

HIMALAYAN MUSK DEER IN ANNAPURNA CONSERVATION AREA, NEPAL

by Achyut Aryal

Musk deer (*Moschus chrysogaster*), one of six deer species that occur in Nepal, belongs to Order-*Artiodactyla*, Family-*Moschidae*. In Asia, it is distributed in Afghanistan, Bhutan, China, India, Myanmar, Nepal, and Pakistan. In Nepal, it is found in the Annapurna Conservation Area (ACA), Kanchenjunga Conservation Area (KCA), Sagarmatha, Langtang, Shey Phoksundo, Rara, Khaptad and Makalu Barun National Parks and Manaslu Conservation Area, where a major problem is poaching (NBS, 2002). In these areas, they are distributed in alpine forest and the vegetation consists of oak, fir, rhododendron, blue pine, juniper, grass, lichens and scrub between elevations of 2,200 to 4,300 m on the eastern and southern edge of Tibet and the southern slopes of the Himalayas. *M. chrysogaster* usually lives in forests with moderate to steep slopes (Kattel, 1991; Green, 1987).

Musk deer is a protected mammal and listed as an endangered species by the National Parks and Wildlife Conservation Act 1973, in Nepal. It is listed by CITES in Appendix I for Afghanistan, India, Nepal and Pakistan, and in Appendix II for Bhutan and China.

The purpose of the study "Status (population, poaching and habitat) of musk deer (*Moschus chrysogaster*) in Annapurna Conservation Area of Manang district" was to determine the musk deer population, habitat structure, extent of poaching activities and the deer's current status in Manang district of Annapurna Conservation Area of Nepal, where this data is lacking. The objectives of the study were as follows:

1. to determine the population status of musk deer in study area;
2. to assess the present habitat structure;
3. to assess past and present poaching activities on musk deer in the study area;

4. to map out distribution and potential poaching areas in ACAP; and
5. to identify current threats to the musk deer population and their habitats.

Musk deer was once widely distributed throughout most of the Nepal Himalayas between about 3,050 m to 4,270 m altitudes. The habitat of musk deer in the upper Langtang Valley, in the vicinity of the Thyangboche monastery in Khumbu, and in upper Budi Gandaki Valley is better protected than in other parts of country. According to Jamwal (1972), areas where musk deer are more commonly found in Nepal are Bajhang, Doti, Simikot, Markhor Lake, Dhorpatan, Manang and Langtang in the west and central regions.

Study area: Manang District

The study area was located in Manang District of the Western Development Region of Nepal (Humde area and Pisang), which lies in the north-central part of Nepal. It covers an area of 2,246 km², lying between 28° 27' and 28° 54' N latitudes and 83° 40' and 84° 34' E longitudes. The elevation ranges from 1,600 m (in Tal) to 8,156 m (in Manaslu I). The altitudinal variation has resulted in diverse climatic conditions. The land use pattern of this district is not suitable for agriculture, which represents only about 0.5% of the total land usage.

Methods

Population status

A pellet count was carried out in transect lines marked out in both study areas and the silent

drive count method was done in one study area (Humde). Pellet groups were counted in the transect lines with the help of local people. Both the silent drive and pellet group count were done in the Humde area. This was done to estimate the population density by pellet groups in other sites with reference to the Humde area result. Only the pellet group count was done in the Pisang area.

Pellet density was also recorded for pellets up to approximately 30 days old in transect lines of 10 m x 500 m from altitudes of 3,500 m to 4,000 m. Both pellet density and silent drive count methods were used in the Humde area. In the Pisang area only pellet density was observed. In the Humde area a pellet density survey and a silent drive count were conducted twice (summer and autumn). Musk deer drop pellets in the same place, so a distinct layer forms comprising older and new pellets; when the lower layer and upper layers are less than 30 days old, they are counted as two pellet groups.

The regression model for the prediction of population density/km² of musk deer through data pellet density/km² was developed on the basis of two data collections from the Humde area; both times the same area was used for the pellet density survey and silent drive count.

Regression equation: $X = a + bY$

Where X = Population density/km² (dependent variable)

Y = Pellet density/km² (independent variable)

$$a = X - bY$$

$$b = \frac{N \sum XY - (\sum X \cdot \sum Y)}{N \sum Y^2 - (\sum Y)^2}$$

Habitat structure analysis

Vegetation analysis

A vegetation analysis was carried out in Musk deer habitat. A floristic survey was conducted with random sampling methods in all representative areas. Sample plots were laid where encounters with pellets occurred and plots were also laid where pellets were absent. The sample plot size for plants used were as suggested by Schemnitz (1980), i.e. 10 m x 10 m for tree layer, 4 m x 4 m for all woody undergrowth to 3 m in height, and 1

m x 1 m for the herb layer in composite plots, calculating plant density, frequency, abundance etc. The IVI of tree species was obtained by the summation of relative density, relative frequency and relative dominance. $IVI = \text{relative density} + \text{relative frequency} + \text{relative dominance}$

Physical feature analysis of habitat/Past and present trend of poaching/Mapping the poaching and distribution areas

Other features of habitat such as cover, ground morphology (broken, unbroken, smooth, presence of boulders or small rocks) and erosion, cliffs, caves and water sources were noted, as was the slope, elevation and aspect, by directed observation using appropriate instruments. Past and present poaching trends were determined through interviews with local people. After completion of the field visit, the data was plotted on the original map to show the poaching and distribution.

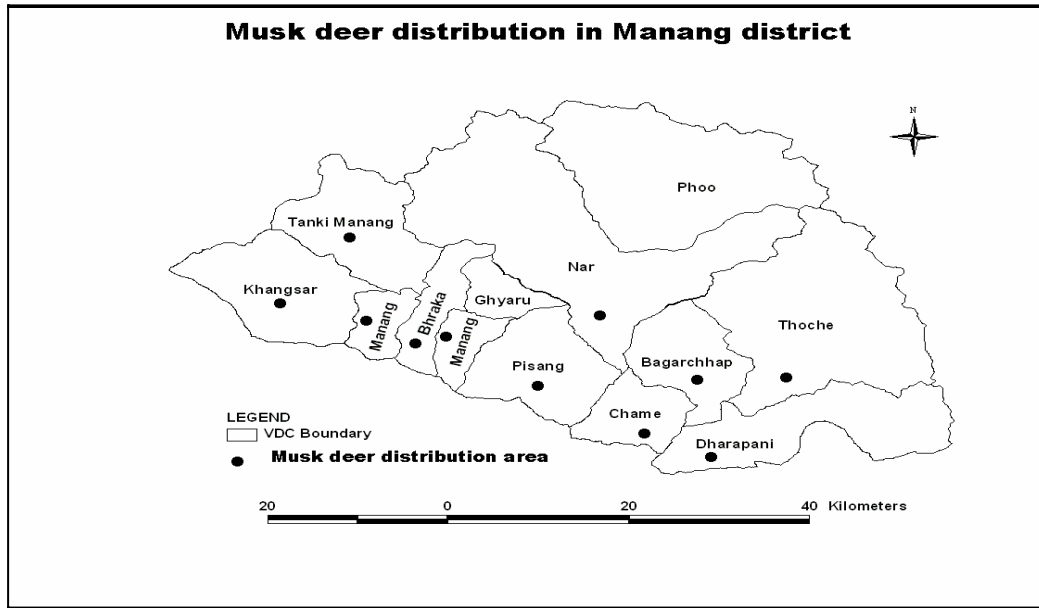
Results and discussion

Present distribution of musk deer in ACAP region

Manang and Mustang districts have provided prime habitat for musk deer. In Manang district they are distributed in Thoche, Tache Bagarchap, Dharapani, Chame, Manang, Tanki Manang, Khansar, and Nar VDCs. Nyeshang valley (which is the largest valley of Manang and starts from Pisang VDC to Throng Phedi and covers the six VDCs) harbors a high density of musk deer populations. Similarly, in Mustang district musk deer is found in Tukuchhe, Jomsom (at higher altitudes), Marpha, Muktinath, Kobang, Dzong and Kagbeni VDCs. In 2000, an ACAP patrolling team, led by Ajay Pandey (Officer-ACAP) and Rajesh Gupta (Ranger-ACAP), encountered musk deer in Parche and Namarjung VDCs of Kaski district as well.

Population status

The study area of Humde was approximately 3 km². Pellet density of musk deer in Humde area was recorded at 11.33/ha in the summer and 11 musk deer were counted. In autumn, the pellet density recorded was 17.45/ha and 16 musk deer



were recorded using the silent drive count method. On the basis of the silent drive count method, the average population density of musk deer was 4.5 individuals/km² in the Humde area. The potential habitat of musk deer in Humde forest is 5.1 km², so we can estimate there are approximately 23 musk deer present.

The pellet density in the Humde area was 11.33/ha and 17.45/ha in the summer and autumn surveys respectively. The pellet density in the Pisang area was 9.33/ha.

Number of Musk deer records in the Humde area in September, 2004, and June, 2005 using silent drive methods of census.

S.N.	Adult			Juvenile	Total
	Male	Female	Unclassified		
Summer	3	-	7	1	11
Autumn	5	6	5	-	16

The regression model for the predication of population density/km² of musk deer through data pellet density/km² was developed on the basis of two data collections from the Humde area. Both times the same area was used for the pellet density survey and the silent drive count.

The regression equation for the estimation of population density/km² (X) is:
 $(X) = 0.59 + 0.003Y$, where $a = 0.59$, $b = 0.003$.

On the basis on this equation the population density of musk deer in Pisang forest was 3.4 individuals/km². There is a 7.82 km² area which provides potential habitat for musk deer; therefore, it is

estimated that at least 27 individual musk deer may be in Pisang forest. There was high poaching pressure in Pisang forest but in the Humde area there have been no recorded deaths of musk deer by hunters/poachers in the last 3 years. This may explain why the population density of musk deer is low in Pisang forest compared to Humde forest.

Population trends

According to the local people, the present population of musk deer is low compared to the past 10 years. Heavy poaching occurred in Pisang VDC. According to interviews with herders and other local people in the study area, in Pisang there is high poaching pressure on musk deer and about

90% of the respondents agreed that the population was gradually decreasing

In both study areas, before 1991, there was a high population of musk deer, and from 1991-1998 there was high poaching pressure. An elderly former herder said that the population of musk deer has changed drastically compared to before 1991. At that time there were more than 200 musk deer in Pisang and more than 100 musk deer in Humde. But now, only around 50 remain in Pisang and about 25 in Manang VDC. Most of the respondents in Pisang indicated that the population of musk deer was declining gradually, but while the respondents in Humde indicated that the population of musk deer was also declining, it was less significant than in the Pisang area because the influence of poachers is lower in Humde than in Pisang. Many respondents blamed poaching, killing by predators, and human and livestock disturbance in its habitat as the main causes of the decline in the population of musk deer.

Habitat preference

The musk deer frequented lower altitudes in times of snow. The preferred altitude of the musk deer in Pisang is 3,800 m (± 300 m) and 3,700 m (± 200 m) in Humde in Manang district.

The highest rates of encounter with musk deer pellets were at 36° to 45° angles of slope in both study areas.

In Pisang, a higher number of pellets were found in the NW aspect compared to other aspects and in Humde almost all pellets were found on northern slopes. This may be due to the pressure of human activities (timber and fuel wood collection) and livestock grazing was higher in other aspects than in the NW aspect of Pisang. The Humde study site faced the northern slope. The musk deer were more active on northern slopes and they rested more on southern slopes. Northern slopes may be warmer at night because they are probably more sheltered (Green, 1987).

During the study period almost all of the ground layer vegetation was dry. The ground level was covered with litter and partly with snow. The

highest amount (34%) of pellet groups were found in very sparse (0-25%) ground cover in Pisang.

Musk deer habitat in Pisang was dominated by *Abies sp.* forest and the musk deer habitat of Humde area was dominated by *Betula sp.* forest.

Tree/shrub/herb status in musk deer habitat

In Pisang, 6 tree species, 9 shrub species and 11 herb species were recorded, while 5 tree species, 4 shrub species and 7 herb species were recorded in a sample plot in Humde.

In Humde, *Betula utilis* was the most prominent tree species of musk deer habitat, while in Pisang, *Abies sp.* was most prominent followed by *Betula utilis*, *Juniperus sp.*, *Cupressus torulosa*, *Pinus wallichiana* and *Rhododendron campanulatum*. Similarly in Humde, the important species were *Betula utilis* followed by *Cupressus torulosa*, *Abies sp.*, *Juniperus sp.* and *Pinus wallichiana*.

Past and present poaching activities and potential poaching areas

Hunters use a variety of techniques to kill musk deer, including snaring and shooting, the latter sometimes aided by dogs. In the past, hunters usually used guns and dogs, but now due to the security situation in the country, shooting has been replaced by snaring. Pisang is one of the potential poaching areas of Manang district. And according to local people, the eastern part of Humde where there is less movement of local people is also a potential site for poaching. Three years ago, many snares were found in Humde but this year patrolling teams were unable to find any snares in the area. In Pisang, which sees heavy poaching every year, many snares were destroyed by the patrolling group. Generally, Meraka danda, Namche, Nalgo, Kyadi and Kyothopa Pakha are high potential poaching areas of Pisang. A high number of snares were destroyed by patrolling teams in Nalgo, Namche, and Meraka danda of Pisang area. The eastern part of Humde is also a potential site for poaching. In 2004, patrol teams from Pisang found 6 snares containing evidence of the remains of musk deer. Ankhwachung Gurung and Bhujung Gurung (CAMC, Pisang), estimated that about 25 musk deer were killed by

poachers in 2002-2004 from Pisang forest. There is also high poaching pressure in Tilche forest of Thoche VDC.

Trade pattern in Manang

It was very difficult to identify the trade pattern of musk deer in the study area. During the study periods many snares and signs of poaching of musk deer were found in the study area, which shows that there is also trade in musk deer. The trade is impossible without the involvement of local people who provide information about patrolling, but do not necessarily set snares or kill musk deer directly, and it is very difficult to discover who is involved. Generally, poachers come from Gorkha, Dhading, Lamjung and Tanahaun districts. According to the local people and former hunters, one male musk deer produces about 3 tola (1 tola = 11.64 gm) of musk. At the local level, one tola of musk is priced at NRs 5,000. Poachers supply to local middle-men, who then send the product to Tibet. Poachers also sell to middle-men in Kathmandu, hiding the musk pods in ghee (clarified butter) bottles. In 2004, patrol teams in Pisang found 6 snares with evidence of the remains of musk deer.

Conservation status of musk deer in Manang

The religion of Manang (Buddhism) advocates the conservation of wildlife. Sherpa Gulcha (a Buddhist Lama), has made great contributions and encouraged the conservation of musk deer in Manang VDC. He encouraged the formation of musk deer conservation committees and provided NRs. 50,000 (approx. US\$715) for the conservation of musk deer. That committee is now under the CAMC, Manang VDC and Tanki Manang VDC, i.e. *Musk deer conservation joint sub-committee, Manang and Tanki Manang VDC*, which was established in 1996. ACAP provided NRs. 85,000 (approx. US\$1,215) as an endowment fund and CAMC Manang and Tanki Manang, VDC also collected the same amount and deposited the funds in the committee's bank account, using the interest for the conservation activities, in particular for patrolling. Presently, the committee has NRs. 209,000

(approx. US\$2,986). The musk deer conservation joint sub-committee has invested about NRs. 50,000 (approx. US\$7,143) over the last 6 years for patrolling and other community development activities. CAMC Pisang also operates a musk deer conservation committee (there is no separate body for the conservation of musk deer). CAMC Pisang has mobilized local people for the conservation of musk deer and does regular monitoring work for the conservation of not only musk deer, but also other wildlife in their area. They patrol musk deer habitat regularly and destroy large numbers of snares every year. They can punish those who are responsible for musk deer poaching. Two years ago, the musk deer conservation joint sub-committee of Manang and Tanki Manang levied fines netting about NRs. 800,000 (approx. US\$11,429) from those responsible for the poaching of musk deer. The funds generated have been used for musk deer conservation work and community development works. These instances indicate that the harnessing of religious elements and indigenous systems with conservation connotations may be beneficial for the overall conservation efforts of ACAP.

The study shows that poaching of musk deer has declined over the last 3 years due to regular patrolling in musk deer habitat by CAMC Pisang and the musk deer conservation joint sub-committee Manang and Tanki Manang VDC. CAMC, Pisang and the musk deer conservation joint sub-committee members have been patrolling during their free time from agriculture work. When the farmers or local people are busy with their agricultural activities, the poachers are more active in putting out snares and hunting musk deer. Therefore, the committee is being more careful and will do regular patrolling with the help of local people.

Threats

Habitat loss

Excessive degradation and fragmentation eventually leads to habitat loss. Potential habitat of musk deer has already been lost due to heavy deforestation and fires in the northwest part of

Humde. Local people in Humde are highly dependent on musk deer habitat for fuel wood, and in Pisang forest they depend on the timber available there. Pisang suffers from high rates of deforestation for timber and fuel wood. Conversion of the northwest part of Humde's forest into degraded land and the heavy pressure on the forests of Pisang and Humde for fuel wood and timber is causing loss of good habitat for the sensitive musk deer.

Predators

According to local people, yellow-throated martens have killed about 15 juvenile musk deer over the last three years. During a field visit in September 2004, the author found a piece of musk deer skull and scat of both snow leopard and yellow-throated marten. The scat of both species contained musk deer hair. Generally though, the yellow-throated marten is the main predator of the juvenile musk deer.

Grazing

Owing to high seasonality and low primary productivity, the Himalayan region supports a relatively low ungulate/herbivore biomass. It is therefore obvious that with the increase in the biomass of domestic livestock in many areas, wild ungulates such as musk deer have suffered competitive exclusion. Sathyakumar *et al.* (1993) reported that increased livestock grazing and the associated impacts have led to low musk deer densities in many areas in Kedarnath Wildlife Sanctuary, India. In Pisang, 58% of the musk deer habitat suffered domestic livestock grazing pressure, while there is 62% grazing pressure in musk deer habitat in Humde.

Poaching

Poaching is one of the main threats to the population of musk deer in the study area. Pisang VDC has a large favourable area for the musk deer but there is also heavy poaching in this region. The musk deer conservation committee and CAMC, Pisang have been patrolling regularly and each year they find many snares and signs of killing of musk deer by poachers. Poaching is higher in Pisang compared to Humde. According

to a field survey, 75% of the respondents of Pisang reported ongoing poaching of musk deer, while only 29% of respondents in Humde reported poaching in Humde.

Conclusions

1. Musk deer is distributed in all VDCs of Manang district except Phu VDC. A high density of musk deer is found in Nyeshang Valley. Pisang harbored a good number of musk deer, followed by Tilcho forest of Thoche VDC, Manang and Tanki Manang, Khansar, Chame, Dharapani, Tache Bagarchap and Nar VDCs.
2. Potential musk deer habitat in the study area covered 7.82 km² for Pisang VDC and 5.1 km² in Humde. A total of 8 and 12 forest sites in Humde and Pisang respectively had the highest potential as musk deer habitat.
3. The average population density of musk deer in Humde area was 4.5 individuals/km² and an estimated 23 animals are present in Humde. Similarly, the population density of musk deer in Pisang area is 3.4 individuals/km² and approximately 27 individuals are present in Pisang forest.
4. The regression equation for the estimation of population density/km² (X) is: $(X) = 0.59 + 0.003Y$ on the basis of pellet density/km² (Y).
5. The musk deer population trend has been declining at a high rate in all VDCs of Manang district, except for Manang and Tanki Manang VDC.
6. Musk deer preferred to occupy the 3,300 to 3,700 m altitudinal range in the study area, having 36 to 45 degrees angle of slope, a northwest and northern aspect, with good cover structure (dense forest).
7. A high percentage of musk deer pellets were counted in forest land, followed by shrub land, grazing land and open land.
8. A high percentage of pellets were counted in areas of 50% to 75% crown cover and 50% to 75% ground cover.
9. In Humde, *Betula utilis* was the most prominent tree species in the Musk deer habitat, while in Pisang VDC, *Abies* sp. was the most prominent tree species, followed by *Betula utilis*, *Juniperus* sp., *Cupressus* sp.,

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Pinus wallichiana and *Rhododendron campanulatum*. In Humde, the important species were *Betula utilis* followed by *Cupressus torulosa*, *Abies* sp., *Juniperus* sp. and *Pinus wallichiana*.

10. Snaring/trapping is currently the preferred method of poaching. In the past, poachers used guns, poison and dogs for killing musk deer.
11. Other threats to musk deer habitat include overgrazing by domestic livestock, forest fires, timber and other forest product collection.

Recommendations

- There is an urgent need to increase trans-boundary co-operation between Nepal, India and China to control the illegal trade of wildlife products.
- An awareness programme is essential for school students, leaders, villagers, etc., to change the attitude of local people towards the conservation of musk deer and other species.
- Detailed studies (ecology, distribution range, movement pattern, population, etc.) should be carried out in the whole potential habitat of Annapurna Conservation Area and ACAP should develop a musk deer conservation Action Plan with full participation by the local people.
- For truly effective conservation measures, popular participation is essential, particularly in the Nepal context of poor enforcement and little rule of law. Hence, the following conservation measures are recommended:
 - Enforcement of existing protection measures against poaching, and vigorous action against hunters and traders.
 - The Humde area of Manang is a potential site for the establishment of a musk deer breeding/farming center. ACAP should take action to explore this potential and seek necessary cooperation and support from the relevant government authorities.
 - Special forest zones should be established for musk deer. A core area should be demarcated in prime musk deer habitat where local people are prohibited to graze domestic livestock, collect forest products,

or to carry out any activities which may disturb musk deer.

- Feasibility studies should be undertaken to explore the potential for ranching and safe harvesting of musk from deer in their natural habitat.
- The musk deer conservation joint sub-committee can be strengthened by training, introducing an incentive programme for local people, etc. for the effective conservation of musk deer in natural habitat.
- Regular patrolling should be done in all musk deer habitats, particularly in times when agriculture work demands many people to be out in the farms and forest land.

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REPORT ON THE SURVEY OF HIGHER VERTEBRATES OF RIVERS YAMUNA AND GANGA

by R.K. Sharma

Introduction

The Forest Departments of Madhya Pradesh and Uttar Pradesh have been concerned about the status and conservation of higher riverine vertebrates (dolphins, otter, crocodilians, turtles and birds) for the last two decades and a number of river sanctuaries have been notified for this purpose. Surveys of rivers to evaluate the status and estimate animal populations are essential for the planning and implementation of these conservation programs. Available information about the occurrence of higher vertebrates in the rivers of northern India are long outdated, besides being anecdotal and fragmentary. The Yamuna River below its confluence with the Chambal, and the section of the Ganga flowing into the Yamuna, have not been systematically surveyed for higher vertebrates so far.

Surveys of the above-mentioned sections of rivers have a special significance with regard to the status of the gharial, because they can reveal information regarding the migration of this species from the National Chambal Sanctuary, which contains breeding populations and releases considerable numbers of captive-reared gharial to supplement wild populations. With the above objectives in mind, a survey was carried out in February 1977. The surveys assumed special importance for the assessment of the effects of

severe floods that occurred in the 1996 monsoon season in the riverine/riparian ecosystem of the Yamuna and Ganga.

Survey methods and program

In northern India, gharials will bask for long periods during the day in winter if left undisturbed. Therefore, daytime counts of gharials in winter can reveal a high proportion of the total numbers of gharial inhabiting a specific section of the river. Counting gharials during the winter daylight hours from a moving craft is a valid method for censusing gharials, as the possibility of counting and individual more than once is precluded because the gharial will remain within their preferred home range after the observer has moved on to the next area.

The Yamuna and Ganga rivers were surveyed during daytime travel on the rivers by a boat equipped with a 40 HP outboard motor. 10x50 power binoculars were used as visual aids. The survey was conducted between 3-7 February 1997, covering a total river length of 650 km along the Yamuna river, extending from its confluence with the Chambal river, downstream to its confluence with the Ganga, and along the Ganga downstream to Varanasi .