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A review of behavioural ecology and conservation of large predators inhabiting the Central Karakoram National Park (CKNP)

Muhammad Zafar Khan[1,2], Saeed Awan[1,*], Babar Khan[2], Saeed Abbas[2] and Amjad Ali[1]

[1]*Karakoram International University, Gilgit, Pakistan*

[2]*WWF-Pakistan, Gilgit-Baltistan, Pakistan*

Abstract

The Central Karakoram National Park (CKNP) stretching across 10,000 km² of the total 72,496km2 of Gilgit-Baltistan is the largest protected area of Pakistan. Been established in 1993; the national park is yet beyond of catering vital information on ecological features. The park provides sanctuary to the snow leopard Panthera uncia and the grey wolf Canis lupus as the major and large predators, which play key role in maintaining and sustaining both the prey species and food chains in the unique mountainous ecosystem. Depredation on livestock by these predators and their killing by local herders in retaliation is a serious conservation issue because livestock rearing is one of the major livelihood sources of local herders around the Park. To strike a balance between the Park ecosystem and peoples' needs, it is important to explore the key behavioural features of the large predators. This paper reviews unique behavioural features of the snow leopard and wolf such as their territoriality, mating, social organization and communication modes. Based on the information extracted, some conservation actions have also been suggested at the end to manage human-carnivore conflict in valleys around the Park.

*Corresponding Author: M. Saeed Awan ✉ saeed.awan@kiu.edu.pk

Introduction

The Central Karakoram National Park (CKNP), measuring 10,000 km² is located amidst the lofty and snow-capped peaks of Karakoram Mountains in Gilgit-Baltistan region of Pakistan (Fig.. 1). In 1993, the Government of Gilgit-Baltistan (the then Northern Areas) declared the area as National Park, which is now the largest protected area in the country, offering tremendous potential of attracting tourists and mountaineers from all across the world. The park harbours some of the world's highest mountain peaks and is home to four eight thousander i.e. K-2, Gashabrum-I, Gashabrum-II, Broad peak. Moreover, the park bears largest glaciers like Baltoro and Biafo-hisper, which together with the adjacent glaciers make the second largest glacial mass outside the polar region (Hagler, 2005).

The Park and the annexed buffer zone is a refuge area not merely for endangered species, *such as* markhor, musk deer, Ladakh urial, Marco Polo sheep (presence to be confirmed in CKNP (Lovari and Bocci, 2009) and the snow leopard, but also provides home to abundant but important "flag" species, such as blue sheep, Siberian ibex, lynx and grey wolf (Roberts, 2005; Schaller, 1977).
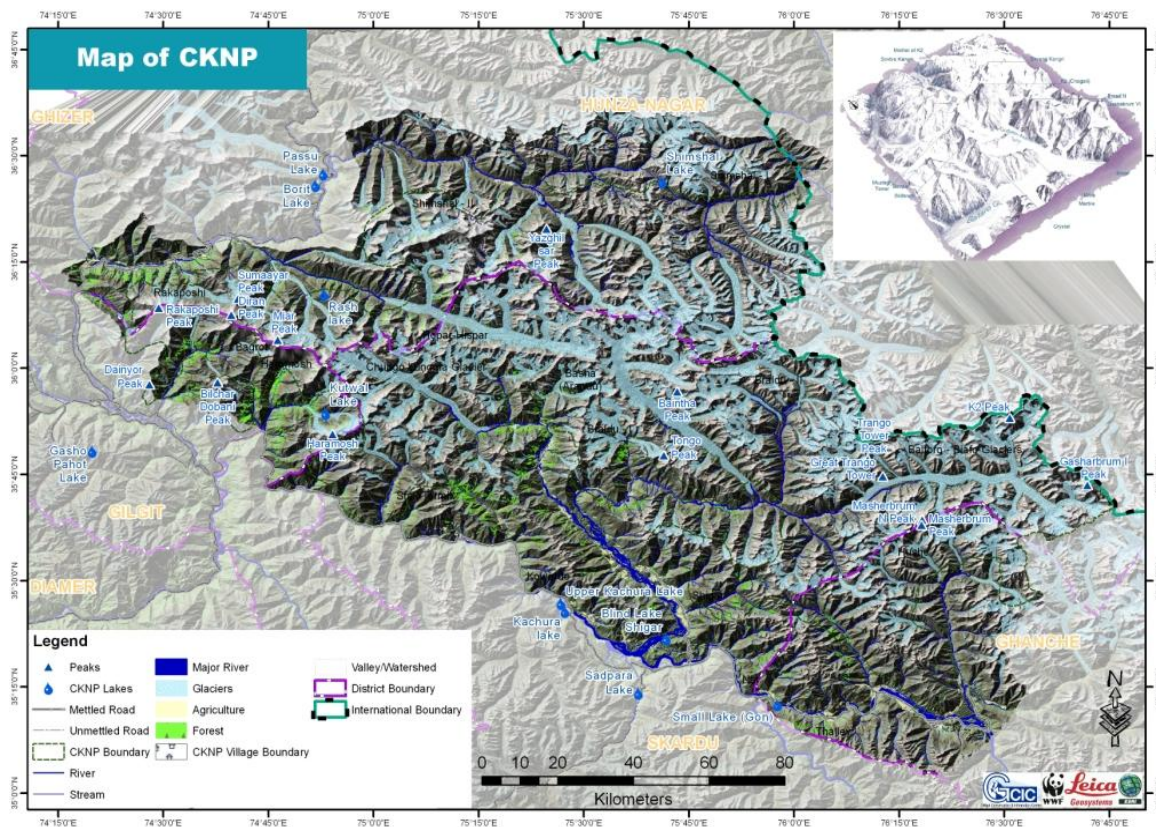

Fig. 1. Map of the CKNP.

Lack of knowledge about key parameters of the mammalian fauna such as their status, distribution and habitat utilization pose significant challenge to the park authorities in devising effective conservation strategies. In practice, the status of the threatened species inhabiting the CKNP is almost unknown, but some available information indicates that the number of the snow leopards and of markhor in particular, is very low and close to their biological threshold (Lovari and Bocci, 2009). Furthermore, all the available information comes from the border areas of the Park, where human settlement and activities are greater and access is easier. However, a major portion of the interior park is formidable to extract information from and is yet to be discovered. In addition to population size and distribution, data is

also deficient on other important factors such as large carnivores prey dynamics, human-wildlife conflicts, dietary competition between livestock and natural prey and the impact of this on large carnivore depredation rates (IUCN, 2009).

Large predators inhabiting CKNP such as the snow leopard (*Panthera unica)* and grey wolf (*Canis lupus chanku)* are not only the integral constituents of the Park ecosystem but significantly concerned for the buffer zone communities due to predation on livestock. These animals are often persecuted by local herders in retaliation when their livestock are attacked. Therefore, it is important for park managers and local communities to understand the behaviour of mammalian predators to reduce human-carnivore conflict.

Tibetan wolves are predatory animals, often coming in conflict with nomadic herders. They prey on livestock and are often killed as a result. The movement of herders up the altitudinal gradient due to climate change has reduced the available habitat and increased the level of conflict. The identification of the Tibetan wolf as a unique specie increases its threat perception (Srivastav and Nigam, 2009). Due to heavy snowfall in winter, wolves move down to lower altitudes (Mech, 1970), overlapping their movement with human activities which increases the chance of their being killed (Lovari *et al.,* 2007).

Similarly, snow leopard has been widely reported to attack livestock and being persecuted by herders in retaliation (Schaller, 1976; Hussain, 2000; Din and Nawaz, 2011). Major threats to snow leopard population in Pakistan have been identified as retaliatory killing by farmers and poaching for pelt and other body parts, loss of natural prey, habitat degradation (over grazing, fodder and fuel wood collection), and lack of awareness about ecological significance of predator species (Hussain, 2003; Din and Nawaz, 2011). In addition, as envisaged by Hussain (2003), if in a community managed conservation area, the sole purpose of an ungulate-focused conservation programme is to promote trophy hunting, the situation may constitute an additional threat to snow leopard population if a beneficiary community thinks that snow leopard may cause them an economic loss by killing trophy animals. Climate change also poses a threat to snow leopard populations causing shrinkage of habitat due to downward shift in tree line (Lovari *et al.*, 2013).

Therefore, local communities living around protected areas such as CKNP must be aware of the large carnivore's behaviour and other relevant features to reduce human-carnivore conflict. In CKNP; there is dearth of information on the behaviour, social organization and other parameters such as territoriality of the large predators. This paper intends to:

A. Review scientific and anecdotal information on behaviour of the snow leopard and gray wolf such as social organization, mating, communication, territoriality; etc
B. Based on the understanding of large mammalian predators' behaviour, recommend measures to reduce human-carnivore conflict in CKNP

Snow Leopard Behaviour
General Features
The striking feature of the snow leopard's behaviour is their nature of secretiveness and camouflage (Jackson and hunter, 1996). They are very rarely seen in the wild, even by the herders who frequently visit their habitat for the agro-pastoral activities. The snow leopards are crepuscular that suggests greater activity at dawn and dusk. In the Areas which are less populated, they may be active and agile throughout the day or they may become primarily nocturnal (active at night) when disturbed by human presence. They may reside in an area for several days and then abruptly move many miles (SLT, 2011).

Snow leopards show non-aggressive attitude towards humans, except at times the animal perceives any threat to itself or its cubs. There has never been

reported a verified snow leopard attack on a human being. Even if disturbed on a kill, a snow leopard is much more likely to run away than to defend the kill (SLT, 2011).

Territoriality

Snow leopard may not be regarded as a high altitude animal (Motion, undated) but rocky landscape and broken terrain is its most preferable niche (Chundawat, 1990).This may be due to suitable foraging condition and lack of disturbance at such places (Motion, undated). Snow leopards also share habitat with ungulates and domestic stock, for example in Sagarmatha, Nepal, Ale *et al.* (2007) found the cat in grazing lands, shrublands and open forests at 3000-5000 meters, whereas Mallon (1991) noticed that in Ladakh snow leopards prefer lower altitudes having a small habitat overlap with Ibexes. Similarly, Wolf and Ale (2009) also observed Snow leopard in Sagarmatha, Nepal preferring lower altitudes in order to avoid steep slopes. Whereas in Hemi National Park, India, Chundawat, (1990) observed snow leopards showing strong preference for very steep slopes (>40 degrees) with broken terrain at an elevation range of 3400 to 4700m, simultaneously using moderately broken terrain in proportion to their occurrence while avoiding smooth terrains.

Social organization

Like most species of cats, the snow leopards are solitary animals except when females raise cubs. The cubs remain with their mother until they become independent, normally after about 18-22 months. Sometimes a male and female pair might be seen together during mating season, or a family consisting of a mother with her young cubs can be spotted. When the cubs are nearly grown, the family may be misidentified as a group of adult cats. However, there is not yet found a particular word in literature to describe a group of leopards (SLT, 2011).

Communication

Olfactory signals such as scent marking in the snow leopard is very important way of communication aimed at maintaining the social structure, individual and kin recognition, intra-population and inter-population communication, sex recognition, mate selection, announcement of reproductive status and various moods including stress, locating and marking of food resources, and territory establishment and maintenance (Sharma *et al.,* 2006; Gorman and Trowbridge 1989; Gorman, 1990). Other modes of social communication include scrapes, which they make by using their hind legs. They also use faeces as marker. The marking activity of snow leopard is an efficient communication system keeping in view their solitary nature coupled with large home ranges and semi-arid resource-scarce habitats (Sharma *et al.,* 2006).The sounds made by snow leopards resemble to those made by other large cats. They mew, hiss, growl, moan, yowl, and make a non-aggressive puffing sound called prusten through their nostrils. However, unlike other large cats, snow leopards cannot roar (SLT, 2011).

Mating

Mating occurs in late winter and 1-5, (usually 2-3) cubs are delivered 90-100 days later conception. In captivity, oestrus in the female is marked by lack of appetite, increase restlessness and more vocalization. They usually leave about one third of the food they eat normally. Oestrus lasts for about seven days and during the span of time, the male mates about 10-20 times a day. The copulation position is the same as in leopards and tigers. During mating the male makes a characteristic cry. After mating a secluded mating den provides sense of security to the pregnant animal (Marma and Yunchis, 1967).

Birth usually lasts for 2-3 hours and in most cases takes place in the morning. Initially the eyes of the cubs are closed which open between the seventh and ninth day. During the first two weeks, mother extends protection to the cub with great care.

Wolf Behaviour

General Features

Two species of wolf, Tibetan wolf (*Canis lupus chanco*) and Indian grey wolf (*Canis lupus pallipes*) are said to be found in the Central Karakoram Range of Gilgit Baltistan (personal communication with Lovari and Bocci, 2009). Further, the significant degree of genetic differentiation of Tibetan Wolf from Grey Wolf and of these two from other wolves, suggests that these two might be new wolf species/subspecies in evolution and can be possibly described as *Canis himalayaensis* and *Canis indica* (or as *Canis lupus himalyaensis* and *Canis lupus indica*), respectively (Srivastav and Nigam, 2009).

Reproduction and Mating

The Alpha male and female make pair for life and breeding is usually confined to the Alpha pair only. Female wolves become sexually mature during their 2nd year whereas male wolves reach sexual maturity during their 3rd year (TLF, 2009). Generally, mating occurs between January and April depending upon their locality, the higher the latitude, the later it occurs. The gestation period lasts for 60 to 63 days. The pups, which weigh 0.5 kg at birth, are born blind, deaf, and completely dependent on their mother. The average litter size is 5-6 pups. Wolves typically reach sexual maturity after two or three years, at which point many of them feel compelled to leave their birth packs and seek out mates and territories of their own. Wolves that reach maturity generally live for 6 to 10 years in the wild, although in captivity they can live twice that age (Srivastav and Nigam, 2009).

Social Organization

Wolves are territorial animals, living in packs of 2-20 individuals with an average pack size 8. A wolf living alone is either an old specimen driven from its pack or a sub adult in search of new territory. While most breeding pairs are monogamous, there are exceptions. Young wolves usually remain with their parents until they reach the age of two years. Wolf cubs are very submissive to their parents, and remain so after reaching sexual maturity. Most young wolves between the ages of 1–4 years leave their family in order to search and start a pack of their own. Dispersed wolves search new territory and companionship. Successful dispersions end when the wolf has found another single wolf of the opposite sex and bonds with it. Thus, it takes two such dispersals from two separate packs for a new breeding pair to be formed, for dispersing wolves from the same maternal pack tend not to mate. Once two dispersing wolves meet and begin traveling together, they immediately begin the process of seeking out territory, preferably for the next mating season (Srivastav and Nigam, 2009).

Wolves have a linear rank order, or hierarchy, which helps keep peace within the pack. There is a separate line of rank for each sex: one for males and one for females. At the top of the rank order is the alpha male and female. The beta male and female is next highest in status. At the bottom of the rank order is the omega "scapegoat" wolf, which may be either male or female. In the rank order, each wolf has a set place. When two wolves from the same pack cross paths, one is always dominant to the other, or higher in status than the other wolf. The lower-ranking wolf is said to be submissive to the higher-ranking, dominant wolf (WP, 2011).

Ancestral wolves have evolved as hunters and now generally live in packs consisting most often of family members (Mech, 2000; AVSAB, 2008). Pack members cooperate to hunt and to take care of offspring. In a given year, generally only the alpha male and alpha female mate, so that the resources of the entire pack can be focused on their one litter (AVSAB, 2008).

In a wolf pack, the highest ranking wolves only lead the hunt for a fraction of the time (Peterson *et al.*, 2002). Furthermore, when they are hunting, they do not keep a tight linear formation based on their rank (AVSAB, 2008).

In a pack of wolves, higher-ranking wolves do not roll on their backs. Rather, lower-ranking wolves show their

subordinate status by offering to roll on their backs. This submissive roll is a sign of deference, similar to when someone greets the queen or the pope by kneeling. Consequently, a more appropriate term for the posture would be a submissive roll (AVSAB, 2008).

Higher ranking wolves don't necessarily have first priority access to food. Once a wolf has possession of food, he may not give it up to another wolf regardless of his rank. When food is not yet in possession of either wolf, ritualized aggression (snarling, lunging) may still occur, with the higher-ranking wolves usually winning (AVSAB, 2008). The alpha male does not always eat first. In fact, the hungriest wolf usually eats first. Even a low-ranking animal can defend food until it is done with eating, and whoever wants the food most usually gets it. An exception to this is the omega wolf, a very low-ranking, "scapegoat" wolf who lives on the fringes of the pack. Omega wolves usually eat last (WP, 2011).

Communication
Wolves, like other canines, use scent-marking to mark their claims to anything from territory to fresh kills. Breeding wolves' scent-mark more frequently with males doing so more often. The most commonly used scent marker is urine (Srivastav and Nigam, 2009). From an early age they establish dominance by growling. They are quite vocal as they whimper and whine in hunger, pain or to attract attention. They communicate by means of body language – ears, nose, teeth, and tail. They howl which is not uniform – each wolf has its own distinctive howl – and often a variation each time it howls. Although wolves do not bark as domestic dogs do – they do use a bark as a form of communication – usually signalling an alarm or a challenge. Howling identifies the packs whereabouts to lost members, serves to avoid aggression between packs and helps demarcate territories. Lone male wolves have a deep mournful howl, lasting for hours that can be heard up to 25km away (TLF, 2009).

Wolf communication involves a lot of signals like these. The postures and facial expressions used vary in intensity or strength, depending on the context: an alpha wolf will often simply look hard at a wolf to send it a dominance message, and a submissive wolf will often just look away from a dominant wolf to give the appropriate response. An excited alpha may give a stronger dominance message, and growl at a lower-ranking wolf or even hold it down. Stronger submission signals include whining and pawing at the dominant wolf. Mostly, signals just get louder and stronger the more excited the wolves get, and fighting occurs rarely (WP, 2011)

Territoriality
Wolves live in all kinds of terrain, from desert to tundra. They prefer areas with cover (places to hide such as brush, shrubs, or trees), near water, and near large congregations of prey (WP, 2011).

Recommendations to reduce human-carnivore conflict in and around CKNP
Majority of the predation incidences in mountainous areas are due to lax guarding practices in the form of insufficient herders tending livestock in higher pastures, especially during spring and summer (Jackson *et al*., 1996). Women and children led guarding has already proved high level of livestock losses (Bhatnagar *et al.,* 1999) and inadequate number of herders (for instance, 153 livestock/herder in GMWS Ladakh, India) has been considered insufficient for effective guarding (Namgail *et al.,* 2007). In most of CKNP valleys, this problem is likely grow more intense in future due to greater involvement of young people in education or tourism. Therefore, one of the options for people of CKNP could be collective hiring of skilled shepherds as suggested by Jackson *et al*., (1996) and for this purpose the community should be supported to generate enough amounts in their conservation fund.

Livestock insurance schemes have been proved useful in reducing human-carnivore conflict in some valleys of Baltistan (Hussian, 2003) such schemes could be expanded to other valleys of CKNP.

Though, not very much encouraged in the local culture, but a possibility could be explored with the local communities of CKNP to use improved breed of guard dogs for warding off predators. Shepherd dogs have been successfully used as alternative livestock-protection options (Coppinger and Coppinger, 1993). Use of herding dogs has also been recommended for snow leopard range countries, e.g. in Nepalese Himalaya (Jackson *et al.,* 1996) and Ladakh, India (Namgail *et al.,* 2007)

Improving veterinary services in CKNP valleys can also reduce predation incidences. Diseased animal when left out for grazing near the village, especially during winter or early spring, their chance of being killed increases many fold, e.g., a diseased goat was killed by an unknown predator just next to the owner's house (Ismail Khan, personal communication, 17 April 2013).

Incidences of livestock killing by snow leopard inside a corral are not very frequent in CKNP valleys but when happened, it has aggravated threat perception of local people. Such killing incidences can be minimized by improving structure of existing corrals, which are poorly constructed with easy access for predator to get inside. The problem is widespread in snow leopard range countries and building predator-proof corrals is considered a suitable remedial measure (*Jackson et al.,* 1996).

References

Ale, SB, Yonzon, P Thapa, K. 2007.Recovery of snow leopard *Uncia uncia* in Sagarmatha (Mount Everest) National Park, Nepal. *Oryx*, **41** (1), 89-92

AVSAB. 2008.Position Statement on the Use of Dominance Theory in Behavior Modification of Animals .American Veterinary Society of Animal Behavior www.AVSABonline.org (Retrieved: 20.12.11)

Bhatnagar, YV, Wangchuk, R. Jackson, R. 1999. A survey of depredation and related wildlife-human conflict in Hemis National Park, Ladakh, Jammu & Kashmir, India. International Snow Leopard Trust, Seatle, WA

Chundawat, RS. 1990. Habitat selection by Snow leopard in Hemis National Park, India, *Int. Ped. Book of Snow leopards* **6,** 85-92.

Coppinger, L. Coppinger, R. 1993. Dogs for herding and guarding livestock. In T. Grandin (ed) Livestock handling and transport. CAB International, Wallingford, UK

Din, JU. Nawaz, MA. 2011.Status of snow leopard and prey species in Torkhow valley, District Chitral, Pakistan.*J. Anim. Plant Sci.* **21**(4), 836-840

Gorman, ML, Trowbridge B. 1989. The role of odor in the social lives of carnivores. In: *Carnivore Behavior, Ecology and Evolution*. pp. 57–88 in J. L. Gittleman (ed.). Ithaca, Cornell University Press, Ithaca, New York.

Gorman, ML. 1990. Scent marking strategies in mammals. *Revue Suisse Zoology,* **97**, 3–29.

Hagler B. 2005. Central Karakoram Protected Area. Volume I: Studies and Recommendations for Preparation of a Management Plan. IUCN Pakistan, Karachi, HBP Ref.: D5MP2CKP.

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

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

IUCN, 2009. Draft Management Plan of the Central Karakoram Conservation Complex. HKKH Technical Paper, Pakistan, Karachi, P. 80-100.

Jackson, R, Ahlborn, G, Gurung, M, Ale, S. 1996. Reducing livestock depredation losses in the Nepalese Himalaya. *In: Proc. 17th Vertebr. Pest Conf.* (R.M. Timm& A.C. Crabb, Eds) Published at Univ. of Calif., Davis. pp. 241-247.

Jackson, R, Hunter DO. 1996. Snow leopard survey and conservation handbook. Second edition. International Snow Leopard Trust, Seattle, Washington, USA.

TLF, 2009. http://www.wolfsa.org.za/content _behaviour.htm (Retrieved 21.12.2011)

Lovari, S, Ventimiglia M, Minder L. 2013. Food habits of two leopard species, competition, climate change and upper line: a way to the decrease of an endangered species? Ethology, *Ecology & Evolution* **25(4),** 305-318.

Lovari, S. Bocci, A. 2009. An evaluation of large mammal distribution on the CKNP. Pages 126-144. Integrated case study of a selected valley in the Central Karakoram National Park. The Bargot valley (HKKH Partnership Project) Ev-K2-CNR, Italy.

Lovari, S., Sforzi, A., Scala, C. Fico, R. 2007. Mortality parameters of the wolf in Italy: does the wolf keep himself from the door? *Journal of Zoology* (Lond) **272,**117-124

Mallon, D.P. 1991. Status and conservation of large mammals in Ladakh. *Biological Conservation.* **56 (1),** 101-119

Marma, BB. Yunchis, VV. 1976. Observations on the breeding management and physiology of Snow leopard (*Panthera u. uncial*). Canids and Felids in Captivity. 66-73.

Mech, LD. 1970. *The wolf: the ecology and behaviour of an endangered species*. New York NY: Natural History Press.

Namgail, T, Fox, JL, Bhatnagar, YV. 2007. Carnivore-caused livestock mortality in Trans-Himalaya. *Environ Manage*, **39,** 490-496.

Peterson, RO, Jacobs, AK, Drummer TD, Mech LD, Smith DW. 2002. Leadership behavior in relation to dominance and reproductive status in gray wolves, *Canis lupus. Canadian Journal of Zoology,* **80**, 1405-1412.

Roberts, TJ. 2005. *Field guide to the large mammals of Pakistan.* Oxford university press, oxford, UK.

Schaller, GB. 1976. Mountain Mammals in Pakistan.*Oryx,* **13,** 351-356

Schaller, GB. 1977. Mountain monarchs. Wild sheep and goats of the Himalaya. The University of Chicago Press, Chicago and London. p 425.

Sharma S, Dutta T, Yash Veer B. 2006. Marking site selection by free-ranging Snow leopard *Uncia uncia*, McNeely, J.A., T. M. Mc Carthy, A. Smith, L. Olsvig-Whittaker, and E.D. Wikramanayake (editors). *Conservation Biology in Asia*. Published by the Society for Conservation Biology Asia Section and Resources Himalaya, Kathmandu, Nepal, pp 197-213

SLT, 2011. Snow Leopard Trust, www.snowloepard.org(retrieved: 18.12.11)

Srivastav, A. Nigam P. 2009. *National Studbook of Tibetan wolf (Canis lupus chanco).* Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi.

WF. 2011. Wolf Park. http://www.wolfpark.org (Retrieved 25-12-11)

Wolf, M, Ale, S. 2009. Signs at the top: Habitat features influencing snow leopard *Uncia uncia* activity in Sagarmatha National Park, Nepal. *Journal of Mammalogy*, **90(3),** 604–611.