 1999. **Winter lynx Lynx lynx predation on semi-domestic reindeer Rangifer tarandus in northern Sweden**. Wildlife Biology 5: 203-211.

The predation behaviour of six lynx Lynx lynx family groups, i.e. adult females with dependent kittens, was studied using radio-tracking and snow-tracking in the Sarek area of northern Sweden during winter 1995/96 and 1996/97. One hundred and six daily radio-locations were obtained, and 340 km of intervening tracks were followed in the snow. Forty-one scats were collected, and 57 hunting attempts, 37 of which were successful, were recorded. Semi-domestic reindeer Rangifer tarandus contributed over 90% to lynx ingested meat calculated from both scats and kills. Eighty-three percent of hunting attempts on reindeer, and 53% of attempts on small prey species, mainly Lagopus sp. and mountain hares Lepus timidus, were successful. Four incidents of multiple-killing of reindeer were documented. Reindeer were generally in poor body condition, with an average femur marrow fat content of 27%. Lynx spent an average of three nights at each reindeer kill- site. Reindeer were less completely consumed than small prey (61% vs 99%). The amount of meat eaten from a reindeer was proportional to the number of lynx-nights on the kill. An overall kill rate of one reindeer per five days was calculated. We concluded that reindeer are a very important food source for lynx in winter, which potentially could lead to problems in resolving the carnivore-livestock conflicts in the region.

Pierce, B.M., V.C. Bleich and R.T. Bowyer. 2000. **Social organization of mountain lions: Does a land-tenure system regulate population size?** Ecology 81: 1533-1543.

Mountain lions (Puma concolor) are thought to regulate their populations via social behavior. The proposed mechanism is a land-tenure system that results in exclusion of individuals from the population through territoriality and temporal avoidance. In the absence of mortality from intraspecific aggression, social behavior can regulate a population only by limiting reproduction. Successful reproduction among large mammals is related to the availability of food. Four states of nature must hold if a population is regulated by social behavior via a land-tenure system in mountain lions: (1) individuals should not be distributed randomly, but each should have its own distinct distribution, and those individuals should maintain regions of exclusivity; (2) use of food within the distribution of an individual should not be random, but should be clumped as individuals try to exclude each other from access to prey; (3) those clumps of prey must not be simply the result of prey distribution, but of social interactions among lions; and (4) social interactions and defense of food should occur in regions where distributions of individuals overlap; therefore, prey use by individual lions in areas of overlap should be less than expected based on the distribution of prey. We tested hypotheses regarding social regulation for a population of mountain lions that co-occurred on a winter range with a population of mule deer (Odocoileus hemionus) in the eastern Sierra Nevada, California, from 1991 to 1997. Individual mountain lions (rt = 10) exhibited distinct distributions, and deer killed by individuals (n = 112) were not distributed randomly within the distribution of the lion that did the killing. Furthermore, the nonrandom distribution of lion-killed deer could be explained by the distribution of live deer alone, but that result was marginally not significant (P = 0.06) and indicated that something else affected the locations of kills made by lions. Results from tests of whether the presence of another mountain lion affected where individuals chose to kill prey indicated that social interactions had no effect. The distribution of deer killed by individual mountain lions in areas of exclusive use and areas of overlap was identical to that expected based on the distribution of live deer alone. That outcome indicated social behavior was not regulating the population of mountain lions via partitioning of prey, and temporal differences in use of space could not explain the distribution of mountain lions we observed. A system of land-tenure and mutual avoidance did not limit the population of mountain lions in Round Valley via partitioning of prey. Our results are concordant with other studies of large mammalian carnivores, which reported that populations were not limited primarily by territoriality but by the supply of food.

Plumptre, A. J., J. B. Bizumuremyi, F. Uwimana, J. D. Ndaruhebeye. 1997. **The effects of the Rwandan civil war on poaching of ungulates in the Parc National des Volcans**. Oryx 31(4):265-273.

One of the greatest threats that the mountain gorilla Gorilla gorilla beringei faces is the repeated setting of snares for ungulates by people living adjacent to the Pare

National des Volcans in Rwanda. Two vets (one expatriate and one Rwandan) are permanently employed to monitor the health of habituated groups of mountain gorillas and to remove snares if an animal becomes caught in one. This study examined how snaring has changed as a result of the Rwandan civil war and how ungulates in the park have been affected. In the region around the Karisoke Research Station ungulate numbers have remained stable and in the case of the black-fronted duiker Cephalophus nigrifrons they have increased at higher altitudes. However, a questionnaire survey among local people showed that there has been a perceived decrease in crop raiding by all ungulates in the west of the park, suggesting It decline in numbers. In the east of the park there appears to have been a decrease in the numbers of black-fronted duikers but an increase in the number of buffaloes Syncerus caffer. The price of bushmeat in real terms has decreased since the war, despite the increase in the price of domestic meat, and poachers interviewed were selling bushmeat more frequently than they did before the war. The level of poaching, therefore, appears to have increased since the war.

Plowden, C. and D. Bowles. 1997. **The illegal market in tiger parts in northern Sumatra, Indonesia**. Oryx 31(1):59-66.
The Sumatran tiger is the only one of three original subspecies of tigers that survives in Indonesia today. Its wild population, estimated to be 400-650 animals, has progressively diminished because of habitat destruction, poaching and the removal of tigers involved in conflicts with local farmers. This paper presents previously undocumented information on the market in tiger products. It shows that, while no documentation of intentional tiger poaching to meet an international demand for tiger bones was recorded, the domestic demand for tiger bones, teeth and claws is still a potential threat to the future survival of this subspecies. In addition to continuing work to protect the integrity of tiger habitat in Sumatra, enforcement actions are required to prevent the domestic market for tiger parts increasing the threats to this subspecies and to ensure its conservation.

Poole, K. G., G. Mowat and D. A. Fear. 2001. **DNA-based population estimate for grizzly bears Ursus arctos in northeastern British Columbia, Canada**. Wildlife Biology 7(2):105-115.
Current harvest management of grizzly bears Ursus arctos in British Columbia (B.C.), Canada, is based primarily on modeling of habitat capability/suitability. No research has been conducted in the northern half of B.C. to verify these habitat-based estimates. We estimated grizzly bear population size in a 8,527 km^2 study area in northeastern B.C. that included the east slopes of the northern Rocky Mountains (Northern Boreal Mountains ecoprovince) and the boreal plains (Taiga Plains ecoprovince) using hair removal to sample bears, microsatellite profiling to identify individuals, and mark-recapture models. We placed bait sites encircled by barbed wire in a grid of 103 9 x 9 km (81 km^2) cells. In each cell a different bait site was set for 12 days in each of five sessions. We collected 2,062 hair samples from 332 sites and detected grizzly bears at 113 sites. DNA profiling of grizzly bear samples identified 98 different bears; 44 of these individuals were females, 47 were males, and the remaining seven individuals could not be sexed. Forty-one grizzly bears were caught at > 1 site. We used a closed mark-recapture model to obtain a naive population estimate of 148 grizzly bears (95% confidence interval (CI): 124-182). We reduced this estimate by 6.8% to account for closure bias, which resulted in an adjusted population estimate of 138 grizzly bears (95% CI: 114-172) within the study area (16 bears/1,000 km^2, 95% CI: 13-20). Within the two biophysical ecoprovinces we estimated a density (corrected for closure) of 29 bears/1,000 km^2 (95% CI: 23-37) for the Northern Boreal Mountains and 10 bears/1,000 km^2 (95% CI: 7-18) for the Taiga Plains. The current habitat-based capability ratings for grizzly bears in the boreal ecoprovinces of B.C. are supported by our results in the Taiga Plains, but are lower than densities we obtained in the Northern Boreal Mountains by about half. With further testing, habitat-based estimates of grizzly bear density in B.C. could be adjusted using the results of DNA-based population estimates.

Porter, J. C. 2002. **Finding teeth for Russian Federation tiger protection laws: using United States gray wolf populations as an inspiration, and United States endangered species legislation as a model for Russian Federation endangered species legal reform.** Penn State Environmental Law Review 10(2).
The primary threats to the Amur Tiger have been identified as poaching, decreased prey species, and loss of large, intact natural ecosystems. If no connection can be made between the killing of the tiger, and the individual apprehended with the tiger or tiger part, it appears as though no penalty can be imposed under existing Russian Federation criminal law. While these regulations are being introduced, the socio-economic instability in the tiger habitat region leads to subsistence poaching of ungulates at an estimated three times the limit for some species. Since being granted protection under the Endangered Species Act, the Gray wolf has made such a remarkable comeback that the U.S. Fish and Wildlife Service has recently proposed a reclassification of distinct geographical populations of the Gray wolf from endangered to threatened status. Proposal For Increased Protection of the Amur Tiger Using the Success With the Gray Wolf as a Model could be developed. Statistically, the Amur tiger population in Russia appears to have made a more dramatic revival than the Gray wolf in the United States.

Ramakrishnan, U., R. G. Coss and N. W. Pelkey. 1999. **Tiger decline caused by the reduction of large ungulate prey: evidence from a study of leopard diets in southern India.** Biological Conservation 89(2):113-120.
Populations of leopards and tigers in the Kalakad-Mundanthurai Tiger Reserve, India, appear to be declining. To identify the cause of this decline, we examined the diets and the relative densities of leopards and tigers, comparing seat from this park with that from the Mudumalai Wildlife Sanctuary, a park known to have high leopard and tiger densities. Results suggested that the leopard density in Mudumalai was approximately twice that in Mundanthurai. No evidence of tigers was found in Mundanthurai. Prey species found in leopard diets in the two parks was similar; albeit, mean prey weight and the proportion of large ungulates were markedly lower in the Mundanthurai leopard diet. These dietary differences are consistent with the infrequent sightings of large ungulates in Mundanthurai. Analyses of satellite data revealed that large areas of grazing land in Mundanthurai have shifted to thicket, reducing available forage for large ungulates. Since large ungulates constitute important tiger prey, the low density of ungulates in Mundanthurai might explain the apparent absence of tigers. Our findings suggest that the tiger population in the Kalakad- Mundanthurai Tiger Reserve could be enhanced via the application of habitat management for large ungulates.

Rasker, R. and A. Hackman. 1996. **Economic development and the conservation of large carnivores**. Conservation Biology 10:991-1002.
Conserving large carnivores in North America binges on protecting vast wildlands, a strategy often assumed to carry significant economic costs in terms of jobs and income foregone. Using case studies, we tested whether there is enough evidence to support the assertion that the protection of wildlands is detrimental to economic development in the northern U.S. Rocky Mountains and the Rocky Mountains of southern British Columbia and Alberta. We analyzed employment and income trends in northwestern Montana (U.S.A.) for counties with a high degree of wildland protection versus counties with high levels of resource extraction and little wildland protection. Employment and personal income levels in ''wilderness'' counties grew faster than in ''resource- extraction'' counties. Wilderness counties also showed higher degrees of economic diversification and lower unemployment rates. No direct cause-and-effect relationship was established between wildlands protection and economic development, but to the assertion that protecting wildland habitat for large carnivores is detrimental to a region's economy, enough counterevidence is presented to suggest an alternative hypothesis: the protection of wilderness habitat that sustains wild carnivores such as grizzly bears (Ursus arctos horribilis) and wolves (Canis lupus) does not have a detrimental effect on local or regional economies. Evidence presented suggests that economic growth is stimulated by environmental amenities. Further, case studies in southern British Columbia and Alberta in Canada and the Greater Yellowstone region, in the U.S., where environmental protection has been explicitly recognized as an economic development strategy, suggest that environmental protection and economic development are complementary goals. In some areas, however, ''amenity-based'' economic growth is rapidly leading to urban sprawl and subsequent loss of wildlife habitat, and there is a need for growth management.

Reading, R. P., S. Amgalanbaatar, H. Mix and B. Lhagvasuren. 1997. **Argali Ovis ammon surveys in Mongolia's south Gobi**. Oryx 31(4): 285-294.
The argali, Ovis ammon, a species of wild sheep, is threatened in Mongolia, suffering from poaching and competition with domestic livestock. The authors conducted ground and aerial surveys of argali in Dundgobi, Omnogobi and Dornogobi aimags (or provinces) of the South Gobi region of Mongolia. Ground surveys were conducted by vehicle and on foot, while aerial surveys were conducted using two Soviet AN-2 aircraft flying 40-km parallel transects. The interactive computer programme Distance was used to estimate population size and density. The authors observed a total of 423 argali in 85 groups (mean group size = 5.0 plus or minus 0.6 SE), including 300 individuals in 61 groups on the ground survey (mean size = 4.9 plus or minus 0.8 SE) and 123 animals in 24 groups during the aerial survey (mean size = 5.1 plus or minus 1.2 SE). Population structure of the groups observed during the ground survey was 14.3 per cent males, 53.3 per cent females, 19.7 per cent lambs, and 12.7 per cent animals of undetermined sex (means = 0.7 plus or minus 0.2 SE males, 2.6 plus or minus 0.6 SE females, 1.0 plus or minus 0.2 SE lambs, and 0.6 plus or minus 0.4 SE undetermined). We estimated a population size of 3900 plus or minus 1132 SE argali in the study area for a population density of 0.0187 plus or minus 0.0054 SE animals/sq km. More rigorous and comprehensive surveys for argali, preferably for each distinct population, should be conducted for more accurate estimates. Argali require more active conservation and management, especially with respect to poaching and competition with domestic livestock.

Reading, R. P., H. Mix, B. Lhagvasuren and N. Tseveenmyadag. 1998. **The commercial harvest of wildlife in Dornod Aimag, Mongolia.** Journal of Wildlife Management 62(1): 59-71.
We analyzed commercial harvest data from 1932 to 1933 for Mongolian gazelle (Procapra gutturosa), gray wolves (Canis lupus), corsac foxes (Vulpes corsac), red foxes (Vulpes vulpes), Siberian polecats (Mustela eversmanni), Siberian marmots (Marmota sibirica), and Tolai rabbits (Lepus tolai) from Dornod Aimag, Mongolia. Analyses

were post hoc and harvests were probably biased by State-imposed harvest quotas; therefore, statistically significant harvest trends may or may not reflect population trends. Gazelle, wolf, marmot, and fox harvests demonstrated significant decreasing trends, while polecats and rabbits displayed no significant trends. Analyses suggest that government-imposed harvest quotas influenced actual harvests of marmots and foxes. The effect of year on actual harvests was important for gazelle, wolves, and marmots, and may reflect population changes. Reports suggest that poaching is an important source of mortality for gazelle and marmots. Several other studies report declines in numbers of Mongolian gazelle, which once migrated in the millions across most of Mongolia. Wolves are strongly disliked and heavily persecuted by local nomads, officials, and biologists at all levels of government. All species harvested commercially in Dornod Aimag require more careful conservation management to ensure the continued existence of viable populations. Currently, little management or monitoring is occurring.

Rempel, R. S., P. C. Elkie, A. R. Rodgers and M. J. Gluck. 1997. **Timber-management and natural-disturbance effects on moose habitat: Landscape evaluation**. Journal of Wildlife Management 61(2):17-524.
We used 16 years of survey data for a moose population, and 3 Landsat satellite scenes, spanning 19 years, to evaluate the hypotheses that Ontario's Moose Habitat Guidelines for timber harvest: (1) mitigate the effects of unmodified clearcuts on moose populations, and (2) create enhanced habitat with greater interspersion of forage with cover and higher habitat suitability indices than areas dominated by unmodified clearcuts. The 5 study landscapes compared were 16,000-91,000 ha, and included landscape disturbance from timber-management and wildfire-burn, and landscapes with and without hunter access. Moose density differed among landscapes, but while neither main effects of hunter access ($P = 0.083$), nor landscape disturbance ($P = 0.31$) were significant, their interactions were ($P = 0.003$), with density increasing if disturbance occurs without hunter access. The habitat suitability index in the wildfire burn was similar (0.80) to both the modified and unmodified clearcut (0.85 and 0.83), and population rate of increase was positive in both the burn ($B = 0.153$, $P < 0.0001$) and the unmodified clearcut ($B = 0.127$, $P < 0.0001$). The population did not increase in the modified clearcut ($B = -0.016$, $P = 0.9901$) because hunter access increased as a consequence of high road density.

Riordan, P. 1998. **Unsupervised recognition of individual tigers and snow leopards from their footprints**. Animal Conservation 1:253-262.
This study presents the testing of two unsupervised classification methods for their ability to accurately identify unknown individual tigers, Panthera tigris, and snow leopards, Panthera uncia, from their footprints. A neural-network based method, the Kohonen self-organizing map (SOM), and a Bayesian method, AutoClass, were assessed using hind footprints taken from captive animals under standardized conditions. AutoClass successfully discriminated individuals of both species from their footprints. Classification accuracy was greatest for tigers, with more misclassification of individuals occurring for snow leopards. Examination of variable influence on class formations failed to identify consistently influential measurements for either species. The self-organizing map did not provide accurate classification of individuals for either species. Results were not substantially improved by altering map dimensions nor by using principal components derived from the original data. The interpretation of resulting classifications and the importance of using such techniques in the study of wild animal populations are discussed. The need for further testing in the field is highlighted.

Roe, D., T. Mulliken, S. Milledge, J. Mremi, S. Mosha and M. Grieg-Gran. 2002. **Making a Killing or Making a Living? Wildlife trade, trade controls and rural livelihoods.** Biodiversity and Livelihoods Issues No.6.
The report shows how wildlife products commonly found on shop shelves often owe their origins to harvesters living thousands of miles away and the importance these products can play to the livelihoods of these people. For the poorest groups, wildlife trade may provide one of the few opportunities for earning cash income which, even in small amounts, can make a critical difference to livelihood security. The report focuses specifically on the impacts of trade controls linked to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Roelke M.E., D.J. Forrester, E.R. Jacobson, G.V. Kollias, F.W. Scott, M.C. Barr, J.F. Evermann and E.C. Pirtle. 1933. **Seroprevalence of infectious disease agents in free-ranging Florida panthers (Felis concolor coryi).** Journal of Wildlife Diseases 29:36-49.
Serum samples obtained from 38 free-ranging Florida panthers (Felis concolor coryi) in southern Florida, March 1978 through February 1991, were tested for antibodies against eight bacterial, parasitic, and viral disease agents. Sera were positive for antibodies against feline panleukopenia virus (FPV) (78%), feline calicivirus (56%), feline immunodeficiency virus/puma lentivirus (37%), feline enteric coronavirus/feline infectious peritonitis virus (19%), and Toxoplasma gondii (9%). All samples were seronegative for Brucella spp., feline rhinotracheitis virus, and pseudorabies virus. In addition, all the animals tested were negative for feline leukemia virus p27 antigen as determined by enzyme-linked immunosorbent assay. Feline panleukopenia virus was considered to be a potentially significant disease agent;

FPV antibodies occurred in the highest prevalences in older age classes (P = 0.027) and in panthers living in the dense mixed hardwood swamps in the western portion of their range compared to the open cypress and sawgrass prairies to the east (P = 0,096). Because <50 animals remain in this relict population and the probable resultant depression of genetic diversity and lowered disease resistance, FPV or other disease agents could contribute to the extinction of this endangered subspecies.

Rotstein, D. S., R. Thomas, K. Helmick, S. B. Citino, S. K. Taylor and M. R. Dunbar. 1999. **Dermatophyte infections in free-ranging Florida panthers (Felis concolor coryi)**. Journal of Zoo and Wildlife Medicine 30(2):281-284.

Three free-ranging Florida panthers (Felis concolor coryi) were diagnosed with clinical dermatophytosis; two were infected with Trichophyton mentagrophytes, and one was infected with Microsporum gypseum. Two of these panthers were juvenile males that were diagnosed with focal to focally coalescing dermatophytosis; one caused by M. gypseum and the other by T. mentagrophytes. These animals were not treated, and clinical signs resolved spontaneously over 6 mo. The third panther, an adult male from southern Florida, presented with a diffuse dermatophytosis due to T. mentagrophytes infection. Initially, the panther had alopecia, excoriations, ulcerations, and multifocal pyoderma of the head, ears, neck, rear limbs, and abdominal region that progressed to lichenification of the skin and loss of nails from two digits. When topical therapy applied in the field at 45-day intervals was ineffective in clearing the infection, the animal was placed in captivity for intensive oral therapy to prevent further development of dermal mycosis, loss of additional nails, and spread of infection to other panthers. The panther was treated orally with itraconazole (9.5 mg/kg) in the food s.i.d. for 6 wk. After treatment, nail regrowth occurred but the multifocal areas of alopecia remained. The panther was released back into the wild after two skin biopsy cultures were negative for fungal growth. Temporary removal of a free-ranging animal of an endangered species from its habitat for systemic treatment of dermatophytosis requires consideration of factors such as age, reproductive potential, holding facilities, treatment regimen, and the potential for successful reintroduction of the animal.

Ross, P. I., M. G. Jalkotzy and M. Festa-Bianchet. 1997. **Cougar predation on bighorn sheep in southwestern Alberta during winter.** Canadian Journal of Zoology 75(5):771-775.

Predation by cougars (Puma concolor) upon bighorn sheep (Ovis canadensis) was studied in southwestern Alberta during winters from 1985-1986 to 1993-1994. We examined 320 kills and found that ungulates provided >99% of the biomass consumed by cougars in November-April. All ungulate species found within the study area were taken by cougars. Predation on bighorn sheep varied greatly from year to year; cougars were known to kill 0-13% of the November sheep population, and 0-57% of over-winter sheep mortality consisted of known cougar kills. Of 29 bighorns killed by cougars, 13 were lambs. The remainder ranged in age from 1 to 17 years and included 9 ewes and 7 rams. Cougar predation on bighorn sheep appears to be largely an individual, learned behaviour; most cougars rarely killed sheep, but some preyed heavily upon them. One female killed 9% of the population and 26% of the lambs over a single winter. For mountain-dwelling ungulates that occur in small groups, the presence of one or a few individual specialist predators may strongly and unpredictably influence demography and behaviour.

Ryser-Degiorgis, M.P., A. Ryser, L.N. Bacciarini, C. Angst, B. Gottstein, M. Janovsky and U. Breitenmoser. 2002. **Notoedric and sarcoptic mange in free-ranging lynx from Switzerland**. Journal of Wildlife Diseases 38: 228-232.

Between March and December 1999, five free-ranging lynx (Lynx lynx) affected by mange were found dead or shot by game wardens in the Swiss Alps. In the first two cases, Notoedres cati was isolated from the skin; in the third and fourth case, Sarcoptes scabiei was the cause of the infection; and in the fifth cased it mixed infection was diagnosed. Red foxes (Vulpes vulpes) affected with sarcoptic, mange and domestic cats infested with N. cati. are likely to be the sources of infection. It seems improbable that mange will occur as an epidemic in lynx in Switzerland, but losses due to infections with N. cati and/or S. scabiei may have an impact on this small, geographically limited lynx population. This is the first report of notoedric mange in a free-ranging lynx: and the first report of mange in lynx front Switzerland.

Sanderson, E.W., K.H. Redford, C.L.B. Chetkiewicz, R.A. Medellin, A.R. Rabinowitz, J.G. Robinson and A.B. Taber. 2002. **Planning to save a species: the jaguar as a model.** Conservation Biology 16(1):58-72.

In March 1999 the Wildlife Conservation Society sponsored a priority-setting and planning exercise for the jaguar across its range, from northern Mexico to northern Argentina. Field scientists from 18 countries reached consensus on four types of information: (1) the spatial extent of their jaguar knowledge, (2) the known, currently occupied range of jaguars, (3) areas with substantial jaguar populations, adequate habitat, and a stable and diverse prey base, and (4) point localities where jaguars have been observed during the last 10 years. During the exercise, these experts also conducted a range-wide assessment of the long-term survival prospects of the jaguar and developed an algorithm for prioritizing jaguar conservation units occurring in major habitat types. From this work, we learned that the known, occupied range of the jaguar has contracted to

approximately 46% of estimates of its 1900 range. Jaguar status and distribution is unknown in another 12% of the jaguar's former range, including large areas in Mexico, Colombia, and Brazil. But over 70% of the area where jaguars are thought to still occur was rated as having a high probability of supporting their long-term survival. Fifty-one jaguar conservation units representing 30 different jaguar geographic regions were prioritized as the basis for a comprehensive jaguar conservation program.

Schneider, R. R. and S. Wasel. 2000. **The effect of human settlement on the density of moose in northern Alberta**. Journal of Wildlife Management 64(2):513-520.
The objective of our study was to determine the net impact of human settlement on moose (Alces alces) at a large scale. Our study area was northern Alberta, Canada, which is divided into a White Zone in which agriculture is permitted and where most human settlement is concentrated, and a Green Zone which is comprised of boreal forest with minimal human settlement, Moose densities were determined using a 1993 moose census that covered almost all of northern Alberta. We found a linear decline in the density of moose with increasing distance from the White Zone. The median density of moose in the White Zone was 0.40 moose/km^2 compared with 0.25 moose / km^2 in the Green Zone. Within the White Zone both human settlement and the density of moose declined with increasing latitude. While access is generally assumed to have a negative influence on moose, we found that at the regional scale the density of moose was positively associated with the density of roads. The regions with the greatest moose densities also had the greatest intensity of licensed hunting. We hypothesize that the observed association between settlement and the density of moose reflects a causal relationship and we provide arguments to support our supposition.

Schwartz, M. K., L. S. Mills, Y. Ortega, L. F. Ruggiero and F. W. Allendorf. 2003. **Landscape location affects genetic variation of Canada lynx (Lynx canadensis).** Molecular Ecology (12)7:1807-1816.
The effect of a population's location on the landscape on genetic variation has been of interest to population genetics for more than half a century. However, most studies do not consider broadscale biogeography when interpreting genetic data. In this study, we propose an operational definition of a peripheral population, and then explore whether peripheral populations of Canada lynx (Lynx canadensis) have less genetic variation than core populations at nine microsatellite loci. We show that peripheral populations of lynx have fewer mean numbers of alleles per population and lower expected heterozygosity. This is surprising, given the lynx's capacity to move long distances, but can be explained by the fact that peripheral populations often have smaller population sizes, limited opportunities for genetic exchange and may be disproportionately affected by ebbs and flows of species' geographical range.

Sharma, U. R.. 1992. **Park-people interactions in Royal Chitwan National Park, Nepal**. Doctoral Dissertation. University of Arizona. 275 pp.
The following issues of conflict between Royal Chitwan National Park (RCNP) and its human neighbors have been addressed in this research: firewood shortage, shortage of grazing land and fodder, and crop/livestock depredation by park wildlife. In addition, previous estimates of annual grass-cutting in the park have been revised. Out of 16 village units, or 144 wards, in the study area that are within 5 km of the RCNP (total study area about 598 sq. km) in the Chitwan District of Nepal, 14 wards were randomly selected for detailed investigation. The investigation included interviews of 140 randomly selected heads of households, livestock census, year-round monitoring of crop/livestock depredation by park wildlife, and monitoring of 11 patches of grassland/savanna (totalling 365 ha) in the nearby park-land for recording trespass grazing. In addition, 1818 randomly selected grass-cutters were interviewed to estimate the harvests of resources in the park. Major resources left remaining after the harvest were field-assessed. Information concerning the subsistence systems and ethnicity of local people has been described. Intensity of livestock grazing in the bordering grasslands/savannas inside the park was found to be 4.1 heads/ha. The livestock biomass was estimated to have been growing by 2.36 percent, and a change in the mix of livestock ownership, including an increase in buffalo and goats, was noticed. Rhino (Rhinoceros unicornis) was found to be the principal crop raiding animal, followed by wild boar (Sus scrofa), and chital (Axis axis). Tiger (Panthera tigris) and leopard (Panthera pardus) were threats on livestock. Smaller carnivores also caused substantial damages to domestic birds. Annual losses of crop and livestock sustained by the average household have been estimated. No strong correlation between distance to park and crop or livestock damage could be found. There were 61,614 participants in the annual 15-day grass-cutting. On the average, 3 m tons of grasses, reeds, binding materials, and firewood per household were harvested from the park. Net contribution from these harvests to the economy was estimated to be US$ 325,166. Competing theories on national park management are examined and a new concept for park management is proposed.

Silori, C. S. and B. K. Mishra. 2001. **Assessment of livestock grazing pressure in and around the elephant corridors in Mudumalai Wildlife Sanctuary, south India**. Biodiversity and Conservation 10(12):2181-2195.
Mudumalai Wildlife Sanctuary in southern India plays an important role in biodiversity conservation, especially of

large mammals, by offering habitat contiguity of about 3300 km^2 with three other protected areas in the region, namely Nagarahole and Bandipur National Parks and Wynaad Wildlife Sanctuary through forest corridors between the Western Ghats and Eastern Ghats forests. The habitat linkage is crucial for large ranging animals such as elephants, which use these forest corridors for migration. Livestock grazing, a major biotic interference in forest corridors, originates from seven settlements of the Masinagudi group of villages on the eastern and the southeastern fringes of the sanctuary. Construction of a series of hydroelectric power stations, numbering about three at Singara, Marvakandy (Masinagudi) and Moyar, around the Masinagudi villages caused a rapid growth in human population (143% between 1961 and 1991), particularly the landless labourers and livestock. Free grazing by about 15 000-17 000 resident as well as migratory livestock every year in and around the forest corridors, coupled with removal of cattle dung from the forest floor, have adversely affected the forest regeneration and helped proliferation of weed species such as Lantana camara, Casia tora, C. occidentalis, Opuntia dillenii, and Ageratum conyzoides. The annual fodder production from the corridor forest could meet the demand of about two-thirds of the resident population, while the crop residues from the marginal agriculture could not support the remaining one-third livestock population. In view of such a situation, measures have been suggested to reduce livestock population and implement the ecodevelopment packages in order to ensure the corridor contiguity for the long-term conservation of the elephant population.

Silveira, L., A. T.A. Jacomo and J. A. F. Diniz-Filho. 2003. **Camera trap, line transect census and track surveys: a comparative evaluation.** Biological Conservation 114(3):351-355.
Rapid faunal assessments can use different methods depending on environmental conditions and costs. To compare the efficiency of three methods in detecting species richness and abundance, we tested them in the grasslands of Emas National Park, central Brazil. Track census was the most effective method for detecting richness, followed by camera-trapping and direct faunal counts. Track census reached an asymptote for number of species after only 12 days, but all methods converged on similar estimates of species richness after around 30 days. There was no significant spatial correlation for species richness or total abundance, between camera trap and tracks, across the 29 samples distributed in the park. However, for some species, abundance showed significant spatial correlation between methods. Also, these rates were significantly correlated across species and the spatial correlation between methods was significantly associated with log-transformed body mass across species. We conclude that, despite the high initial costs for camera-trapping, this method is the most appropriate for mammal inventory in all environmental conditions, allowing a rapid assessment of wildlife conservation status.

Silver, S. C., L. E. T. Ostro and L. K. Marsh. 2002. **The use of camera traps to estimate jaguar populations.** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.
A major obstacle to developing an effective, range-wide conservation strategy to protect jaguars (Panthera onca) is an absence of robust, reproducible population estimates. Occurring at low densities and being shy and secretive, jaguar populations have been historically very difficult to assess. Using a technique originally developed for tiger populations, we installed 20 camera trap stations sample an area of approximately 145 square kilometers of tropical forest in the Cockscomb Basin Wildlife Sanctuary, Belize. Using the distinctive markings to identify individuals, we concluded that 11 jaguar were photographed over the 59 day sampling period. Using mark/recapture models for closed populations analyzed by the CAPTURE program, we were able to estimate the abundance of jaguar in the sampled area. The results of this study indicate the photographic mark/recapture technique designed for tigers can be adapted for other felids. The technique enables biologists studying jaguar to estimate population abundances and provide them with information they need to promote conservation actions based upon sound population information.

Smallwood, K. S. 1994. **Trends in California mountain lion populations**. Southwestern Naturalist 39(1):67-72.
The status of the California mountain lion (Felis concolor californica May) population has been controversial and central to disputes regarding its management. Track survey methods and transects were developed during the 1980s to provide the only standard estimate of mountain lion population trends in California. In 1992, I repeated the 1986 statewide survey for mountain lion track sets, in which a track set is any continuous trail of tracks made by the same animal. Track set density increased 313% in the mountains of southern California, but they decreased 52% in northern California, and 61% in areas where timber was removed since 1986. Most of the areas preferred by resident mountain lions in 1986 were avoided in 1992 after they were clearcut. Whereas residents preferred unharvested and non-forest areas in 1992, track set densities of deer were the same with or without timber loss. Mountain lion track set density might have decreased due to degradation of habitat quality other than prey availability, or it might have decreased as part of a natural population cycle, which is common among species of Carnivora. When this decrease was added to the changes observed at three sites monitored since 1980, the pattern resembled nearly one complete cycle. Plans for management and research of mountain lions should include the effects of habitat loss and natural population dynamics.

Solanki, G. S. and R. M. Naik. 1998. **Grazing interactions between wild and domestic herbivores**. Small Ruminant Research 27(3): 231-235.
Grazing interactions among blackbuck, chinkara, nilgai, four-horned antelope and domestic heifers and goats were studied on the campus of Agriculture University in India. Chinkaras and blackbucks preferred grasses, while forbs were preferred by nilgai, four-horned antelope, and heifers. Goats were browsers, using mostly trees and shrubs. All animals had a high preference for legumes. Nilgai displayed the most diverse food habits.

Spearing, A. 2002. **A note on the prospects for snow leopard census using photographic capture.** Pages 173 – 185 *in* T. M. McCarthy and J. Weltzin, editors Contributed Papers to the Snow Leopard Survival Strategy Summit. International Snow Leopard Trust, Seattle, Washington, USA.
Here I have demonstrated that camera-traps can provide a crude estimate of cat numbers, and could be used to examine the correlation between cat numbers with sign and prey densities across the range. In addition it will be a useful tool in examining the effect of pilot conservation initiatives on local snow leopard populations: knowledge of which will be useful in range-wide conservation planning. A high visitation rate here also points to the possible use of photographic rates to study snow leopard population trends and density.

Spong, G., M. Johansson and M. Bjorklund. 2000. **High genetic variation in leopards indicates large and long- term stable effective population size.** Molecular Ecology 9:1773-1782.
In this paper we employ recently developed statistical and molecular tools to analyse the population history of the Tanzanian leopard (Panthera pardus), a large solitary felid. Because of their solitary lifestyle little is known of their past or present population dynamics. Eighty-one individuals were scored at 18 microsatellite loci. Overall, levels of heterozygosity were high (0.77 +/- 0.03), with a small heterozygote deficiency (0.06 +/- 0.03). Effective population size (N-e) was calculated to be 38 000-48 000. A N,:nr ratio of 0.42 (average from four cat studies) gives a present population size of about 100 000 leopards in Tanzania. Four different bottleneck tests indicated that this population has been large and stable for a minimum of several thousand years. F-ST values were low and no significant genetic structuring of the population could be detected. This concurs well with the large migration values (N-m) obtained (>3.3 individuals/generation). Our analysis reveals that ecological factors (e.g. disease), which are known to have had major impact on other carnivore populations, are unlikely to have impacted strongly on the population dynamics of Tanzanian leopards. The explanation may be found in their solitary life-style, their often nonconfrontational behaviour toward interspecific competitors, or that any bottlenecks have been of limited size, localized, or too short to have affected genetic variation to any measurable degree. Since the genetic structuring is weak, gene flow is not restricted to within protected areas. Local loss of genetic variation is therefore not of immediate concern.

Stahl, P., J.-M. Vandel, V. Herrenschmidt and P. Migot. 2001. **Predation on livestock by an expanding reintroduced lynx population: long-term trend and spatial variability.** Journal of Applied Ecology 38:674-687.
In recent decades, the Eurasian lynx Lynx lynx has recolonized former habitat, bringing it into potential conflict with livestock. We studied the spatial and temporal distribution of lynx attacks on sheep in the French Jura between 1984 and 1998, during and after its population expansion. We estimated the local and regional impact of lynx predation on livestock. The number of attacks increased from three in 1984 to 188 in 1989, concurrently with the colonization of the main sheep range by lynx. During subsequent years, 66-131 attacks were recorded annually (92-194 sheep killed per year). On average, 1.6 sheep were killed per attack. Lynx preyed disproportionately on lambs and subadult sheep. A small percentage of flocks (9.5-22.9%) were attacked, most of which (75.2%) were attacked once or twice a year. At the regional level, annual sheep losses to lynx were 0.14-0.59% of the total number of sheep. The major lynx-livestock problem was due to clustered attacks in a few small areas. Each year, two to six 'hot spots' (33-69% of the attacks) were identified. Hot spots covered 0.3-4.5% of the total area where attacks occurred (1835-4061 km^2). Roe deer abundance was higher in hot spots and, even here, sheep only made up 3.1% of the lynx diet. These data show that lynx were not killing sheep due to shortages of alternative prey or in response to an increased need for food when rearing young. The concentration of hot spots in only nine small areas between 1984 and 1998 indicated that only a few individual lynx were involved. The reappearance of hot spots at the same sites, after years of interruption and despite the removal of lynx, suggested that the ultimate factors causing hot spots were factors inherent to those sites. Further investigation is needed to identify causal factors with a view to eliminating them. These may relate to landscapes features, animal husbandry practices or the behavioural ecology of lynx. In future, where large predator reintroductions are planned, the potential for concentrated, localized, impact should be evaluated and mitigation measures put in place. For scattered and episodic lynx damage, financial compensation is the only realistic option at present. In hot spots, the cost-effectiveness of guard-dogs or the selective removal of some individual lynx should be evaluated

Stahl, P., J.-M. Vandel, V. Herrenschmidt and P. Migot. 2001. **The effect of removing lynx in reducing attacks**

on sheep in the French Jura Mountains. Biological Conservation 101:15-22.
The selective removal of carnivores from local areas is sometimes proposed to reduce the number of attacks on livestock. For the lynx, neither the existence of problem individuals nor the efficacy of their selective removal has been demonstrated. In France, from 1989 to 1999, eight lynx and two large carnivores thought to be lynx were legally removed from high conflict areas by trapping (n=7), shooting (n=1) or poisoning with toxic collars on sheep (n=2). The efficacy of the 10 removals was assessed on the farms where a lynx was caught and in the 5-km-radius areas encompassing both these farms and nearby sheep farms. The sex-ratio of captured lynx was seven males : one female. On four farms and in six 5-km- radius areas lynx attacks on sheep reappeared within 40 days after lynx removal, but we observed a significant decrease in the overall number of attacks. In the medium-term (48-365 days), the number of attacks decreased on two farms and in four 5-km radius areas when compared with the number observed in control plots > 10 km away from the removal sites. In the long-term, attacks reappeared on the same sites indicating a "site" effect. In such situations, selective removals may only temporarily reduce the problem of concentrated lynx damage. The only way to obtain a durable effect is to improve shepherding techniques.

Stander, P. E., P. J. Haden, Kaqece and Ghau. 1997. **The ecology of asociality in Namibian leopards.** Journal of Zoology 242:343-364.
Data on the ecology of leopards (Panthera pardus) from north- eastern Namibia are presented and discussed in terms of the possible costs and benefits of solitary behaviour. In an area of low leopard density, where individuals lived alone, both males and females occupied large home ranges, (male = 210-1164 km^2; female = 183-194 km^2). Despite resource and reproductive advantages in maintaining exclusive ranges, the degree of range overlap both between and within sexes was substantial. Average overlap between males was 46% and between females 35%. The cost of dispersal appeared high as all three marked sub-adults died, and most recorded mortalities were of sub-adults. Females with dependent young showed a significant increase in per capita food intake compared to single females and males. Higher foraging success by females with cubs was revealed through two energy expenditure parameters (kg/km travelled/day and kg/hunt/day). Differential food intake between females with cubs, single females and males can be explained partly by differences in day ranges, body size and costs of parental care. Females shared 27% of their food with cubs and the costs of sharing food does not appear as high as previously suggested. Inter-specific competition over food and the defence of carcasses is suggested as an important cost to group living. Leopard kills were visited by other large carnivores (12%) but food loss was minimal (2%). Leopards successfully avoided conflict with inter-specific competitors by dragging and hiding kills in thick vegetation. We argue that solitary and secretive behaviour enables leopards to avoid the costs of defending carcasses against larger and gregarious carnivores.

Stander, P. E., Kaqece, Nisa, T. Dabe and D. Dabe. 2001. **Non-consumptive utilisation of leopards: community conservation and ecotourism in practice.** Pages 50-57 in J. van Heerden, editor Proceedings of a Symposium on Lions and Leopards as Game Ranch Animals. Widlife Group, South African Veterinary Association, Onderstepoort, South Africa.
In north-eastern Namibia approximately 856 Ju/Hoan San make a sparse existence from a mixture of hunting, gathering and small scale livestock farming. The San community share their land with a wide range of wildlife species including leopards. Large carnivores are seen as a nuisance since they kill livestock. Cattle, especially calves, horses, chickens and domestic dogs fall prey to these carnivores, to give an annual financial loss of N$257 per village. Leopards are responsible for losses amounting to N$55 per village per year. Some leopards (N=12) were translocated after killing livestock. The San community was involved in finding solutions to the human wildlife conflict by, firstly, quantifying their traditional knowledge and skills, such as tracking, as scientifically measurable criteria. Secondly, these skills were employed in studying the ecology of the leopards and in developing an ecotourism product. This product, tested vigorously for feasibility and reliability, proved highly successful as the community generated funds that exceeded their annual losses to large carnivore predation by several fold. The success of the ecotourism enterprise depended on a collaborative effort between the Ju/Hoan community, the tourism industry and the local conservation authorities.

Steinel A., C.R. Parrish, M.E. Bloom and U. Truyen. 2001. **Parvovirus infections in wild carnivores**. Journal of Wildlife Diseases 37:594-607.
Various parvoviruses infect carnivores and can cause disease. In this review article the knowledge about infections of free- ranging or captive carnivores with the feline parvoviruses, feline panleukopenia virus, and canine parvovirus, including the. antigenic types CPV-2a and -2b, as well as Aleutian disease of mink virus and minute virus of canines are summarized. Particular emphasis is placed on description of the evolution of canine parvo-virus which apparent ly involved wild carnivore hosts.

Sunde, P. and T. Kvam. 1997. **Diet patterns of Eurasian lynx Lynx lynx: What causes sexually determined prey size segregation?** Acta Theriologica 42(2):189-201.

The influence of sex, body weight, physical condition, age and season on diet choice was investigated by hunting reports and intestinal analyses of 441 lynx Lynx lynx (Linnaeus, 1758) from Norway killed during 1960-1996. Of self-provisioning (greater than or equal to 1 yr) lynx (n = 280), males preyed proportionately more upon cervids (primarily roe deer Capreolus capreolus and semi-domestic reindeer Rangifer tarandus) compared to small game (mountain hare Lepus timidus and tetraonids) than females did. Only 5.4% of the variation in prey preference towards small game and cervids (p = 0.0002) could be explained by sex. In a logistic regression model, no additive effect of weight or any other parameters was found after sex had been included. We did not find sufficient evidence for body weight (sensu stricto) being related to prey choice, but propose that sexually determined prey segregation in lynx is caused by different ranging behaviour resulting in different encounter rates with different kinds of prey.

Sunde, P., T. Kvam, J.P. Bolstad and M. Bronndal. 2000. **Foraging of lynxes in a managed boreal-alpine environment**. Ecography 23:291-298.
Foraging of Eurasian lynxes Lynx lynx was studied with telemetry and snow tracking in central Norway. In all habitats and at all seasons, medium-sized ungulates (roe deer Capreolus capreolus, reindeer Rangifer tarandus and domestic sheep Ovis aries) dominated the diet (81% of ingested biomass estimated from faeces). Mountain hares Lepus timidus and galliform birds comprised the remainder of the diet (15% and 3%, respectively). Lynxes with different life history status did not differ in prey choice, but adult males utilised carcasses of ungulate prey considerably less (16% of the edible parts) than did females with offspring (80%) and subadults (58%). Forest habitats in lowlands and adjacent to cultivated fields were the most favourable foraging habitats (indexed as the prey encounter rate per km lynx track) primarily owing to the presence of roe deer. Two family groups tracked in winter killed 0.2 ungulate per day. The importance of agricultural land as a foraging habitat and the dominance of livestock in the diet in remoter areas indicate that the lynx has responded to agriculture and reindeer husbandry during the past century by switching from small game to ungulates.

Sunde, P., T. Kvam, P. Moa, A. Negard and K. Overskaug. 2000. **Space use by Eurasian lynxes Lynx lynx in central Norway.** Acta Theriologica 45(4):507-524.
Habitat and spatial organisation of 11 radio tagged Eurasian lynxes Lynn lynx Linnaeus, 1758 were studied in a low-density (ca 0.3 ind/100 km^2) population in a boreal-alpine environment with low and temporally varying densities (less than or equal to 180 ind/100 km^2 in winter) of ungulate prey, primarily roe deer and semi-domestic reindeer. The use of habitat measured as 4 biome categories ranked from south boreal to alpine influenced mountain vegetation did not vary seasonally, but lowlands were much preferred to alpine habitats. Adult males moved almost 3 times farther per day in linear distance ((x) over bar = 5.9 km, n = 3) than did females with kittens ((x) over bar = 2.0 km, n = 4) or subadult females ((x) over bar = 2.5 km, n = 6; p = 0.002). Subadults (n = 5) dispersed 42 +/- 13 ((x) over bar +/- SE) km during the first 9 months of independence, but often visited their natal range during the first year on their own. Adult lynxes roamed over very large annual ranges [males: 1906 +/- 387 km^2 (n = 4), females: 561 +/- 102 km^2 (n = 6)] that took greater than or equal to 5 days to pass through, independently of sex. The only male monitored over more than 1 year maintained 2 separate home ranges each year. The larger home ranges and the possible tendency towards less defined territory boundaries than previously reported for the species, may be caused by the lower prey and population densities, though culling of adult individuals may also have played a role by continuously. creating empty gaps in the territorial mosaic.

Taber, A. B., A. Novaro, N. Neris and F. H. Colman. 1997. **Food habits of sympatric jaguar and puma in the Paraguayan Chaco.** Biotropica 29(2):204-213.
Food habits of jaguar and puma were studied in two regions of the Paraguayan Chaco. Biochemical analysis of 280 scats attributed 106 to jaguar and 95 to puma. Overall dietary overlap was 65 percent and they shared six of seven main prey types. For both cats 43 percent of prey items and 15 percent of prey biomass taken were mammal species <1 kg, 23 percent of items and 289 percent of the biomass were from species 1-15 kg, and 27 percent of items and 53 percent of the biomass were from larger species. Birds, reptiles, and insects made up the remainder. In a developed region no significant differences between their diets were found, while in an undeveloped area more small mammals were taken by both species, and jaguar took more large prey than puma. The potential roles of competition and of differences in habitat structure and prey availability between the two areas on these species' diets are discussed.

Theile, S. 2003. **Fading footsteps: the killing and trade of snow leopards**. TRAFFIC, Cambridge, United Kingdom.
Research for this report was conducted with the aim of understanding the reasons for this upsurge in killing and to assess the scope and scale of the trade in snow leopards and their body parts. The information was collected in 2002 and 2003 from a range of source including literature, interviews and questionnaire with experts and governmental officials, and targeted market surveys in selected range States (Pakistan and Mongolia). Findings indicate that the incentives for killing snow leopards vary on a geographical basis. In a number of range States, notably in the Himalayan area, the

majority of killings are motivated by the desire to protect livestock, although the skins and other parts of the snow leopards may still end up in trade. Conflicts between snow leopards and domestic herders in India, Pakistan, Mongolia and Nepal have been reported for decades and loss of stock to predators can have a significant impact on herders' livelihoods. Snow Leopards are also killed primarily for profit, gained by selling the animals' body parts, chiefly the skins. Such targeted killings for trade are particularly problematic in some of the Central Asian Republics, for example Kyrgyzstan, where illegal killings of snow leopards are said to have increased three- to four-fold since the early 1990s. Some trade in live snow leopards also still occasionally occurs. Killing and trade of snow leopards is illegal in almost all range States for the species, but there is clear evidence that there are problems in enforcing these laws designed to protect the species. Demand for snow leopard skins is at national and international levels. The report suggests recommendations for remedial actions to reduce the killing and trade of snow leopards.

Trolle, M. and M. Kéry. 2003. **Estimation of ocelot density in the Pantanal using capture-recapture analysis of camera-trapping data.** Journal of Mammalogy 84(2):607-614.
Neotropical felids such as the ocelot (Leopardus pardalis) are secretive, and it is difficult to estimate their populations using conventional methods such as radiotelemetry or sign surveys. We show that recognition of individual ocelots from camera-trapping photographs is possible, and we use camera-trapping results combined with closed population capture–recapture models to estimate density of ocelots in the Brazilian Pantanal. We estimated the area from which animals were camera trapped at 17.71 km^2. A model with constant capture probability yielded an estimate of 10 independent ocelots in our study area, which translates to a density of 2.82 independent individuals for every 5 km^2 (SE 1.00).

Uphyrkina, O., D. Miquelle, H. Quigley, C. Driscoll, and S. J. O'Brien. 2002. **Conservation genetics of the far eastern leopard (Panthera pardus orientalis).** Journal of Heredity 93(5):303-311.
The Far Eastern or Amur leopard (Panthera pardus orientalis) survives today as a tiny relict population of 25–40 individuals in the Russian Far East. The population descends from a 19th-century northeastern Asian subspecies whose range extended over southeastern Russia, the Korean peninsula, and northeastern China. A molecular genetic survey of nuclear microsatellite and mitochondrial DNA (mtDNA) sequence variation validates subspecies distinctiveness but also reveals a markedly reduced level of genetic variation. The amount of genetic diversity measured is the lowest among leopard subspecies and is comparable to the genetically depleted Florida panther and Asiatic lion populations. When considered in the context of nonphysiological perils that threaten small populations (e.g., chance mortality, poaching, climatic extremes, and infectious disease), the genetic and demographic data indicate a critically diminished wild population under severe threat of extinction. An established captive population of P. p. orientalis displays much higher diversity than the wild population sample, but nearly all captive individuals are derived from a history of genetic admixture with the adjacent Chinese subspecies, P. p. japonensis. The conservation management implications of potential restoration/augmentation of the wild population with immigrants from the captive population are discussed.

Wambuguh O. 1998. **Local communities and wildlife: a spatial analysis of human-wildlife interactions in Laikipia district, Kenya**. Doctoral dissertation. University of California, Berkeley.
In Kenya, demand for land has led to agricultural development in former wildlife areas, but benefits to landowners are minimized by the damage caused by wild animals. This study of human-wildlife interactions in Laikipia District seeks to determine 1) how wildlife and livestock interact, 2) how wildlife affects agriculture, 3) how landowners feel about biodiversity conservation, and 4) the best land use options for landowners that will conserve biodiversity. The analysis used existing models relating 1) annual precipitation to primary productivity and 2) herbivore body weights to daily dry matter off-take. Wildlife abundance was assessed twice by aerial censuses in 1996. Livestock numbers were obtained from interviews, questionnaires, and existing data. Existing models were used to assess land use potential for wildlife utilization, and a Geographic Information System was used to illustrate spatial patterns. Results indicate that 1) over half of Laikipia may be underutilized by herbivores; 2) small-scale farms suffer extensively from wildlife and may not be sustainable without a source of irrigated water; 3) landowners favored countering wildlife problems by gleaning benefits from wildlife utilization, being compensated for damage, and practicing animal control; and 4) the most economic land use alternatives compatible with conservation combine animal husbandry and wildlife utilization with little or no crops. Approaches to encourage biodiversity conservation include negotiating with landowners, promoting biodiversity education, developing local institutions, offering incentives, fostering derivation of tangible wildlife benefits, and incorporating adaptive management strategies.

Wegge, P. 1997. **Preliminary guidelines for sustainable use of wild caprins**. Pages 365-372 *in* Shackleton, D. M. editor. Wild sheep and goats and their relatives. Status survey and conservation action plan for Caprinae. IUCN. Gland. Switzerland.
Consumptive use through local subsistence and

trophy management can contribute significantly to the conservation of wild caprin species. There are two main reasons for this; First, subsistence hunting may contribute to conservation because it meets traditional needs by local people. Alienating local communities from traditional resource use may otherwise lead to uncontrolled illegal harvesting and habitat deterioration. Second, trophy hunting, because of its unique customer base, may generate substantial revenues which can be used for local conservation purposes and local community benefits. At the same time, trophy hunting requires a high quality animal population base, which again is only maintained if habitats are maintained and other negative impact are closely controlled. Within limits set by ecological and demographic characteristics of the species and populations to be harvested, low level off-takes of 20 to 25 % of all trophy size males (usually <4% of the total pre-harvested population) and up to 5% of all adult females, may be harvested each year without negative effects on population viability. The general prerequisites for implementing a consumptive utilization of the program are: (1) prior to and after setting hunting quotas, populations are regularly (e.g. annually) monitored through appropriate census techniques, (2) Local communities are involved in the decision making process and benefits from hunting programs, (3) professional hunting operations are given long-term lease contracts in specified areas and levied fees which allow for and promote sustainability of operations, (4) trophy hunting operations are under government supervision and harvested animals are inspected and measured for monitoring purposes and (5) tangible and effective benefits for the taxon, its habitat and other members of the ecosystem accrue from hunting.

Wikramanayake, E.D., E. Dinerstein, J.G. Robinson, U. Karanth, A. Rabinowitz, D. Olson, T. Mathew, P. Hedao, M. Conner, G. Hemley and D. Bolze. 1998. **An ecology-based method for defining priorities for large mammal conservation: The tiger as case study.** Conservation Biology 12:865-878.

To facilitate the best use of limited conservation resources, researchers created an objective, ecology-based method for identifying priority areas for conservation that incorporates both habitat representation and landscape-level features. Using tigers as an example, the method captures the range of ecological habitats where they occur, accounting for ecological, demographic, genetic, and behavioral differences. The analysis is hierarchical. Researchers divided the tiger range into distinct bioregions and identified tiger habitat types within each. They then delineated tiger conservation units throughout the bioregions and ranked the units based on habitat integrity, poaching pressure, and tiger population trends. To maintain representation of tiger populations and their ecology in the different tiger habitats, they made comparisons only among tiger conservation units from the same tiger habitat types nested within the same bioregion. They identified 159 tiger conservation units in three bioregions - the Indian subcontinent, Indochina, and Southeast Asia. They ranked the units in three categories that reflect the probability of long-term persistence of tiger populations (highest in level I units). Twenty-five tiger conservation units were classified as level I, 21 as level II, and 97 as level III. An additional 16 tiger conservation units for which little information is available were identified for immediate surveys. Levels I, II, and those identified for immediate surveys are the priority areas for immediate funding and for a regional tiger conservation strategy. One feature emerging from the study showed that protected areas cover only small areas of tiger conservation units. If the long-term prospects for tiger conservation are to improve, poaching must be stopped and protected areas increased in number, linked, and buffered by natural habitats. To enhance landscape integrity, the priority tiger conservation units that straddle international borders should be managed as transboundary reserves, giving tiger conservation a stronger regional structure. Like tigers, populations of other wide-ranging mammalian carnivores and large herbivores also are declining due to poaching and loss of habitat. The method presented for tigers can be adapted readily to improve conservation strategies for these species as well.

Wilson, G. J. and R. J. Delahay. 2001. **A review of methods to estimate the abundance of terrestrial carnivores using field signs and observation**. Wildlife Research 28(2):151-164.

This paper reviews field methods for estimating and monitoring the abundance of terrestrial carnivores that do not involve capture. Effective methods of monitoring abundance are important tools for the management and conservation of many species. The development of methods for carnivores presents particular challenges, as they are often secretive and widely dispersed. Nevertheless, a variety of approaches based on direct observations and quantification of field signs have been employed. These techniques are described in relation to carnivore ecology and resource implications, and the advantages and deficiencies of each are discussed with reference to case studies.

Woolf, A., C. K. Nielsen, T. Weber, and T. J. Gibbs-Kieninger. 2002. **Statewide modeling of bobcat, Lynx rufus, habitat in Illinois, USA.** Biological Conservation 104:191-198.

We used sighting location and remotely sensed habitat data, multivariate statistical techniques, and a geographic information system to model bobcat (Lynx rufus) habitat in Illinois, thereby providing state wildlife managers with information to review the listing of bobcats as a state-threatened species and contribute to the development of a statewide management plan. We used canonical discriminant function analysis to model presence/absence

and relative abundance of bobcats statewide. These models suggested that bobcats occurred in moderate to high abundance in 23 of 98 counties statewide (23%). We used stepwise logistic regression (SLR) analysis to model statewide habitat suitability. Spatial modeling of the SLR equation predicted that 29% of Illinois contained suitable habitat classified as P > 0.50. Models were accurate when validated with an independent data set and indicated the importance of woods-related habitat variables to bobcats. In conclusion, these models provided tools to rapidly assess status that contributed to delisting bobcats as a threatened species in Illinois and provided further information to guide conservation efforts.

Zahler, P. and P. Graham. 2001. **War and wildlife: The Afghanistan conflict and its effects on the environment**. International Snow Leopard Trust Special Report: 1-13.
In the months leading up to the recent conflict in Afghanistan the United States and its allies focused discussion and planning on the political and, to a lesser degree, the humanitarian issues of the pending war. Little consideration was given to the effects on wildlife or the environment. The report brings attention to the looming international environmental disaster and specifically the cost of ignoring the link between environmental degradation and political/economic instability. Immediate effects of the war were thought to include increased poaching of wildlife for food and loss of wildlife to bombing and land mines. Long-term effects include movement of wildlife into marginal habitat to avoid active conflict areas, influx of refugees, increased habitat fragmentation, loss of legal and physical protection of parks and reserves, and collapse of infrastructure that supports conservation (NGOs, government agencies, scientific institutes, etc.). Mitigation measures are suggested and include establishing a clear link between sustainable livelihoods and the environment.

Zhang, E., G. B. Schaller, L. Zhi and H. Zhang. 2002. **Tiger predation on livestock in Gedang, Medog, Southeast Tibet, China.** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.
Medog County holds the last remnant tiger population in Tibet. From May to June, 2000, we conducted a survey in Gedang Xiang, the only place where losses of livestock to tigers are high. The xiang's cattle population dropped by 11% in 1990s. In 1999, the xiang lost 7.8% of its cattle and 1.9% of its horses to tiger predation. A total of 21 households were interviewed. Of these a household lost on average 0.8 cattle and 0.2 horses during the previous 12 months; nine households had no losses. One reason that tigers are tempted by livestock is lack of sufficient wild prey. Widespread illegal hunting has greatly reduced tiger's principal prey populations. Until recovery of wildlife populations, an effort must be made to reduce tiger predation on livestock. Conservation recommendations were as follows: 1) villagers should herd and guard their animals cooperatively instead of permitting livestock to wander untended, 2) overgrown abandoned fields, slopes covered with tall bracken fern, and thickets near villages should be cleared and converted to open pastures to remove cover in which tigers can hide, and 3) Some animals could also be housed in stalls, especially in winter when much of the predation occurs.

Zimmermann, A. 2002. **Attitudes of ranchers in brazil's pantanal to conflicts with jaguars.** Presentation at 2002 Society for Conservation Biology Annual Meeting, Canterbury, UK.
In many parts of the world, human-wildlife conflict is an economic, social and conservation problem for which solutions are difficult to find. The jaguar, Panthera onca, is threatened by habitat loss and persecution throughout its range in Latin America. The Pantanal of Brazil is a region of widespread traditional cattle raising where jaguar-rancher conflict is common and presents a serious threat to both jaguars and the well being of the human community. This study used a questionnaire survey to determine ranchers' attitudes to jaguar depredation patterns, to conservation and protected areas, including sustainable use, tourism, education and incentive measures. The results showed the potential of ranchers as advocates and facilitators of regional conservation programmes, and indicate that ranchers share a strong inherent appreciation of their local natural heritage. Hence, a strategy for jaguar-rancher conflict resolution needs to be based on incentive measures and rewarding schemes. Compensation, translocation and similar approaches are not recommended, while trophy hunting may prove a useful tool in the future but requires further investigation.

Snow Leopard Survival Strategy

This Snow Leopard Survival Strategy (SLSS) was undertaken to provide comprehensive conservation and research guidelines to ensure a range-wide coordinated effort in the fight to save the endangered snow leopard. The Strategy would be arrived at after a thorough analysis of the threats facing the species, the potential conservation actions to address those threats, and determination of the information needs. The SLSS will then be taken back to the range-countries for further review and input at the local level after which area specific action plans can be developed based on the guidelines of this Strategy. The target users of the SLSS are range-country policy makers and natural resource managers, conservation biologists, development specialists, researchers, and students, any of who are engaged in, or contemplating, snow leopard studies and conservation programs.

International Snow Leopard Trust

Snow Leopard Network

International Snow Leopard Trust / Snow Leopard Network
4649 Sunnyside Ave. N. Suite 325,
Seattle, WA 98103, USA

Available at:
http://www.snowleopard.org/sln/
http://www.carnivoreconservation.org/snowleopard/