CONSERVATION OF LEOPARDS IN AYUBIA NATIONAL PARK, PAKISTAN

By

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Professional Paper

presented in partial fulfillment of the requirements
for the degree of

Master of Science
in Wildlife Biology

The University of Montana
Missoula, MT

Spring 2007

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Conservation of leopard in Ayubia National Park, Pakistan

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Large carnivores are important for biodiversity and ecosystem function, yet are very difficult to conserve because of their large home ranges and conflicts with humans. I examined human-leopard conflicts in and near Ayubia National Park, Pakistan, to provide management recommendations for the conservation of leopards. Persecution of leopards by humans has been on the rise primarily due to depredation on livestock and risk to human lives. Since 1989, 16 humans have either been killed or injured in and around Ayubia National Park while leopards faced 44 human-caused mortalities during the same period. I examined the management strategy adopted by NWFP Wildlife Department for leopard conservation, identify gaps, and suggest possible management actions to mitigate the conflicts. For this purpose, I reviewed the management of carnivores including mountain lions, wolves, and grizzly bears to learn from management successes and failures in North America. Based on my review, I make the following recommendations to improve leopard management in and near Ayubia. First, to minimize human-leopard conflicts, educational and information programs to modify human behavior to reduce risks should be developed. Second, predator compensation programs and livestock vaccination programs would help reduce livestock conflicts. Lastly, broader scale management changes such as enhanced protection of areas surrounding Ayubia National Park, re-introduction of extirpated native ungulates as prey for leopards, and improvements in monitoring could benefit leopard conservation.

ACKNOWLEDGEMENTS

All praise is for Allah subha na'u ta'ala for giving mankind the wisdom and intelligence to understand, appreciate, and peacefully co-exist with other creations. I consider myself fortunate for having Dr. Daniel H. Pletscher as my advisor. He extended all possible encouragement, guidance and support to me during entire course of studies. I am also grateful to my committee members, Dr. Kerry Foresman and Dr. Mark Hebblewhite for their technical support and friendly advice and cooperation.

I would like to highly appreciate Dr. Muhammad Mumtaz Malik, Chief Conservator Wildlife NWFP Wildlife Department, for his role as mentor, tutor and sincere supervisor. All credit goes to him for initiating wildlife conservation efforts in NWFP and building a team of technically sound officers through human resource development program. I also thank the entire faculty, staff and my fellow students in Wildlife Biology program who always extended a helping hand and have been courteous during my stay in Missoula. I also take this opportunity to extend my deepest gratitude to my colleagues back home including Messrs. Iqmail Hussain Shah, Malik Nazir, Saeed-uz-Zaman, Mubarik Ali Shah, Safdar Ali Shah, Mohsin Farooq, Muhammad Arif, Abdul Faraz and Muhammad Ali for their sincere prayers and well wishes. I am thankful to Mr. Ashiq Ahmad Khan, CTA, WWF-Pakistan for providing information and technical assistance whenever I needed during the course of completion of this paper.

I thank all my friends in Missoula including Todd, Kerry, Ryan, Khalid, Elliott, Joynel, Jesse, Saleh, Athar, Manish, Krishna, David, Adnan, Ayaz, Niaz, Iftikhar, and Sajjad for their friendly encouragement and support. Frankly, it would have not been possible for me to timely complete my paper without the help of my Pakistani colleagues who continuously provided me with fertile ideas, suggestions and proof reading multiple drafts.

I extend my heartfelt thanks to all those who have always stood behind me and wished me success and whose names could not have been mentioned. Shoaib, Tahir, Dawlat, and Liaqat are among those who always came up whenever I needed help and I feel indebted to all of them.

Last but not the least, I acknowledge the support of my family who always gave me hope in future and confidence in myself which has been a driving force throughout my life. I wish my well-wishers all the happiness and satisfaction both in this life and hereafter for their prayers. I would like to dedicate this work humbly to my father, Asghar Ali Lodhi, who is a source of inspiration and a role model to me.

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I. INTRODUCTION

Large carnivores are integral parts of ecosystems because of their ecological roles through both direct and indirect interactions. For example, wolves (*Canis lupus*) in the Greater Yellowstone Ecosystem (GYE) may indirectly benefit plant populations through direct control of herbivore populations (Ripple et al. 2001). Ecologically, reduction in the top trophic level in the ecosystem may bring dramatic imbalance to the ecosystem (Miquelle et al. 2005). Because overabundant herbivore populations can have large impacts on plant species diversity, richness, and performance (Alverson et al. 1988, Rooney and Waller 2003, Rooney et al. 2003, Cote et al. 2004, Allombert et al. 2005), loss of top predators such as leopards (*Panthera pardus*) may have unpredictable effects on ecosystem dynamics.

Despite their important ecosystem role, carnivores are difficult to effectively conserve because they are wide ranging, requiring the protection of large wild areas (Gros et al. 1996). However, expansion of human populations and over-utilization of living natural resources have caused the extirpation of many species of large carnivores that require large home ranges and have low reproductive rates and densities (Kenny et al. 1995, Noss et al. 1996, Purvis et al. 2000, Gittleman et al. 2001). Human tolerance for large carnivores can also be low. In some areas, large carnivores kill not only livestock but also jeopardize the lives of people living near them. The conflict between people and wildlife and particularly with large carnivores has recently been identified as a threat to wildlife and their habitats (Gittleman et al. 2001).

Conflict between wildlife and humans is a major problem throughout the world (Distefano 2005). Where human and large carnivore populations overlap, three types of conflicts are common: carnivores kill livestock and sometimes people; prey populations are depleted from over-exploitation by humans, leading to declines in carnivore populations; and human-caused mortality of carnivores (Johnson et al. 2006). Conflicts between humans and predators arise most often because of competition for shared, limited resources. The conflicts can be particularly controversial when the resources concerned have economic value and the predators involved are legally protected (Graham et al. 2005). Poaching and habitat fragmentation through human developments have led to near extinction of the Far Eastern leopard (*Panthera pardus orientalis*) in the wild in Russia, China, and Korea (Uphyrkina and O'Brien 2003). Martins and Martins (2006) have also listed habitat loss, reduction in prey, and heavy persecution by farmers as key threats to leopard survival in the mountainous regions of the Western Cape in South Africa. Fragmentation and isolation of geographic ranges often result in restriction of wide-ranging movements of leopards and leading to conflicts with humans (Fergus 1991, Mizutani 1999, Seidensticker et al. 1999). Mammalian carnivores are particularly vulnerable to local extirpation in fragmented landscapes because of increased direct contact with and persecution by humans (Noss et al.1996, Woodroffe and Ginsberg 1998, Crooks 2002, Martins and Martins 2006).

The large home ranges of felids relative to the size of protected areas often draw them into conflict with humans (Michalski et al. 2006). I have adopted

IUCN definitions for the terms “protected areas” and “national parks”. “A protected area is an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means” (IUCN 1994:5). Any area which is specifically managed or protected for the purposes of biodiversity conservation thus falls into the category of protected areas. A national park is a sub-category of protected areas managed mainly for ecosystem protection and recreation. Protected areas, where natural processes and population dynamics may occur with minimal modern human influence, play a vital role in conserving wildlife populations (Doak 1995, Noss et al. 1999). Conflicts between local people and wildlife in many parts of the world have been reported where people are living in or adjacent to the protected areas (Newmark et al. 1994). People living with wildlife can bear conflicts with species from which they gain. But people living in and near protected areas often cannot afford the damage caused by predators because they do not get any tangible economic benefits from large carnivores (Berger 2006).

Livestock killing by mammalian carnivores is one of the most frequent sources of conflict between humans and wildlife throughout the world and is common in and around protected areas in the developing world (Distefano 2005). Because of the important ecosystem role of carnivores, such conflicts pose a significant conservation problem for protected areas. People who are affected may react through persecution of carnivores, resistance to the declaration of protected areas, and opposition to the reintroduction of extirpated carnivores.

These perceptions hinder the conservation of rare and threatened species and contravene the public and political aims of large carnivore management (Graham et al. 2005). For example, the active persecution of leopards by humans for livestock depredation is the main cause of the decline of the leopard populations in Kenya (Mizutani and Jewell 1998, Kolowski and Holekamp 2006).

To make matters more complex, an increase in predation on livestock often occurs following establishment of protected areas because carnivore populations are protected from persecution as reported from India, Tibet, Nepal, Bhutan, and Mongolia (Saberwal et al. 1994, Oli et al. 1994, Studsrod and Wegge 1995, Mishra 1997, McCarthy 2000, Maikhuri et al. 2001). The future of most protected areas hinges on the degree to which local people's concerns, needs, and aspirations are addressed by conservationists (Jackson et al. 1996, Wangchuk and Jackson 2001). Border zones of protected areas may be population sinks where conflict with humans is the major cause of mortality (Woodroffe and Ginsberg 1998, Distefano 2005). However, even within protected areas, humans often kill carnivores because of conflicts with nearby human populations (Kenny et al. 1995, Jackson et al. 1996, Kolowski and Holekamp 2006); this is especially common when those protected areas are small.

For example, Wang and Macdonald (2006) studied livestock depredation in Jigme Singye Wangchuck National Park in Bhutan by carnivores including leopards (*Panthera pardus)*, tigers (*Panthera tigris*), and Himalayan black bears (*Ursus thibetanus);* they reported that predators attacked livestock that are grazed in, or close to, forest areas. They also reported increased depredation

since the creation of the park in 1993 and enforcement of conservation laws. Butler (2000) reported similar cases in Zimbabwe where lions and leopards attacked cattle at night, with an average annual loss per household equivalent to 12% of the total family's income. Vijay and Pati (2002) reported that lions (*Panthera leo*) and leopards have strayed outside Gir National Park (Gujarat, India) to hunt prey such as domestic buffaloes, cows, pigs, and dogs. Saberwal et al. (1994) reported persistent attacks on humans by lions in the Gir forest in Gujarat that hinder support among the local people for lion conservation.

Human-carnivore conflict has a negative impact on carnivore populations because of retaliatory killings. On the other hand, the people living in and around carnivore habitat have also suffered in the form of loss of livestock and sometimes-fatal human attacks. Pakistan has been facing increased human and livestock killings by leopards during the last few years. While efforts have been made to mitigate the situation and ensure that such conflicts are minimized, the problem has never been systematically studied. Increased frequency of leopard-human conflicts raises questions of whether and how dispersing populations of leopards and humans will coexist and what factors regulate the leopard population. What is being done in India and North America for management of similar species? What can be learned and adapted for use in Pakistan? I will review similar species and human conflict in other areas in an endeavor to identify broader guidelines to handle the problem from an ecological and social perspective. Conservationists have been working in other parts of the world on many options to reduce leopard-human conflicts through compensation, proper

zoning of habitats, and promotion of eco-tourism. In endangered species conservation, diagnosing the factors that affect population dynamics is imperative because recovery is dependent upon recognizing the conditions that caused a species to decline (Mills 2007). Therefore, in this professional paper, I will focus on i) a review of human-leopard conflicts in Ayubia National Park, Pakistan; ii) the existing management of leopards and natural resources in Ayubia National Park; iii) management strategies adopted for large carnivores such as mountain lions (*Puma concolor*), gray wolves (*Canis lupus*), and grizzly bears (*Ursus arctos*) in North America; and iv) recommendations for the management and conservation of leopards in Pakistan.

II. INTRODUCTION OF AYUBIA NATIONAL PARK

Study area

Ayubia National Park lies between $34^{O}00'48''$ and $34^{O}06'23''$ N latitude and $73^{O}22'54''$ and $73^{O}27'15''$ E longitude in the Reserved Forests of Galiat, North West Frontier Province (NWFP), Pakistan. (Figure 1). The national park core area is spread over 33 square kilometers; surrounding reserved forests cover an area of 150 square kilometers. The Park is comprised of sub-alpine meadows, moist temperate forests, and the sub-tropical pine forest ecotype. The purpose of the Park is to conserve the unique flora and fauna of the moist temperate western Himalayan ecosystem. The leopard had become extremely rare by early 1980s and had reached the verge of extinction in Galiat and adjoining areas,

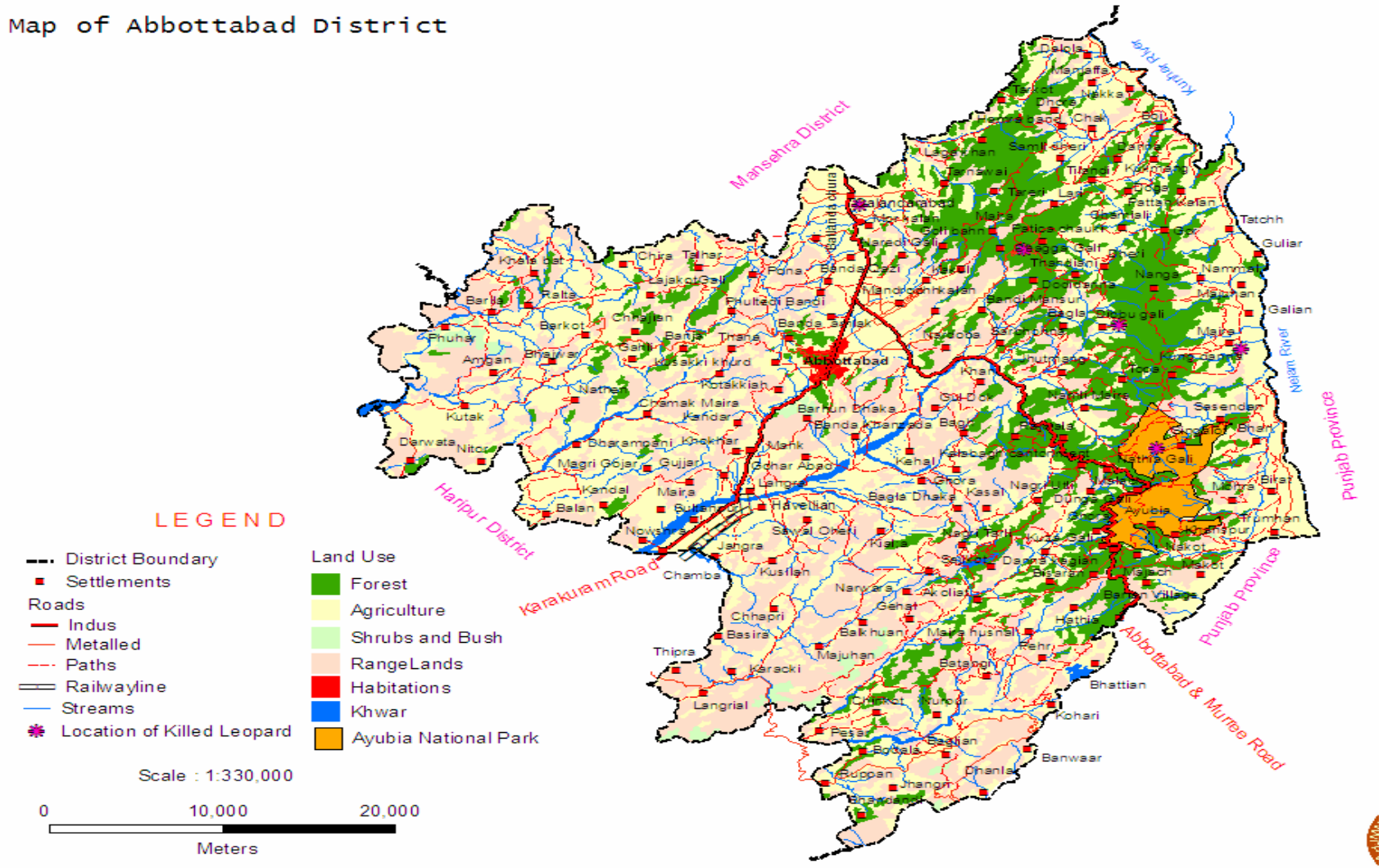

Figure1: Map of Abbottabad district showing settlements and Ayubia National Park, Pakistan

however the establishment of this national park provided protection to leopards in the Galliat.

The Park is bounded on the north by Namli Maira and Phalkot Reserved Forests while portions of Bakot, Darwaza Reserved Forests, and the village of Khanuspur lies in the south. Birot Reserved Forest and Lahur village lies in the east, whereas Bagh Reserved Forest and villages of Kalabagh, Nathiagali, Kundla, and Tohidabad lie to the west of the Park. The land tenure system describing reserved and guzara forests is shown in 1.The communities are dependent on resources of Park and Reserved Forests for fuel wood collection, livestock grazing, and timber. The Park headquarters is at Dungagali, 34 km southeast of Abbottabad and 30 km west from the famous hill resort of Murree. The Park is approachable via road running from Abbottabad to Murree. At the time of establishment of the park in 1984, its total area was 1684 ha, but it was extended to 3322 ha in 1998.

The altitudinal variation ranges from 1050-3027 m; the Park receives a mean annual rainfall between 1065 - 1424mm and snowfall between 1-2.5 m. Ayubia National Park has approximately 200 species of birds, 31 species of mammals, 16 species of reptiles, 3 species of amphibians, 23 species of butterflies, and 650 described species of insects (ANP Management Plan 2002). The dominant vegetation includes *Pinus wallichiana* (Blue pine), *Abies pindrow* (Fir); mixed within these coniferous tree species are scattered broad-leaved tree species such as *Aesculus indica* (Horse chestnut – Ban Khor)*, Quercus dilatata*

Box 1: Land Tenure System

The main villages around Ayubia National Park include Mallach, Pasala, Moorti, Kuzagali, Darwaza, Riala, Lahur kas, and Khunkhurd with a total population of approximately 18,000 people (ANP Management Plan 2002). The inhabitants of these villages were issued over 2000 citations for various wildlife offenses including fodder and fuelwood collections during 1993-98 (ANP Management Plan 2002).

The land tenure system of the areas has been reported in detail (ANP Management Plan 2002). Annexation of this area to British rule in 1847 empowered the Government to promulgate rules to set apart any area to grow trees. The Government adopted rules in 1850s to manage forests by regulating tree cutting, cattle trespassing, or limiting extension of agricultural fields into the forests in any area, if considered necessary for forest regeneration.

Forests were classified as Reserved Forests and Public Wasteland (Guzara) Forests in the 1870s. In the Reserved Forests, all acts were prohibited unless specifically permitted by the Government. People did not have any rights in the reserved forests, however concessions could be granted for restricted grazing, fuelwood collection, and lopping of broad-leaved species. Guzara Forests were left for public use around the Reserved Forests to provide for the needs of local people. People have rights in Guzara, however they need a permit from the Forest Department for timber cutting for construction purposes. The rights of community people have been settled and recorded in the village administration document (Wajibul Arz). The right holder is entitled to get timber free of cost for construction purposes in addition to firewood, grazing, grass-cutting, and lopping privileges. Areas set aside as Guzara Forests were adequate to meet local requirements of fuelwood and timber until the beginning of twentieth century, which witnessed a human population explosion in these areas.

Reserved Forest is located mainly on ridges and has been divided into 4 ranges, Abbottabad, Kalabagh, Dunga Gali, and Thandiani (Fig 7) over an area of 15,716 ha (15% of Galliat area). Besides Reserved Forests, the Forest Department also manages the Guzara Forests covering an area of 8224 ha. In case of any commercial sale of timber from Guzara, Government gets only 20% as administrative charges.

Areas of 452 ha and 279 ha were carved out as Cantonment Forests and Location Forests, respectively, from Reserved Forests in 1878. Cantonment Forests are under the management of the Cantonment Board for military purposes and some areas have been fenced. Location Forests were set aside for construction of offices, residences, hotels, and tourism facilities.

Since the 1920s, the Government through the Forest Department regulates grazing, grass-cutting, and collection of dry fallen wood in the Reserved Forests through a system of permits and lease. However, free illegal grazing and fuelwood collection is a common practice as the field staff of the Forest Department is primarily concerned with illegal harvesting of timber only. A portion of the Reserved Forest was declared as Ayubia National Park in 1984 and all the concessions within the park area were withdrawn. Moreover, the staff of Wildlife Department was more vigilant in checking illegal grazing and fuelwood collection which created a feeling of resentment against the Wildlife Department among the people.

(Holly Oak), *Ulmus wallichiana,* and *Prunus padus* (Bird Cherry - Kalakat). Other tree species include *Picea smithiana* (Spruce), *Taxus wallichiana* (Yew), *Acer ceasium* (Maple), and *Populus ciliata* (Palach). *Cedrus deodara* (Deodar), an introduced species, is now regenerating naturally in the area.

The leopard has now been reported from all over Galiat from Turnawai forest in the north to Murree hills in the south and Margalla hills in the west. Figure 2 shows the locations of leopard sightings by wildlife department staff around Ayubia National Park in 2005. Key elements of faunal diversity for leopard conservation in the park includes *Pucrasia macrolopha* (Koklass pheasant), *Lophura leucomelana* (Kalij pheasant), *Macaca mullata* (Rhesus monkey), *Petaurista petaurista* (Giant Indian flying squirrel), *Hylopetes fimbriatus* (small Kashmir flying squirrel), *Martes flavigula* (Yellow-throated Marten), and *Hyperacrius wynnei (*Murree Vole). During the last five decades, four mammalian species including *Selenarctos thibetanus* (Black Bear), *Moschus moschiferus* (Musk Deer), *Naemorhedus goral* (Grey Goral), *Muntiacus muntjak* (Barking Deer) and one bird species, Monal pheasant, have been reported extinct from the area. Though no study has been done to determine the causes leading to these extinctions, direct persecution by human beings and habitat change are the main causes reported in the recently compiled management plan for the park (ANP Management Plan 2002).

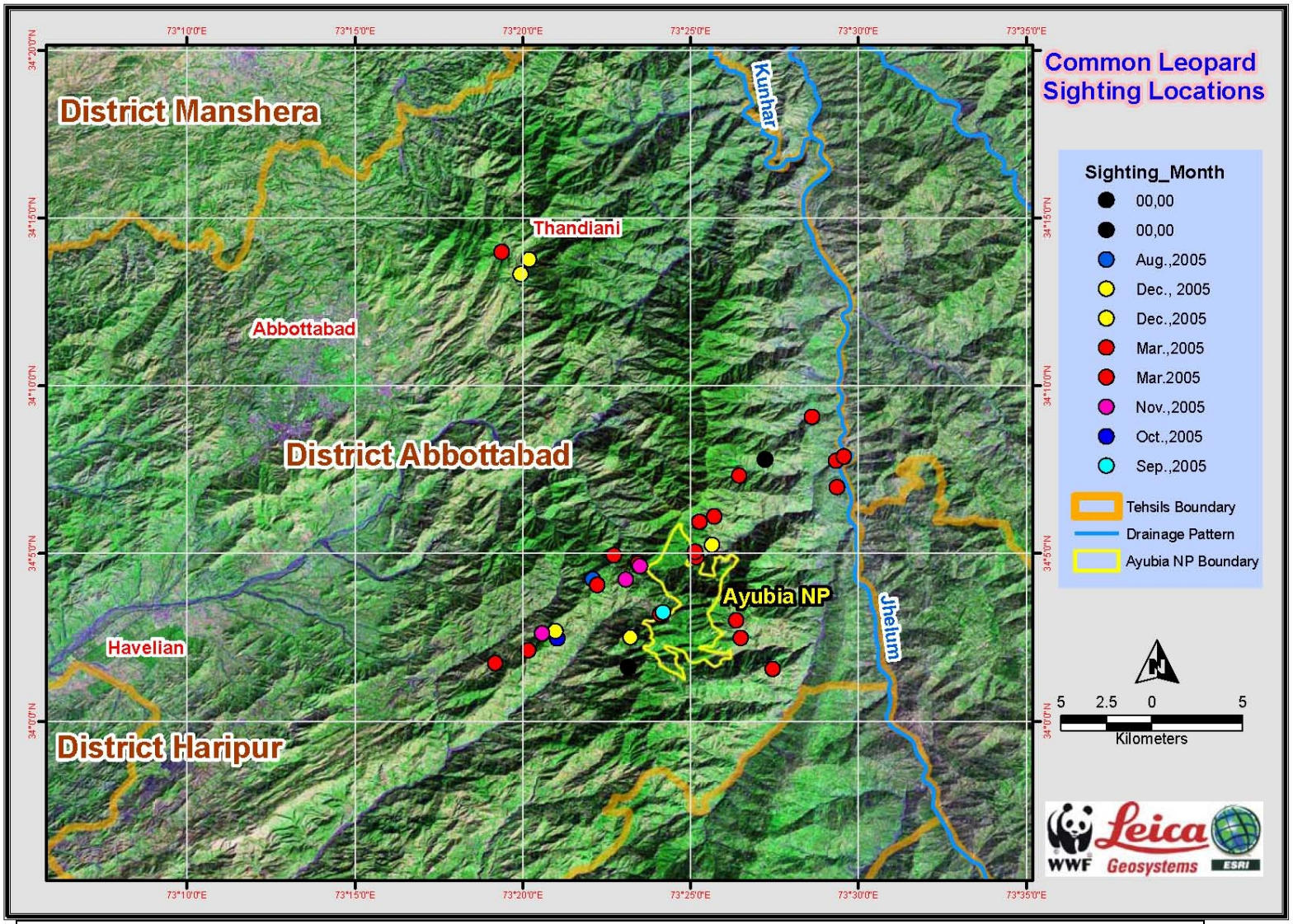

Figure 2: Locations of leopard sightings during 2005 around Ayubia National Park,Pakistan

Natural History

Leopards are listed as endangered in the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) Appendix 1. Leopards are among the most widely distributed large cats worldwide, and are found throughout Africa and Asia (Al-Johany 2007). In Asia, leopards occur throughout Sri Lanka, Malaysia, Burma, southern China, India, Pakistan, and the Middle East. In Pakistan, leopards are found in the Himalayan forest regions up to the tree line and in lower altitude valleys in more arid mountainous regions. Despite their worldwide distribution, many leopard populations are locally threatened and endangered because of human persecution.

The leopard is the top predator of Ayubia National Park. It is found in the entire park except for the exposed peaks of the Mukshpuri and the lower altitudes near Lahur Kas. During previous surveys conducted by NWFP Wildlife Department (1997), the distribution of this species was assessed from leopard scats, scrapes, scent marks, and pug marks, which were recorded throughout the Park. These signs were observed along the trails and pathways as well as at the bases of cliffs. The animal has also been frequently reported crossing the metalled roads around the National Park in Dungagali, Nathiagali, and Kalabagh. Road crossings have often been reported between Kuzagali and Ayubia in Darwaza Forests, between Dungagali and Tohidabad in Bagan Forest, between the Dungagali and Murree water supply tanks, and around the Governor’s House in Nathiagali (Malik 1999) (Figure 2).

Ayubia National Park is likely too small in size to harbor large numbers of leopards because average home range sizes are equal to or larger than the size of the park. For example, Karanth and Sunquist (2000) found that home range sizes (measured using minimum convex polygons (MCP)) of leopards in Nagarahole, India, ranged from 17 to 26 square kilometers. Nearby in Nepal, Odden and Wegge (2005) found that leopard home ranges were approximately 48 square kilometers for male leopards and 17 square kilometers for females. Odden and Wegge (2005) compared their home ranges to those of African leopards and concluded that south Asian home ranges were much smaller. These studies emphasize that the size of Ayubia National Park at 33 square kilometers is likely too small to be home to a self contained population of leopards. Therefore, leopard conservation will also rely on areas surrounding Ayubia National Park.

Hayward et al. (2006) reviewed over 30 studies of leopard diet from Asia and Africa to determine preferential prey species body mass and found that leopards prefer to prey upon species weighing between 10 and 40 kg. Seidensticker (1983) reported that leopards in south Asia prey upon monkeys only when larger prey species are rare. Ramakrishnan et al. (1999) observed in India that leopard prey typically range from a few hundred grams (e.g. rodents) to over 100 kg with a preferred weight being between 20-50 kg. Preferred prey species like ungulates occur in small herds in dense habitat (Hayward et al. 2006). Like the mountain lion, leopards are adapted to kill large prey but may depend largely on locally abundant small prey in difficult times (Hayward et al.

2006). Leopards in Pakistan feed on a variety of prey including several species of wild mammals, birds, and reptiles; food habits depend upon the place of occurrence and availability of prey (Roberts 1977). In Ayubia National Park, the main prey of leopard is the Rhesus macaque (*Macaca mulatta)* (Roberts 1977).

Leopards readily kill livestock in addition to wild prey when opportunities arise (Meriggi and Lovari 1996, Karanth et al. 1999, Michalski et al. 2006). Livestock killing is a worldwide problem. For example, wolves and bears (*Ursus* spp.) kill sheep and cattle in North America and Europe (Kaczensky 1999), mountain lions and jaguars (*Panthera onca)* kill cattle in South America (Polisar et al. 2003), numerous carnivores kill cattle and goats in Africa (Jackson and Nowelll 1996), and tigers (*P. tigris*) and Leopards *(P. pardus*) kill livestock in Asia (Karanth and Madhusudan 2002). Predation on livestock including cows, goats, and donkeys has been reported from the areas adjoining Ayubia National Park. Stray dogs from the surrounding villages are one of the most preferred prey species (Malik 1999).

III. COMMUNITIES AROUND THE PARK

Ayubia National Park, situated in the hilly tract of Galliat, is surrounded by local communities that are dependent on park resources for their subsistence. This can lead to resource depletion within the Park. Three small towns (Nathiagali, Ayubia and Khanspur) and 8 communities (Figure 3) are at the periphery of the Park (ANP Management Plan 2002).

Aumeeruddy-Thomas et al. (2004) reported a social assessment study on the dependence of local communities on Ayubia National Park conducted by WWF-Pakistan. This study focused on activities and impact of communities on park resources such as fodder and fuel wood collection in addition to the fodder production system in village suburbs. According to this study, about 6,000 households comprising 42,000 people use park resources mainly for fodder and fuel wood despite complete legal prohibition. In addition to these, the local people rear livestock as a major means of meeting dairy requirements. Therefore, grazing of livestock in the park is also common. Fodder and fuel wood consumption are regarded as the major causes of deforestation in the entire area. The local people consider the use of natural resources everywhere (including inside parks) as their right (as reviewed in Box 1). Many social advocates contest establishment of protected areas as they take away the property and rights of local people (Wilkie et al. 2006).

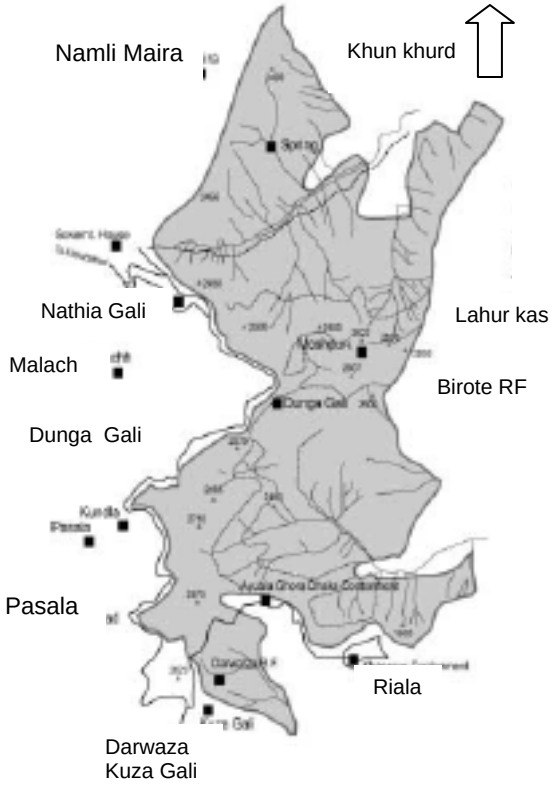

Figure 3: villages around Ayubia National Park

As a general practice, women go out in groups into the forests to collect or cut fuel wood that they use for their daily requirements for heating and cooking; they also store wood for the winter.

Though women prefer collecting deadwood, pruning of green branches and felling of small trees are also reported (Aumeeruddy-Thomas et al. 2004). Though *Quercus* and *Taxus* are good fuelwood species, women mostly collect *Abies* or *Pinus,* perhaps because they are lighter than greenwood and can be carried over long distances. *Quercus* is used as fodder and therefore women do not collect it for fuelwood. Grasses and forbs have also been collected in large quantity from April to September from small clearings in the park, which are clearly identified and bear specific names (Aumeeruddy-Thomas et al. 2004). Other resources collected from the park include medicinal plants, wild vegetables, and mushrooms. Similarly, people cut wood for building and repair of houses. Some of the adjacent areas designated as Reserved Forests or Guzara forests are now denuded lands or at best grasslands. In spring and summer, women collect grasses and tree fodder from within and outside the park area. According to Aumeeruddy-Thomas et al. (2004), the women usually bribe 50-200 rupees ($1-4) to the protection staff in the park for each bundle of fuelwood and 100-400 rupees ($2-8) for cutting down a small tree.

At higher altitude pastures such as Mukshpuri Top inside Ayubia National Park, oxen and buffaloes graze freely and are left unattended during summer time, which adversely affects regeneration of broad-leaved palatable species (Aumeeruddy-Thomas et al. 2004). Goats are not left grazing alone in the park for fear of leopards. Many researchers have reported that vulnerability of livestock to predation increases due to grazing in distant pastures (Jackson 1996, Mishra 1997, Sekhar 1998, McCarthy 2000, Wang and Macdonald 2006).

However, Aumeeruddy-Thomas et al. (2004) reported unrestricted grazing of cattle and goats outside the park in the reserved and guzara forests.

Farmers living around the park have usually small landholdings (0.25 to 0.50 ha) and usually have 1 or 2 domestic animals to meet their family's daily needs of milk. Farmers usually rear a cow, goat, buffalo, or horse. In winters (November to May), all animals are stall fed with residues of agricultural harvest and grass fodder from homestead areas. Broad-leaved trees inside the villages can be found without any regeneration due to free grazing of goats and cattle in the agricultural lands after harvesting of crops.

The boundaries of guzara (subsistence forests) and reserved forests are disputed by locals. Though people are allowed to collect deadwood freely in guzara, the Forest department has control over standing trees, which leads to debarking by local people to create more deadwood. Some influential groups also cut trees from the reserved forests (Aumeeruddy-Thomas et al. 2004). The empowerment of local communities in the guzara forests with clear management prescriptions may provide a potential alternative to reduce the pressure on the national park.

According to Aumeeruddy-Thomas (2004), the average weight of wood stored between mid-June and mid-September is 2,385 kg/household. A family around ANP collects 8,517 kg of fuelwood at an average from the forests during the snow-free months (May-October, Aumeeruddy-Thomas 2004). Any shortage is supplemented by agricultural residues. In summer, each family uses an average of 19.8 kg of wood per day, while use in winter use increases to 42.2 kg

per day. This highlights that one family needs 11,037 kg of fuel wood per year. Similarly, an average 50.9 kg of wood per day is consumed in summer by the 21 hotels surveyed, while in winter the consumption of wood per day is about 45.6 kg when open. This means that about 300,000 kg of wood with 14000 kg per hotel per summer season is consumed. The hotels use mostly *Quercus* and *Taxus* for cooking and heating. The vacation homes maintained by wealthy people for use during summer only use an average of 8.5 kg per summer day while in winter it's about 10,000 kg per house per year.

Blangy and Mehta (2006) found that local communities increasingly think of ecotourism as a prospective tool for promoting sustainable livelihoods. This study also found tourism increased by more than 100% between 1990 and 2000 in the world's biodiversity hotspots. The adverse effects of tourism result from park infrastructure and accommodation facilities (Blangy and Mehta 2006). Galliat tract offers great recreational resources, attracting tourists from far and near especially on hot summer days. According to the local estimates, 90,000-100,000 people visit Ayubia National Park per year (Aumeeruddy-Thomas 2004). Based on this, tourist facilities in surrounding areas in the form of vacation homes, hotels, and restaurants, in addition to the stores and shops, provide means of income generation for the local people who then put increased pressure on the forest resources for fuel wood. However, due to the large need for wood in the hotels and vacation homes, many of them buy wood or use propane. However, these more recent efforts to find alternative fuel sources are just starting, and extraction of wood for fuel from the park is a persistent problem

IV. TRENDS IN HUMAN- LEOPARD CONFLICT

The establishment of Ayubia National Park served to increase monkey, porcupine, and other small mammal populations and may have resulted in the increase in leopard population size. Because Ayubia and its surrounding areas are primarily used for tourism, shopkeepers feed monkeys along the roadside to attract tourists. Many garbage dumps around towns also attract monkeys. We do not know whether leopards follow monkeys to human dwellings and then also kill livestock and dogs or if they come near these dwellings in the pursuit of livestock as prey. Because of these complex relationships, leopards are regarded with a mixture of fear and contempt in Pakistan, and local communities persecute them whenever an opportunity arises.

This negative attitude has had an effect on leopard-human conflicts from data collected by the NWFP Wildlife Department in Pakistan (Figure 4).

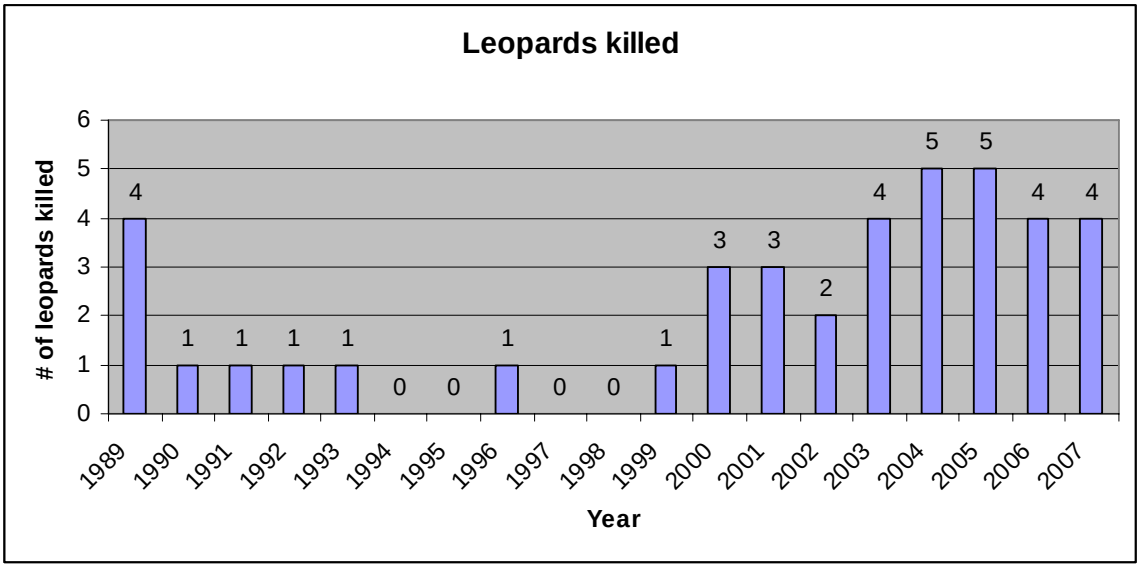

Figure 4: ***Leopards killed in NWFP since 1989***

People killed 44 leopards during the last 17 years either in self-defense or retaliation. Twelve humans were also killed by leopards during the same period (Figure 5).

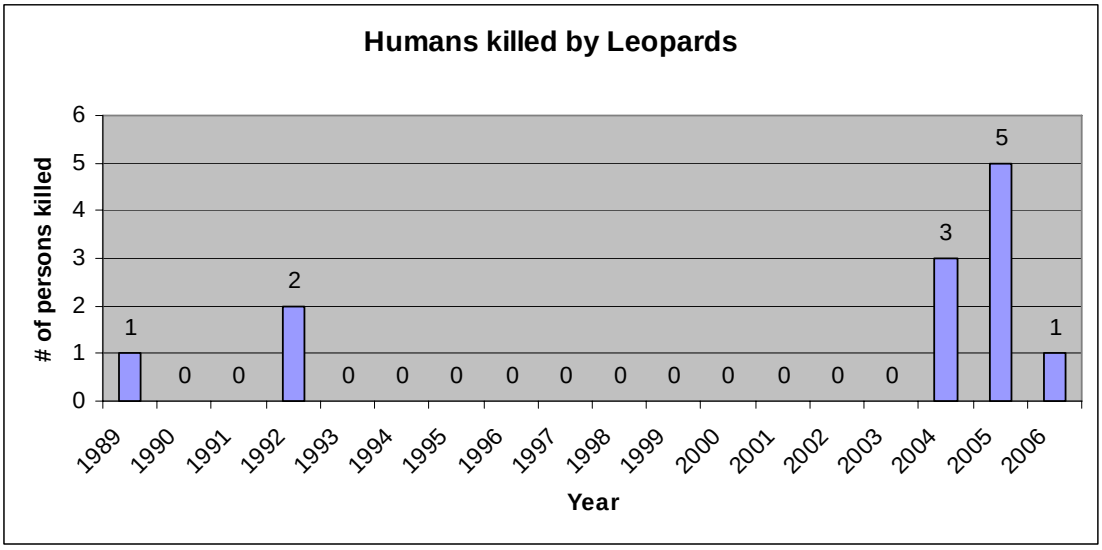

Figure 5: Humans killed by leopards since 1989

Unfortunately, a leopard or leopards killed five women who went into the forests for grass-cutting and fuel wood collection within a two week period in July 2005. Another woman was killed in 2006 under similar circumstances. At the same time, the communities demanded compensation for approximately 142 plus livestock kills by leopards (Figure 6).

Livestock damage complaints cannot always be termed reliable because some people do not lodge a complaint at all with the Wildlife Department because they knew that Government does not compensate for livestock losses. Another problem is that people sometimes exaggerate the numbers of livestock damage complaints with the hope of receiving more money from the Government, if possible.

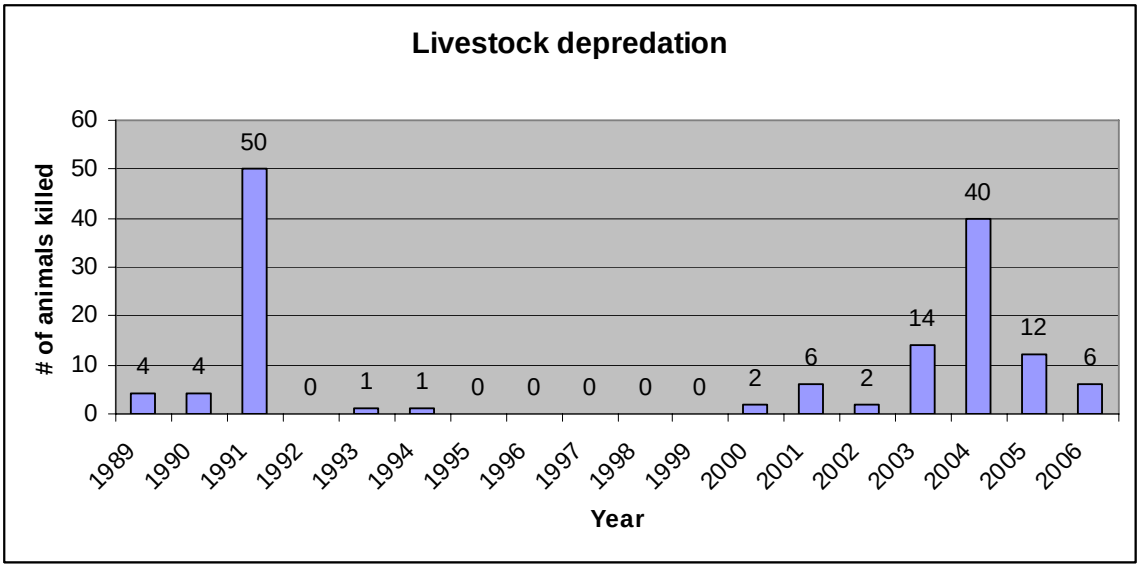

Figure 6: ***Livestock depredation cases reported since 1989***

The map at Figure 7 shows the sites of human and livestock killing/injury by leopards in 2005 in the districts of Abbottabad and Mansehra. Until recently, neither the government or conservation organizations compensated for the damages caused by leopards. For the first time in 2006, however, the Pakistani Government paid $1666 (U.S) for each human life lost due to leopards in 2005. Local communities do not look upon the conservation of leopards favorably.

According to Wang and Macdonald (2006), human-wildlife conflicts become heightened when the species involved is endangered or where the conflict poses a serious threat to human welfare. The attitude toward leopards became more hostile in Ayubia National Park following the killing of 5 women near the park in July-June 2005.

The situation was extremely alarming and concern arose in the media. The wildlife department sent messages to all the villages surrounding Ayubia National Park that they had legal permission to shoot the leopard in defense of human lives and in protection of livestock outside the park. The local people

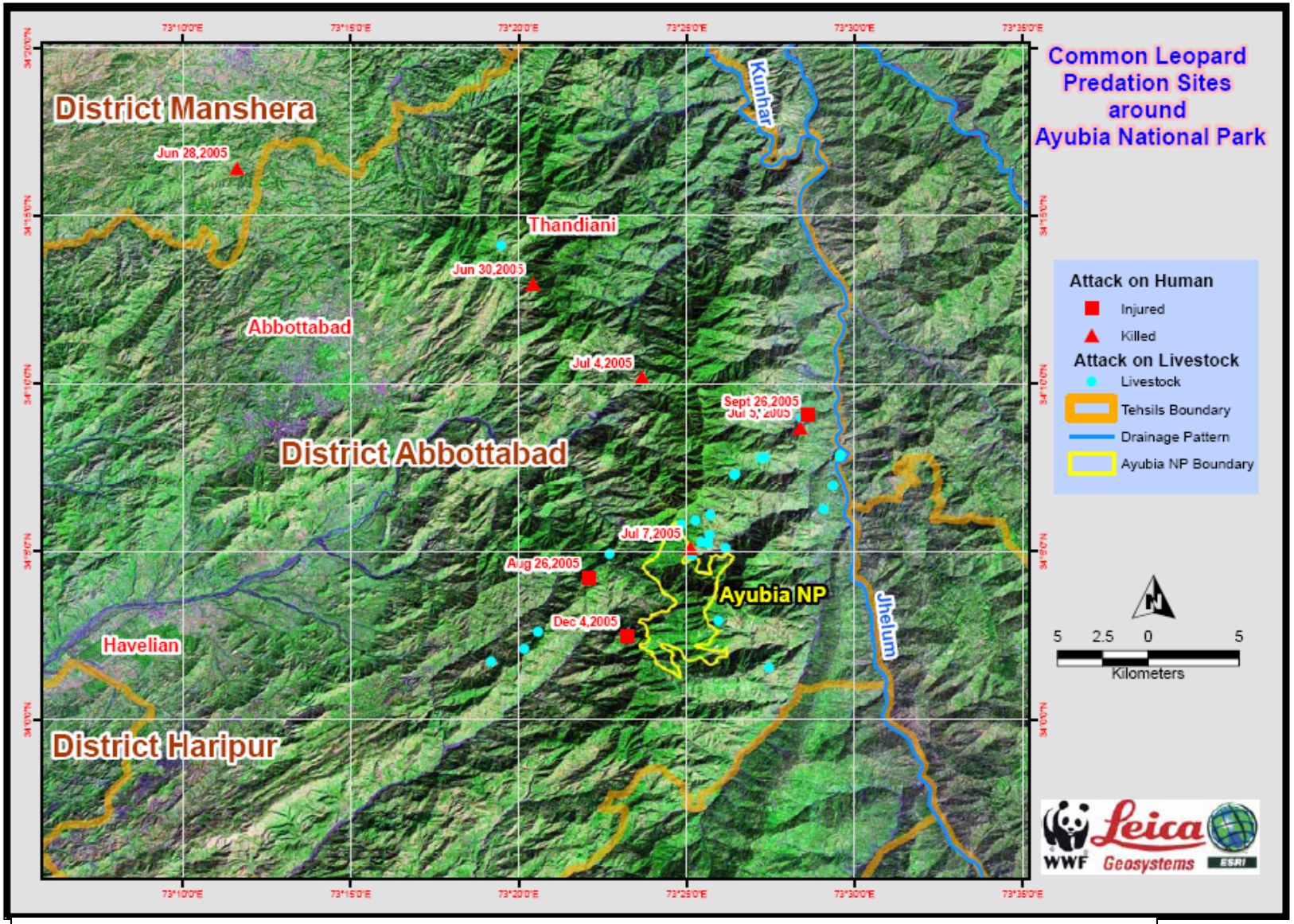

Figure 7: Map showing sites of killing of humans and livestock by leopard around Ayubia National Park, 2005

approached the political leadership for help against the leopards and compensation for the bereaved families. Subsequently, the wildlife department trapped and killed a large (75 kg) 15 year old male leopard near Seri village in July 2005. One 4 year old female was also killed near Mulia- Bakot during the same period. Both animals were killed on the presumption that they were responsible for killing humans. The male leopard had 2 broken canines and was probably too old to kill wild prey easily; therefore, it may have resorted to attack human beings as an easy alternative prey in the forest. In an attempt to determine whether these leopards had killed the humans, stomach contents from the killed leopards were sent to the hospital at Abbottabad. The hospital lacked a molecular and DNA analysis facility; from the histopathology report it could not be determined with certainty whether the leopards were those that killed these women near Ayubia National Park.

The government, the affected local communities, and other stakeholders must come forward with a joint solution for the coexistence of humans and leopards. Media emphasized the importance of conducting awareness-raising programs, field studies, advocacy, and training of local people in avoiding leopard attacks at a large scale by government agencies to relieve the people and maintain a natural harmony with the wild animals.

WWF Pakistan organized a high-level gathering of local community members, politicians, and Government personnel to agree on a strategy for dealing with the situation and future incidents regarding human-leopard conflicts in Gallies on August 11, 2005. About 250 people, including the deputy speaker of the National Assembly, a member of the Provincial Assembly from Abbottabad, officials of the Federal Environment Ministry, Chief Conservator Wildlife NWFP, and other conservationists from different Non-Governmental Organizations, attended the mini-assembly.

The following resolution was adopted during the meeting (Khan 2005):

1. “The provincial government should provide compensation to all those bereaved families who recently suffered fatal attacks by leopard which should not be less than the previously paid compensation.
2. Although there are relevant rules and regulations present regarding safety from the wildlife, people are unaware of them, and these rules are not being implemented smoothly. In order to reduce the damage caused by the leopard it is imperative to educate the public and that the department should work vigorously to achieve this end.
3. The people are unaware of the safety precautions and there was no relevant training organized in this context. The concerned authorities should come up with measures to reduce the prevailing fear among the people.
4. Based on the changing environmental scenario there is a need to formulate a policy that take into account the safety of lives and property of

the local people besides maintaining a balance between wildlife and needs of the people concerned.

5. A committee should be formed at each Union Council level that should also be comprised of two representatives of the Ministry of Environment that would help to review the current recommendations and future policy for a better implementation.
6. District Coordinator Officer (DCO) Abbottabad should be the focal person to implement the recommendation under personal guidance."

Financial compensation to the bereaved families may help to reduce conflict between local people and leopards. Based on these incidents, the wildlife department educated the local communities about the legal killing of leopards in defense of human lives or their property, but not about avoiding human-leopard conflicts. However, none of the other recommendations were followed-up by WWF or the Provincial Government. One of the main goals of this professional paper is to begin the process towards development of an appropriate leopard management policy, as recommended by the stakeholders.

V. CONSERVATION INITIATIVES

Ayubia National Park is among the best preserved areas in terms of biodiversity and natural resource conservation in the western Himalayas. However, wildlife conservation in the face of pressures from the surrounding communities for subsistence on the park resources offers a great challenge. The NWFP wildlife department has a mandate to manage this important protected

area through enforcement of the NWFP Wildlife Act 1975 and rules. The following activities are prohibited in the National Park:

1. Hunting, shooting, trapping, killing, or capturing any wild animal in the National Park or within a three mile radius of its boundary.
2. Firing any gun or doing any other act which may disturb any animal or bird, or doing any act which interferes with nesting and denning sites.
3. Felling, lopping, burning, or in any way damaging or destroying any plant or tree in the Park.
4. Clearing or breaking up any land for cultivation, mining, or for any other purpose.
5. Polluting water.
6. Grazing by livestock.

For the general protection and management of Park, one Park Ranger, one deputy Ranger, and four Wildlife Watchers were employed inside the Park, all of whom report to the Divisional Forest Officer Wildlife, Abbottabad. The Wildlife Department implemented two projects to develop basic infrastructure and tourist facilities, namely, “Establishment of Ayubia National Park” and “Development of tourist facilities in Ayubia National Park” completed in 1988-89 and 1998-99, respectively. However, most of the facilities were completely destroyed due to heavy snowfall and snow slides in 2002-03 and 2004-05.

In the1990s, the concept of community participation in conservation opened new vistas for managing natural resources through donor-funded projects and community-based interventions designed to provide benefits to local

communities and ensure sustainability. The European Union provided financial assistance for a 5-year project entitled Natural Resource Conservation Project (NRCP) in Galliat to reduce dependence of the local communities on park resources. The Project was completed in 2004.

NRCP was primarily executed by NWFP Forest Department which focused on reducing pressure on forest resources. For this purpose, nurseries of fast growing species were established on communal land for the people as a source of fuel wood. About 75 nurseries of fast growing species were established with preferred trees such as *Robinia, Ailanthus, Aesculus,* and *Populus* species. Secondly, fuel efficient stoves were provided to the local people at subsidized rates to improve their heating and cooking methods. Special training was arranged for community members. About 200 such stoves were installed in different communities in the project area.

In an attempt to reduce collection of firewood from the park, NRCP also established 2 fuel wood depots at Nathiagali and Khanspur which provided firewood to the local villagers at subsidized rates. For this purpose, Terms of Partnerships were signed with villages to implement the activity. The wildlife sector also worked to enhance the capacity of tourist guides and community wildlife watchers.

Different conservation based activities were undertaken in various sectors (e.g. forestry, livestock, agriculture, wildlife, training, capacity building). The forestry sector was responsible for raising fast-growing species with subsidized

seeds and planting bags. Plantations in open areas were also carried out to improve cover. Dams were developed in hilly areas to reduce soil erosion. The livestock sector provided good breeds of poultry and cattle at subsidized rates. The exotic cattle species could be stall fed and give high quality dairy output. The agricultural sector provided subsidized seeds with technical support for raising different fruit species and for raising grass for livestock.

Educational programs have also been developed to aid wildlife conservation in the province. For example, the Wildlife Department established school Wildlife Clubs in the vicinity of the park to educate children regarding natural resource conservation. Plant nurseries were created in the schools to gain support of students and teachers in the cause of conservation. These few examples illustrate the potential for new education projects to be developed to aid wildlife conservation.

The Government of NWFP prepared a Management Plan for Ayubia National Park under NRCP. However, the Plan could not be implemented because NRCP ended in 2004. To implement the activities envisaged in the management plan for the park, the Government of Pakistan began a 5-year project in 2004 implemented by the NWFP Wildlife Department. Activities outlined in the Ayubia National Park Management Plan include basic tourist and park infrastructure development, habitat management, fire fighting provisions, community participation, staff and community training, and awareness programs. However, the activities of various sectors of Natural Resource Conservation Project were not well coordinated and communities did not realize the basic aim

behind all these incentives: mitigating pressures on forest resources. The communities simply considered the Project as a poverty-alleviation donor fund.

An Ethnobotany Project for the communities living around Ayubia National Park was started in 1997 through collaborative effort between WWF-Pakistan and the People and Plants joint program of UNESCO, WWF, and the Royal Botanical Gardens (KEW). This Project focused on activities related to estimation of dependence of local people on park resources like fodder and fuel wood, and fodder production system in homestead areas. This Ethnobotany Project also analyzed the social forestry approach and energy conservation efforts including fuel wood efficient stoves. Promotion of a new grass fodder variety as well as improved maize seedlings was undertaken as well as experimentation with the domestication of native medicinal plant species and exotic species. The Project recommended that grasses, mushrooms, and wild vegetables be collected in well-defined sites inside the Park. At the same time, free grazing and fuelwood collection would be discouraged in lieu of new guzara and grasslands, provision of seedlings for fodder and fuelwood, and ownership of tress by the communities (Aumeeruddy-Thomas et al. 2004).

VI. CONSERVATION OF PREDATORS IN THE USA

In order to identify the gaps in management of leopards, I reviewed the management of large carnivores including grizzly bears, wolves, and mountain lions in western North America. These species faced similar threats of extinction due to their depredation on livestock and risk to human lives. Conservation models adapted by United States or any other country for resolving the human-carnivore carnivore conflict will not provide an accurate model for Pakistan to be blindly adopted. However, we can understand the sequence of events followed for resolving the conflict and develop our own models to examine the problems associated with extirpation of top predators and increase the ability of the Wildlife Department to predict the system dynamics for achieving a balanced ecosystem by addressing the concerns of stakeholders.

The science and management developed for large carnivores in North America may provide a platform for wildlife managers in Pakistan to understand some of the complexities and uncertainties associated with human-carnivore conflict and evolve a proactive strategy to address the issues. In this context, I will briefly review below the causes of extirpation of grizzly bears, wolves, and mountain lions in North America and subsequent management strategies adopted for the recovery of these species. This will enable me to come up with a few suggestions on how to address the killing of humans by leopards, minimize

livestock losses, and enabling the leopard population to survive in the wild in Pakistan.

Grizzly Bears

I will briefly review the history of the grizzly bear restoration program starting with its designation as an endangered species under the ESA and the subsequent U.S. Fish and Wildlife Service (USFWS) management of the bear. This will enable me to understand management guidelines to resolve human-bear conflict and social acceptability of the bear recovery program.

"Without reductions in human lethality after 1970, there would have been no chance that core grizzly bear range would be as extensive as it is now" (Mattson and Merrill 2002:1123). This statement shows the significance of social acceptance for grizzly recovery in United States. Grizzly bears occupied a substantial portion of western North America as late as the mid 19 century, but were reduced to less than 2% of its historic range in the lower 48 contiguous states (Mattson and Merrill 2002) because humans and grizzly bears came into direct conflict for food and space. Thirty-one of 37 grizzly bear sub-populations reported in 1922 were extirpated by 1975 (Servheen 1999). In 1975, the grizzly bear was listed as a threatened species under the ESA and a recovery plan was developed for the remaining bear populations (USFWS 1993). To recover the grizzly bear populations, a recovery zone was defined as a large area with good habitat quality and capable of effectively supporting a recovered bear population.

Coordination and support of various agencies and citizens were solicited through the formation of an inter-agency grizzly bear committee and study team.

The three demographic sub-goals set to recover grizzly population that could sustain a defined level of mortality and is well distributed were (USFWS 1993):

i. Maintain a minimum of 15 unduplicated females with cubs-of-the-year (COY) over a six-year average both inside the recovery zone and within a 16-km area immediately surrounding the recovery zone (37,547 square kilometers).

ii. Sixteen of 18 Bear Management Units (BMUs) within the recovery zone must be occupied by females with young, including COY, yearlings, or two-year olds, as confirmed by Interagency Grizzly Bear Study Team (IGBST) from a six-year sum of observations. No two adjacent BMUs may be unoccupied during the same six-year period. This is equivalent to verified evidence of at least one female grizzly bear with young at least once in each BMU over a six-year period.

iii. The running six-year average for total known, human-caused as confirmed by the IGBST is not to exceed 4% of the minimum population estimate. The running six-year average annual known, human-caused female grizzly bear mortality is not to exceed 30% of the 4% total mortality limit over the most recent three-year period. These mortality limits cannot be exceeded in

> any two consecutive years. Beginning in 2000, probable mortalities were included in the calculation of mortality thresholds, and COY orphaned as a result of human causes will be designated as probable mortalities.

A lesson for leopard conservation could be learned from the fact that even in United States the causes of natural mortality for grizzly bears are not well known and human-caused mortality is the main problem (USFWS 1993). Servheen et al. (2004) examined the major causes of human-induced mortality in grizzly bears during 1975-2003. They reported that bear-human conflicts are the ultimate cause of the majority of bear mortalities. Bear mortalities have been caused by private individuals shooting bears illegally and capture killings by managers. People kill bears for three main reasons: self defense, mistaken identification, and vandal killing. Killing in self defense or defense of property occurs when people shoot bears because they feel directly threatened. Killing due to mistaken identification are those when people were hunting for black bears and did not intend to shoot a grizzly; and vandal killing is by people who illegally shoot grizzly bears for unknown reasons.

Translocation of problem animals appears to be a better ecological option than killing bears; however it is not feasible in the long run. For many years, the strategy for dealing with nuisance grizzlies that came in direct conflict with humans remained capture and relocation to other areas. Translocation did not result in a long term solution in most cases and many translocated bears returned to their site of capture (Schwartz 2002, Gunther et al. 2004).

Prior to 1992, the management of the Greater Yellowstone Ecosystem was divided among many agencies and records of conflicts were scattered. The Yellowstone Ecosystem Subcommittee and the Interagency Grizzly Bear Committee recognized the need to consolidate and standardize the collection of conflict data and the job was entrusted to Yellowstone National Park in 1992. Since then, information on conflict has been collected and recorded in a standard format. Since Wildlife and Forest departments in NWFP also work in the same area with different management goals, coordination is also necessary for leopard conservation. It is therefore imperative that a defined working relationship between departments is developed to benefit the conservation of leopards.

Adult male bears occupy the most productive and safe habitat. To avoid confrontation with male adults, adult females and sub-adults often locate their home ranges in proximity to humans. Consequently, they can become human habituated and food conditioned (Mattson and Reid, 1991). Food conditioning is a specific behavior that relates to the attraction of a bear to any source of food associated with human developments. The food-conditioned bears look for human-related food in gardens, garbage, livestock and pet food, native and non-native plants, livestock carcasses, and septic treatment systems near camps and residential areas. These bear behaviors often result in shooting of food conditioned or habituated bears or to translocation. The primary concern related to developed sites is mortality related to food conditioning and bear habituation. Habituation to human activities is a behavioral change under which bears begin to live in proximity to human settlements. High levels of human-bear contact may

result in loss of fear of humans by bears. It is, therefore, important that major seasonal food sources are effectively managed within the grizzly bear habitat so that bears do not settle near human habitations in search of food (USFWS 2003).

Grizzly bears are opportunistic feeders and consume a wide variety of foods in the wild in different seasons. Mattson and Reid (1991) identified four food items that are major components of the diet of grizzly bears during various seasons in the GYE. These are the seeds of Whitebark pine (*Pinus albicaulis*), army cutworm moths (*Euxoa auxiliaris*), ungulates, and spawning cutthroat trout (*Oncorhynchus clarki).* Each one of these food sources is limited by distribution and availability. When these food sources are abundantly available, very few grizzly bear-human conflicts occur in the Greater Yellowstone Ecosystem (Gunther et al. 2000). Immediately before and after denning, bears require food rich in protein to meet their nutritional requirements. When wild food sources are rare, grizzly bears seek foods within or near human habitations and these forays often result in conflict with humans. The absence of easy prey in the wild might be one reason why leopards are attracted to human domesticated animals in Ayubia.

USFWS (2003) defined a strategy so that bears can be prevented from accessing food from humans through aversive conditioning, physical protection of food sources, or the removal of offending animals. The use of non-lethal aversion techniques, that is, repellants and deterrents, has also been stressed. Repellants (such as pepper spray) may be used to turn a bear during a close approach or attack while deterrents (such as electric fencing or rubber bullets)

may be used to prevent the undesirable behavior by turning bears away before a conflict occurs. Herrero and Higgins (1998) have reported that repellent sprays containing capsicum are helpful in repelling aggressive bears in many situations. The use of devices such as bear-resistant food storage containers and bear-proof garbage containers has been encouraged. Electric fencing has also been used successfully to reduce conflicts at gardens, orchards, beehives, and garbage storage facilities on private lands (Gunther 2004). These are specific suggestions that could help in Pakistan.

Gunther et al. (2004) recommended analysis of livestock depredation data and cattle husbandry practices for reducing cattle depredation in Wyoming in a cost-effective manner for livestock producers. They also recommended that wildlife management agencies inform hunters and recreationists about bear behavior and methods to reduce encounters and defuse confrontations when they occur.

Mountain Lions

Though eradicated in most of the Americas by 1930s, mountain lions (*Puma concolor*) increased their distribution and abundance throughout the West after World War II (Padley 1997), and are reported now in areas where they were historically rare or absent (Nero and Wrigley 1977, Berger and Wehausen 1991). The increase in mountain lion populations created new challenges not only for the people living, working, and recreating in the West, but also for wildlife

agencies that lacked information to manage mountain lions in this changing environment (Olsen 1992). Increases in mountain lion-human incidents in the 1980s and 1990s (Beier 1991, Riley and Aune 1997) quickly elevated mountain lion management into political arenas (Stevens 1994) and raised questions of whether and how expanding populations of mountain lions and humans will coexist. The dispersal movements of sub-adult mountain lions increase their negative encounters with humans due to their inexperience, unfamiliarity with the new area, and hunger (Cougar Management Guidelines Working Group 2005).

Mountain lions prey on ungulates including white-tailed deer (*Odocoileus virginianus),* mule deer (*O. hemionus),* and elk (*Cervus elaphus)* (Hornocker et al. 1992). Bighorn sheep (*Ovis canadensis)* are distributed in discrete patches in the mountains of Montana; however, bighorns may constitute a large seasonal component of the lion's diet (Williams 1992). Moose (*Alces alces)*, mountain goats (*Oreamnos americanus),* and pronghorn antelope (*Antilocapra americana)* are rarely killed by mountain lions (Anderson 1983). Ungulates provide 99% of the biomass to the mountain lion during November – April period (Ross et al.1997). Restoration of mountain lions in North America has largely been due to the recovery of ungulate populations and the designation of the mountain lion as a game species (Wagner 1978). The increased prey abundance and controlled harvest led to an increase in mountain lion populations in Montana. In contrast to mountain lion, the leopard in Pakistan is designated as an endangered species facing prey shortage and habitat fragmentation.

The diverse groups interested in mountain lions included hunters, ranchers, animal protectionists, and homeowners in Montana, which made a difficult working environment for wildlife managers (Riley 1998). Approximately 600 mountain lions were killed in Montana in 1995. This figure is 3.6 times larger than the highest recorded annual take of lions during the bounty system (Riley 1998); yet, the mountain lion population is doing very well.

The increase in mountain lion populations increased concerns of ranchers about livestock predation while hunting of lions also increased over 12% annually during 1971-1995 (Ripley and Aune 1997). To reduce livestock depredations and to provide hunting opportunities, wildlife managers tend to increase hunting quotas for mountain lions as well as increase animal damage control actions.

Mountain lions have also attacked several pets and human beings including a fatal attack on a young boy in 1989 and 2 serious injuries to children in Glacier National Park in 1991 and 1992 (Riley 1998). According to the Cougar Management Guidelines Working Group (2005), mountain lion attacks have increased in recent decades in USA. Beier (1991) recorded 7 fatal and 44 non-fatal attacks on humans in North America between 1890-1990. Fitzhugh (2003) documented seven fatal and 38 non-fatal attacks between 1991-2003.

The management of increasing mountain lion populations throughout western North America has been becoming difficult over time for wildlife managers as they attempt to balance both the beneficial and detrimental aspects of this large carnivore. With increasing public desire to restore the roles of large carnivores in western ecosystems, the concern for the effective management of

mountain lions has increased (Kellert 1985, Noss et al. 1996). Concurrently, the increased frequency of mountain lion attacks on humans and their pets made lion management a national issue (Stevens 1994).

In North America, two American states (Wyoming and Colorado) and one Canadian province (Alberta) pay compensation for livestock claims to mountain lions. Reported incidents of predation are investigated by provincial wildlife agencies and claims reviewed by a regional committee consisting of private producers and government representatives from animal health, production, and wildlife management interests. Since 1990, the program has paid 100% of the value of the livestock as compensation for confirmed kills, 50% for probable kills, and no compensation for missing animals (Nowell and Jackson 1996). Efforts were also made to minimize livestock depredation by changing human behavior such as grazing practices, targeted control of specific problem animals, and restrictive regulations on land development (Keiter and Locke 1996).

Management actions should specifically address the problem and objectives should be clearly and explicitly stated (Keeney 1995). Mountain lions are a game species and provide recreation as well as public safety concerns. Thus, mountain lion populations in the wild are regulated through sport hunting which can sustain 20-30% harvest depending on age and sex composition (CMGWG 2005). Success or failure of any mountain lion hunting program depends on human attitudes. Because public attitude towards conservation can only be altered through information and education programs, it is necessary that information on public safety be provided (Cougar Management Guidelines

Working Group 2005). This working group also proposed interpretation of mountain lion behavior to assess the risk level and appropriate response as well as standard format for mountain lion observations.

Wolves

Human – wolf conflict in North America started when Europeans arrived. A campaign for killing of wolves was started for three reasons: the wolf was considered a physical threat to humans; it was considered a threat to the expansion of the livestock industry; and its fur was prized for clothing (Young and Goldman 1944, Rutter and Pimlott 1968). The wolf was originally found throughout the United States except the Gulf Coast state of Texas before it was eliminated by the 1960s (Young and Goldman 1944, Nowak 1983).

The USFWS encouraged natural re-colonization of wolves in Montana, Idaho, and Wyoming through dispersal from Canada (Ream et al. 1991) as well as through reintroduction in central Idaho and GYE in 1995 and 1996 (Fritts et al.1997). Though wolf packs settled well in the core zones within recovery areas in central Idaho and GYE, wolves settled outside protected areas in northwestern Montana in close proximity to humans and livestock (FWS 1999). The efforts of the U.S. Fish and Wildlife Service for the conservation and restoration of the wolf proved fruitful and restored the population. Consequently, in 2003 the status of the wolf was changed from endangered to threatened except for the Yellowstone area, central Idaho, Arizona, and New Mexico (Musiani and Paquet 2004).

Bradley et al. (2005) found the lowest survival rate in northwestern Montana. Because livestock production is a major source of income in this area, any livestock depredation by wolves creates negative attitudes toward the wolf restoration program (Bangs et al. 2005). Increasing numbers of wolves in Montana, Idaho, and Wyoming has become a concern for livestock producers. Reducing livestock damages caused by wolves is important for the successful recovery of the wolf (Bradley et al. 2005). Bradley and Pletscher (2005) looked into the various factors affecting wolf-livestock conflicts and found that wolf depredation on livestock increased in larger pastures with more cattle and that the presence of elk served as an attractant to wolves. Surprisingly, carcass disposal methods, calving time, and the distance of grazing cattle from the forest edge had no relationship with livestock depredation by wolves. Treves et al. (2004) found that wolves in Wisconsin and Minnesota preyed selectively in areas with a high proportion of pastures and high density of deer (*Odocoileus virginianus).*

Conflicts between people and large carnivores can be reduced through compensation programs for the losses and effective non-lethal methods (Bradley et al. 2005). Though black bear hunters, livestock producers, and general residents of Wisconsin approved of compensation payments for wolf depredation as a management strategy, the stronger predictors found for tolerance of wolves were social identity and occupation (Naughton-Treves et al. 2003). Nyhus (2003) reported negative attitudes of many political leaders and agencies towards wolf conservation and the genuine needs to compensate ranchers for livestock

damages by wolves in a fair, transparent, and quick process. They reported restoration of wolves in Yellowstone National Park was due to increased tolerance among ranchers because of adequate compensation by an NGO, Defenders of Wildlife. Ranchers are paid compensation at the full market value in cases of confirmed losses and half the amount for probable losses. This compensation program gained success because it is quick, transparent, and above all the ranchers have no paper work to fill out. To reduce leopard-human conflict in Pakistan, it is imperative that such a fast mechanism for compensation is developed to increase tolerance among the communities.

Parks and Harcourt (2002) studied the effects of protected area size and human population on the extinction rates of large mammals in the 13 national parks of the western United States and concluded that extinction rates were not significantly affected by the size of the area protected but by the human population density. They suggested that the processes outside the boundary of protected areas might have a strong influence on the species within the protected area. However, edge effects are more severe on smaller national parks and protected areas.

Musiani and Paquet (2004) considered that wolf-specific education programs may contribute in developing positive attitudes among the people for enhancing wolf tolerance. Education and information play a significant role in changing pubic attitude and perception towards wolf conservation (Anderson et al. 2003).

VII. LEOPARD CONSERVATION STRATEGY

My purpose in this paper is to suggest guidelines for leopard management in Ayubia National Park, Pakistan so that a self-sustained breeding population of leopards can exist in North West Frontier Province. The increased frequency of leopard – human conflicts raises questions of whether and how expanding populations of leopards and humans will co-exist, and what factors regulate leopard populations. For managing any wild species, managers should know where and how the species lives. This includes information about distribution, habitat preference, dietary requirements, activity patterns, and social organization; each of these is important in developing a management strategy.

For the successful management of leopards, conservation efforts should focus on both biological and social issues that can be systematically monitored and evaluated. The management objectives should be based on ecological data and social information to ensure that management benefits both the species of concern and the local communities who are impacted by leopard conflicts.

I make suggestions for leopard conservation in Ayubia National Park and for reducing human-leopard conflicts based on a review of the management of other large carnivores (grizzly bear, wolf, and mountain lion) in the USA and leopard management guidelines in India. The following biological and social management recommendations only provide knowledge and information to the decision for framing clear management objectives. The management actions should be relevant, useful, and clear to solve a particular problem. Managers

should always know the methods for collecting the right type of information without indulging into collection of unnecessary information.

A. BIOLOGICAL MONITORING

The review of the management of grizzly bears, wolves, and mountain lions shows that increases in species population were possible by increased efforts of the concerned agencies to understand the biology of the species along with increased tolerance among the people. It is imperative for the Wildlife Department to establish a monitoring program. This will allow gathering reliable information that can be used for decision-making in the future. Broader research needs recommended by Cougar Management Guidelines Working Group (2005) have been modified for leopards in Ayubia National Park (Box 2); this will enable managers to obtain reliable information for the adaptive management process. Research needs have been categorized into three classes: i) priority research needs for designing and evaluating management actions; ii) long-term research needs (10-plus years) to benefit leopards and their habitat; and iii) modeling needs that may allow the wildlife department to structure hypotheses regarding leopard management. Management prescriptions should be as general and flexible as possible and can be modified as the situation changes. The NWFP Wildlife Department should have clear and reliable answers to some basic questions to evaluate the success or failure of the leopard management strategy.

Box 2: Research needs

A. Priority research needs for adaptive management

- Reliable maps of relative leopard density, habitat quality, and landscape linkages
- Reliable methods to estimate or index leopard abundance.
- Identify and investigate the ability of a source population to restore sink populations
- Effects of control actions on leopard populations and the management objectives (for example, changes in livestock losses).
- Leopard behavior in wild and human-developed areas
- Effects of aversive conditioning on leopards.
- Human attitudes and values related to leopards

B. Long-term research

- Leopard population dynamics.
- Leopard habitat use patterns, use of habitat linkages, exploration movements, and responses of leopards to habitat changes.
- Relationships of leopard to prey populations
- Relationships to other carnivore species.
- Effects of information and education programs about leopards on leopard management

C. Model development needs

- Develop and validate models on leopard population dynamics.
- Develop and validate models for leopard habitat use.
- Develop and validate models on trends of leopard predation on livestock.
- Develop and validate models on effects of leopard predation on prey populations.

Source: Modified and adopted from Cougar Management Guidelines Working Group (2005)

For example, a management plan should contain the following biological information:

i. the distribution of leopards populations and their prey;

ii. movement patterns, habitat use, and leopard handling;

iii. awareness, information, and capacity building.

Species Distribution

The very first step in monitoring the leopard population is to map the distribution of leopards and their principal prey species. GIS provides an important tool for entering and interpreting leopard observation data with their proper geographic locations. With GIS it is easier to produce occurrence maps efficiently at different scales, covering different areas and showing separate layers with information on type of observation, date, and geographic location.

In the initial stage, the prey distribution (macaques) will be used to describe the current distribution of leopards; these data will be supplemented with depredation kills and indirect signs (denning sites, tracks, scats, pugmarks, and scent). In the next stage, the initial range map may be overlaid on a habitat map to eliminate habitat that is unavailable to leopards so as to depict actual leopard habitat range (the map may be refined through ranking of highly suitable to least suitable habitats). The areas with high human activities and conflicts should also be recorded. This range map should be updated when mortalities and depredations occur. This will provide some information towards monitoring the leopard population through time.

Population sampling

In the past, total counts or a census-based approach were attempted in an effort to understand the distribution and status of wild animal populations, however this is almost impossible with leopards due to their secretive nature. Hence, population sampling methods be used to monitor leopard populations. Capture, mark, and re-capture sampling has emerged as an important conceptual approach for population sampling.

Genetic sampling is an excellent technique for monitoring leopard populations. Genetic analyses can help estimate population and sex ratio of leopards in the region. DNA is just like fingerprints for ascertaining the identity of an individual. Staff must be trained in tissue sample collection techniques so that these samples can be sent to a Forensic laboratory for DNA extraction and genotyping to identify the species and individual.

It is important to expose wildlife staff to scientific methods of animal population estimation. This will enable them to understand the reasons for sampling protocols. The ultimate objective of any species monitoring program should be to estimate the rate of annual survival, mortality, recruitment, and change in population through long term studies. However, estimating these vital rates require skilled manpower and resources for the advanced techniques and equipment. It is, therefore, imperative to coordinate with a university or research organization with expertise in this area to develop an advanced leopard

monitoring program and to build the capacity of field staff. Access to current scientific literature is also essential.

Estimation of prey distribution and abundance

The estimation of prey abundance and distribution may give important information about leopard predation on livestock and attacks on humans. We know that leopards feed on a large variety of prey from large ungulates to small birds and rodents. Leopards are flexible in their diet under a variety of habitat conditions. In Ayubia National Park, information should be collected on the presence and use of various prey species. Hair samples from each prey species should be collected and reference slides prepared for comparison to the hair found in leopard fecal samples to determine dietary composition. The wildlife field staff should be trained in collecting fecal samples and recording relevant information including the date, location, specimen number, and freshness. Through time, we will understand the leopard diet in various seasons, habitat, and geographical locations.

However, it would be wise to experimentally carry out re-introduction efforts for musk deer, grey goral, and barking deer). Reintroductions of these native prey species would provide leopards with alternative prey in addition to macaques; this might alleviate human-leopard conflicts. Restoration of these ungulates would also enhance biodiversity within Ayubia National Park and would restore the ecological roles these species served.

Movement patterns

Because leopards are secretive and wide ranging animals, movement patterns of leopards should be identified by using GPS radio-collars. This will also help us acquire information about spatial distribution, areas used during various seasons, territoriality, hunting and activity patterns, and breeding sites of leopards in and around park. Understanding movements of leopards would help managers predict leopard-human conflict areas, where to restore prey species, and how leopard populations are connected.

Habitat use

Understanding the requirements of leopards for food, cover, and social organization is important to sustain the leopard population. We should strive to understand factors that correlate with species absence or presence. Human disturbance, as well as habitat features, can be used to develop a predictive model of leopard habitat selection. This will help the department in understanding the future distribution of leopards and protect connectivity between various known populations. Knowledge of movement patterns and connectivity will enable the Wildlife Department to consider seasonal closure of certain areas or tracts for public safety and for leopards.

Population goals

The Wildlife Department should properly document leopard mortality whether they are human caused or natural so that the data may be used to assess i) distribution of leopard mortalities, ii) age and sex structure of animals dying, iii) population status, and iv) major causes of mortality. Bones and skulls of the dead animals should be preserved for research and education purposes. The teeth of dead animals should also be preserved so they can be used for cementum annuli aging (G. Matson, personal communication).

The NWFP Wildlife Department should also establish a target for a minimum population of breeding adults within and near Ayubia National Park. Because the size of Ayubia National Park is too small to sustain a viable population of leopards, further studies may be conducted to understand the connectivity and movement patterns between breeding populations across the range of leopards in NWFP. This information will help managers evaluate population trends and ensure the long-term persistence of leopards in the Province.

Park and protected area management

Because the Galliat forests already enjoy the status of a Reserved Forests, it is easier for the Government of NWFP to declare the whole area as National Park. The proposed extended area is shown in Fig. 8. Other alternatives to complete park expansion could be to adapt management policies of national park’s buffer zone to be more compatible with the wildlife and conservation

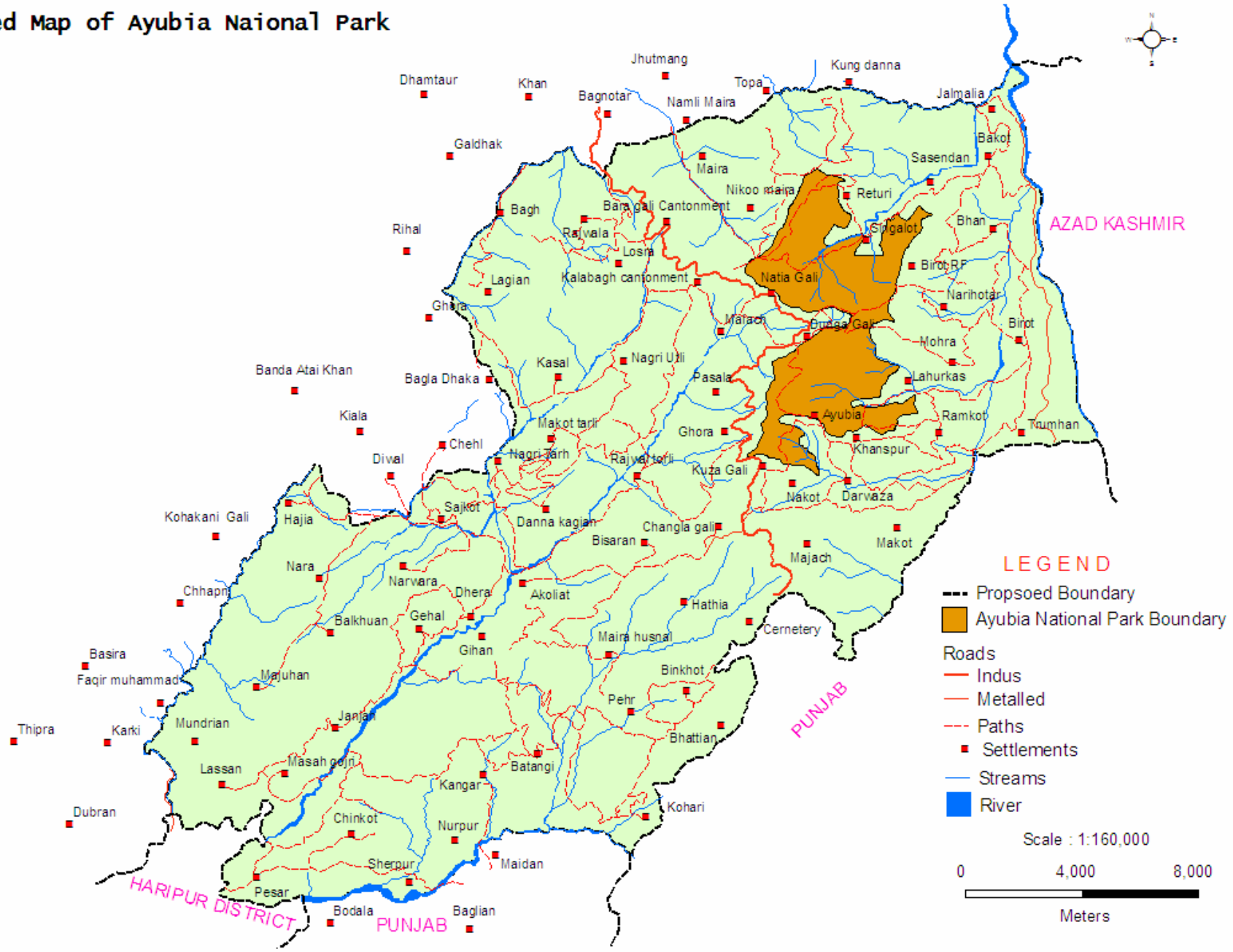

Figure 8: Proposed extension in the area of Ayubia National Park, Pakistan

policies of Ayubia National Park. For example, the forestry operations may be carried out only when it is not detrimental to the conservation and management of wild species in the area.

Leopard center

A leopard education center or educational materials including leopard skulls, hides, and even taxidermy mounts could be used for environmental educational purposes to benefit leopard conservation. Numerous opportunities to obtain leopard samples during handling and release of captured animals have arisen in the past. However, neither any body parts nor derivatives were kept nor were any animals successfully reared in captivity. This is mostly due to lack of technical capacity of the staff and facilities to support these activities. I suggest that NWFP Wildlife Department should explore the possibility of establishing a leopard center for research and education purposes. Such a center would also be a destination for tourists in the area.

Capacity building

The conventional approach of enforcement of wildlife law has been useful to a great degree in conserving endangered species. With an increasing human population and shrinkage of wildlife habitat, the scenario has become more complex. The use of both natural and social science seems inevitable to address growing problems and foreseeing future needs. I therefore consider it imperative to organize frequent short courses for the wildlife staff to understand field

research techniques. Collaborative research projects with university researchers and established field scientists will build the capacity of the NWFP Wildlife staff. The staff of conservation organizations like WWF and IUCN may also be trained for undertaking scientific field studies. A Leopard Study Team should be formed comprised of wildlife managers, conservation organizations, and universities to build the capacity of field personnel.

B. SOCIAL ASPECTS

Human-leopard conflict is a complex issue influenced by the biology of leopards, management actions, and political and social attitudes. In India, leopards have been reported living in close proximity to human habitations and feed on feral dogs, pigs and livestock (Mukherjee and Mishra 2001). These prey items for leopards result in an escalation of human-leopard conflicts. Effective management requires not only biological information about the species, but also critical social issues including basic needs for fodder, fuelwood, and livestock grazing. To address human needs, an adaptive management strategy should be followed that explores the options for allowing limited access rights to local people for fuelwood and fodder collection in Reserved Forests. It is, however, obvious that leopard-human conflict will occur, though conflicts can be reduced through effective management. Humans are not the natural prey of leopards, though sub-adult transient leopards and sick or starving adults may show the tendency to attack humans.

Human-leopard interaction

Leyhausen (1979) reported that the predatory behavior of all cats, domestic or wild, is quite similar. Attack on prey and avoidance of non-prey species depends on learned as well as innate behavior. Fortunately, cats do not expect prey to fight back and usually retreat on facing any resistance (Leyhausen 1979). Interpretation of various leopard behaviors and the appropriate response by humans in case of an encounter or attack by leopard are listed in Appendices 1 & 2. Considering leopard behavior, the Wildlife Department may choose thresholds for tolerance or removal of problem leopards. Management actions based on interpreting level of risk from predatory behavior of cats has been attached as Appendix 3. However, managers should not consider these interpretations risk free because leopards are ambush predators and may appear suddenly.

Athreya et al. (2004) has made following suggestions to reduce man-leopard conflicts in India:

i. Translocation of problem leopards should not be permitted. Problem leopards should either be permanently removed through lethal control or kept in captivity.

ii. Trapping should be done after careful consideration and by following management guidelines.

iii. Low levels of livestock attacks should not be handled by trapping but by monetary compensation. Leopards should be allowed to feed off the livestock they have killed.

iv. A database on leopards should be maintained by collecting scat and hair samples and pugmark images/casts. A reference library can be maintained for leopards as well as their prey base.

v. Direct shooting of problem leopards by the public should not be allowed because injured animals are very dangerous.

vi. Establish a Leopard Center in the vicinity of the Protected Area for education, awareness and research.

vii. Habitat management for the recovery of associated species.

viii. A long-term telemetry study on leopards should be conducted to support sound decision-making.

The Wildlife Department should consider these recommendations and tailor them according to the situation and needs within NWFP.

Education and outreach program

The Cougar Management Guidelines Working Group (2005:90) made an interesting statement, “It should be much more effective for humans to modify their own behavior than it is for humans to modify cougar behavior.” So it is necessary to educate the public about leopard behavior and in how to avoid conflicts. It is therefore essential to disseminate information to local community members, students, tourists, and conservation organizations. Print and electronic media (such as fliers, brochures, articles, stickers, videos etc.) should be used to education the community about leopards. Proper education and reliable information will help reduce the fear among the public and increase the level of

tolerance for “Living in Leopard Country”. Educational kits such as those used in North America (e.g., the bear edu-kits developed by Friends of Banff National Park) could be developed to make educational materials portable and accessible to schools in the greater Ayubia system.

Livestock conflict

Livestock predation can be mitigated by eliminating the problem animals; improving the livestock husbandry and anti-predator management; and through compensation for the livestock killed. Measures such as vaccination of livestock against disease and improved husbandry measures to increase pregnancy and juvenile survival rates may substantially mitigate the losses caused by leopard depredation and increase the profitability to owners of livestock. Recommendations of IUCN Cat Specialists Group could be modified and adopted to reduce conflicts with livestock (Box 3).

Box 3: Anti-predator management actions

1. Proper disposal of livestock carcasses so that predators do not acquire a taste for livestock
2. Guards or guard dogs for day time grazing
3. Controlling birth seasons rather than allowing births to take place randomly
4. Keeping experienced herd lead animals, so that they can appropriately teach cautious behavior to younger animals
5. Keeping a few cows or steers with horns in the calving herd.
6. Improving the security of enclosures through better fencing
7. Rounding up livestock at night into secondly fenced enclosures and posting guards with lights.
8. Permitting smaller wild prey species to co-exist with livestock.
9. Fencing off grazing areas in prime leopard habitat.

Source: Nowell, K. and Jackson, P. (1996)

humans or livestock. Sample formats, adapted from Athreya and Belsare (2007) for properly recording damage reports to humans and their property, are placed in Appendices 4 & 5. Similarly, a standardized leopard observation form is attached as Appendix 6 for consideration by the Wildlife Department.

Compensation program

Compensation schemes for livestock losses may substantially increase tolerance among the communities. Conservation organizations like WWF and IUCN should explore the possibility for compensation following what Defenders of Wildlife has done in the United States. This step alone will greatly increase the level of tolerance among the communities.

In India, the compensation program is quite complicated and filing a claim and its settlement requires a long time (Nowell and Jackson 1996). No compensation is payable there if the incident occurred in a protected area or the carcass is disturbed in any way; I recommend that these requirements occur in NWFP, as well. Any compensation program should be simple enough to permit illiterate villagers to make claims quickly but also effective enough to detect and discourage abuse.

Trophy hunting

The impact of tourism and trophy hunting of leopards should be examined in greater depth. I recommend that after setting up a leopard population monitoring program, limited trophy hunting program for culling 1-2 animals may

be considered by the Wildlife Department as an economic incentive for the local communities. However, in any harvesting program, protection to the female segment of the leopard population should be ensured.

VIII. CONCLUSION

Human-wildlife conflict is not a new issue in the field of wildlife management. However, the methods of handling carnivore-related problems remain unique and distinct for each species depending on area, time, and resources. The recent increase in attacks on humans by leopards around Ayubia National Park, Pakistan led me to focus on species-specific management based on lessons learned from the successes and failures in management practices for mountain lions, wolves, and grizzly bears in the western United States. This review enabled me to suggest broader management actions to achieve the ultimate goal of leopard conservation. High density of human settlements in leopard country perhaps negatively affected habitat quality and increased depredation incidents in Ayubia National Park. This forced the Government to make ad hoc decisions to decrease threats to human lives and their property.

The entire reserve forest in Galiat constitutes leopard habitat and it would not be wise to conduct operations that would adversely affect it. I suggest that reserved forest be included into the national park area to provide good leopard habitat. The management of public subsistence forest (Guzara forest) should be

completely devolved to local communities and the Wildlife Department should act as the regulatory authority for public acceptance of the Park.

Leopard-human conflict may not be completely eliminated in any leopard strategy, however, the level of risk and threat to human lives and their property may be reduced substantially by following an adaptive management strategy. To start with, standardized reporting methods should be adopted. Problems or questions faced in the field should be clearly identified, prioritized, and articulated for a realistic study design.

I underline the need to monitor the leopard population and designing long term studies for leopard biology and population dynamics. These studies will help managers understand population density, dispersal of sub-adults, genetic variability, prey distribution, and the level of tolerance and risk to humans. This may eventually lead to developing and validating leopard models to answer what-if scenarios and population growth predictability. This will enable the Wildlife Department to adopt a proactive role in decision-making instead of reactive to various leopard-related incidents.

Because it is difficult to modify the behavior of leopards, efforts should be focused on modification of human behaviors and adopting appropriate responses through education and information programs. Improved agriculture and livestock husbandry practices along with pubic safety measures may not significantly reduce conflicts with leopards in Ayubia National Park. But these actions may result in increased tolerance if proper compensation and incentives are offered to communities.

Capacity building of wildlife staff through training courses and joint research programs with research universities and conservation organizations cannot be over-emphasized. Research publications will not only provide confidence to field staff, but also help the global community to understand leopard related issues in Pakistan.

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Appendix – I

Interpretation of cat behavior to assess risk

Observation	**Interpretation**	**Human Risk**
Opportunistically viewed at a distance	Secretive	Low
Flight, hiding	Avoidance	Low
Lack of attention, various movements not directed toward person	Indifference, or actively avoiding inducing aggression	Low
Various body positions, ears up; may be shifting positions; intent attention; following behavior	Curiosity	Low – provided human response is appropriate
Intense staring; following and hiding behavior	Assessing success of attack	Moderate
Hissing, snarling, vocalization	Defensive behaviors. Attack may be imminent	Moderate, depending on distance to animal
Crouching; tail twitching; intense staring; ears flattened like wings; body low to ground; head may be up	Pre-attack	High
Ears flat, fur out; tail twitching; body and bead low to ground; rear legs “pumping”.	Imminent attack	Very high and immediate

Source: Cougar Management Guidelines Working Group.(2005)

Appendix – II

Precautionary measures that human can take during encounter to prevent injury

Precautionary measures	Reasons
Keep children under close control, and in view. Pick up small children immediately if you encounter a leopard. Do not hike alone	Most victims have been unsupervised children or lone adults. Small children are specially vulnerable.
Announce your presence in leopard habitat and do not run on seeing a leopard.	Running and quiet movements may stimulate chasing and catching response
Stand. Wave your arms. Raise jacket over your head. Appear as large as possible. Move to higher ground if nearby. Throw sticks, rocks, or other objects if within reach and accessible without bending too low.	Prey size, vulnerability, and "positioning' influences leopard response. A crouching person might be mistaken for prey.
Avoid dead animals never approach kittens. Talk calmly. Back away.	Non-prey may be attacked if viewed as a threat
Maintain eye contact. Do not look away. But if leopard appears agitated use peripheral vision to keep track of its location	Eye-to-eye contact often restrains large cats. Direct eye contact from prey may inhibit predatory action.
Be alert to your surroundings.	Cats exploit all vantage points/cover when investigating prey.
If attacked, fight back.	A cat grasps with its teeth only if it meets no resistance. Violently struggling prey may be released.
Do not chase or surround a leopard	Stress may cause the leopard to attack in its attempt to escape.
Secure pets and hobby animals in predator-proof enclosures between dusk and dawn. Keep pets on leashes and off trails in the back country.	Domestic prey animals may sustain leopard populations at unnaturally high levels. Also feral dogs could be attractors for leopards.
Keep garbage under control to avoid attracting raccoons, skunks, etc. Do not feed pets outside and remove extra feed from domestic animal pens. Do not feed deer and wild turkeys.	Leopard may be attracted to concentrations of potential prey.
A leopard that treats humans as prey is a public safety threat.	Once a learned behavior develops it may not be possible to modify this behavior.
Leopard that enters yards or campsites to kill pets may be candidates for removal. Keep pets under control	Once a learned behavior develops it may not be modifiable.

Source: Cougar Management Guidelines Working Group.(2005)

Appendix – III

Suggested protocols in decision making process according to cat behavior

Risk category: Specific behavior – number of occurrences	**Recommended type of response**	**Recommended management actions**
Low risk – single occurrence	Wait and see	Continue or initiate public education
Low risk – multiple occurrence	Take appropriate action. Evaluate circumstances of observations.	Post warning signs. Consider use of hazing. Consider database for observations.
Moderate risk. Deliberate approach (curiosity) – single occurrence	Take appropriate action. Evaluate conditions leading to approach	Post warning signs. Try to mark and monitor animal. Consider use of hazing. Map observations and document observations and management in database.
Moderate to high risk – multiple occurrences.	Take appropriate action. Evaluate conditions leading to approaches. Evaluate removal.	Post warning signs, or close area. Increase education effort. Patrol area with loaded firearm to kill leopard if perceived as dangerous, or haze if perceived as curious.
High risk: near attack – single occurrence	Take immediate action; evaluate if behavior was predatory or defensive. Evaluate removal	Post warning signs, or close area. Increase education effort. If decision is to remove, patrol area with loaded firearm to kill leopard
High risk: nonfatal attack – single occurrence	Take immediate action. Evaluate if attack was defensive	Secure victim. Post warning signs and close area. Secure incident scene, contact wildlife services, and kill leopard. Contact media
High risk: fatal attack – single occurrence	Take immediate action	Close area. Secure incident scene, contact wildlife services, and kill the leopard. Assist and support victim's family. Contact the media.

Source: Cougar Management Guidelines Working Group.(2005)

Appendix IV

LEOPARD DAMAGE FORM – I *Livestock damage form*
HAZARA WILDLIFE DIVISION
ABBOTTABAD

Recorder Information
Name:_____
Designation:_____
Duty Station:_____
Date :_____

Site of Incident

Name of place:_____
Compartment:_____
Range:_____

Habitat

Agricultural fields:_____
Fuel wood collection site:_____
Grazing/fodder collection site:_____
Rakh(grassland):_____
Livestock shed:_____
Others:_____

A. Attack on livestock

Species of livestock_____

Injured:_____ Age:_____ Sex:_____

Killed:_____ Age:_____ Sex:_____

Condition of carcass/injury:_____

Time of attack:_____

Details of attack:_____

Information on leopard, if any_____

Reliability of information: High_____ Medium_____ Low_____

Name and address of person interviewed:_____

Signature of Officer:_____

Appendix V

LEOPARD DAMAGE FORM – II *Human attack form*
HAZARA WILDLIFE DIVISION
ABBOTTABAD

Recorder Information
Name:_____
Designation:_____
Duty Station:_____
Date_____

Site of Incident

Name of place:_____
Compartment:_____
Range:_____

Habitat
Agricultural fields:_____
Fuel wood collection site:_____
Grazing/fodder collection site:_____
Rakh(grassland):_____
Livestock shed:_____
Others:_____

A. Attack on human being

Name of affected person:_____

Sex:_____ Age:_____

Nature of attack:_____

Time of attack:_____

Activity of person at time of attack:_____

Details of attack:_____
_____

Name and address of person interviewed:_____

Leopard sighted by:_____
Description of leopard:_____
How long leopard was in view:_____
Observer's distance from leopard:_____
Information on leopard, if any_____

Signature of Officer:_____

Appendix VI
Leopard sighting

LEOPARD OBSERVATION FORM
form
HAZARA WILDLIFE DIVISION
ABBOTTABAD

Recorder Information
Name:_____
Designation:_____
Duty Station:_____
Date :_____

Site of Incident

Name of place:_____
Exact location:_____
Compartment:_____
Range:_____

Habitat

Agricultural fields:_____
Fuel wood collection site:_____
Grazing/fodder collection site:_____
Rakh(grassland):_____
Livestock shed:_____
Others:_____

A. Leopard killed

Leopard killed: _____ Sex:_____

Age: Kitten/Sub-adult/adult/:_____

Body length: _____ tail length:_____

Weight:_____ Condition: Healthy/weak:_____

Overall body color:_____ Reason for killing:_____

Management action:_____

Details of attack:_____

Body recovery/bones recovery:_____

Signature of Officer:_____

B. Leopard Sighting

*Type of interaction: _____
Size of pugmark: _____
Leopard sighted: _____ Sex:_____
Spatial location: Latitude:_____Longitude:_____
Map Datum:_____ Recorded with GPS: Yes/ No
Elevation:_____ (m)

Age: Kitten/Sub-adult/adult/unknown:_____

Body Condition: Healthy/weak/injured:_____

Overall body color:_____

**Person activity at time of observation:_____
**Person's response:_____

***Leopard activity at time of observation: _____
***Leopard response:_____

Details of attack:_____

****Management actions:_____

Signature of Officer:_____

***** Interaction examples: scat, trek, sighting, encounter, near attack, others.

****** human activity and response examples: on/off trail, walking, running, standing, sitting, crouched, lying down, camping, stopped, fled, stood, faced animal, quiet, spoke to animal, shouted, waved arms, threw things.

*** leopard activity and response examples: standing, walking, running away/towards person, sitting, crouched, lying down, hiding, feeding, with cubs, ignored, charged, moved/stalked closer, ears back/forward, teeth bared, growled, tail quiet/lashing, rear legs pumping, body low to ground, head low to ground, watched intently/casually.

**** No action, reporting to higher authority, increased monitoring, aversive conditioning, close area, relocation/removal of animal.