SUMMARY

Introduction

The Indian Grey Wolf *Canis lupus pallipes* is one of the smallest wolves of the world. This subspecies represents the southern most limit of the range of wolf distribution in the world. The distribution range of the *Canis lupus pallipes* extends from Israel, Syria, southern Iraq, southern Iran, Kuwait in the Middle East to southern Afghanistan and Pakistan to India.

Wolf as well as Blackbuck *Antelope cervicapra* are classified as endangered species in the Indian Wildlife (Protection) Act, 1972. The range of these species has constricted mainly because of shooting and destruction of grasslands. Except for preliminary status surveys in India, there is lack of information with regard to wolf behaviour, dynamics, natality, mortality, food supply and livestock depredation which results in wolf-man conflict.

During the first two decades of independence, the Blackbuck which was abundant all over the Indian plains but especially in the Deccan, was hunted out in most of its range. However, since the enactment of Wildlife (Protection) Act of 1972, there has been resurgence of Blackbuck populations in certain areas such as Nannaj. The Blackbuck being a major natural prey of the wolf, the latter has also increased or stabilized in some areas. However, wolf is a regular predator of livestock, which
brings it in direct conflict with humans which needs special emphasis. This study was focused on the following objectives:

1. Population of primary prey species
2. Status and dynamics of wolf population
3. Habitat use and preference
4. Interactions with Blackbuck and livestock
5. Breeding biology and
6. Suggest recommendations to the Sanctuary managers and prepare a conservation and management plan for the wolf based on findings of this study.

**Methods**

Open width Transects in different habitats were monitored to find out the abundance of Blackbuck which is the major prey species of wolf at the study site. Simultaneous counts were made for two consecutive days from 07:00 to 08:30 H on 15 July every year. The pack was not radio-collared, the individual wolves were recognized by natural marks.

For investigating habitat use of wolf, the area was intensively searched for wolf tracks and signs. The pack was observed directly with binoculars and spotting scope for habitat use. Whenever possible the pack was followed on foot during its movement in different areas. Usually, the pack was spotted in the morning hours around water holes or on Blackbuck kills and followed till it entered a woodlot or shaded area to rest during the day in a secluded area away from human
interference. Such areas were later investigated for habitat characteristics.

The Nannaj Pack was monitored on an intensive, regular basis from July 1991 to August 1994. This wolf pack was usually spotted at a kill between 06:00-07:00 H. With the passage of time and experience, it was not difficult to locate the pack on kills. Once the pack was spotted at a kill, a continuous attention was paid to it until the pack members moved away from the kill. Data was collected on sex and age of the kill, biomass left unconsumed and distance of the kill from the protected area where the animal was supposedly killed. The terrain and the vegetation of the site were also recorded. Similarly for domestic ungulates (goats and sheep), data on age, sex, location and distance of the kill from the protected area of the Sanctuary were recorded.

The weight of each kill left unconsumed and the number of wolves that were known to have fed on the kill with certainty were recorded to compute the mean consumption rate of wolves.

Pups refer to the individuals less than six months of age, subadults or juveniles as 6-7 months old individuals, yearlings as 1-2 years and adults two and more than two years of age. However, it is extremely difficult to distinguish yearlings from adults in the field unless they are observed from very close quarters.

The breeding period (December-August) includes denning and post-denning
periods (during which the pups are reared till they start hunting on their own). Dens were located by keeping regular notice on the movement of the pack during December to January. Once a den or rendezvous site was located, care was taken not to disturb wolves by not going close to them at these sensitive sites. After an active den was located, hide was placed at about 300 m distance from it for observing them at dens.

Results

The total count of Blackbuck population in Nannaj area was found to be around 700 which keeps fluctuating year-to-year depending on precipitation in the area and hunting pressures on the population. A part of the population is also removed by wolves and stray dogs round the year.

The contribution of the adult females to the total population was highest followed by the sub-adult females (about 20%) while the adult males (M1 and M2) comprised 7.7% of the population in 1991. In 1992, again adult females constituted the highest population (88%).

The sex ratio of Blackbuck was found to be disproportional and highly biased towards females. The factors for mortality other than natural death are natural predators such as the Indian wolf and stray dogs. It was found that M1 and M2 males and fawns are more prone to predation by wolves than any other age and sex class of the Blackbuck.
The maximum concentration of Blackbuck was always seen in and around the grassland Site-1 mainly because of less disturbance in this area. Thirty nine percent of the total Blackbuck kills were located at this site.

The grassland had highest Blackbuck density among all the habitats during all seasons except summer when it is less or nearly the same as in the woodlots.

In summer, the density was maximum (92/km²) in the grassland Site-1 and the woodlot (91/km²). The density was minimum for grassland Site-2 (10 individuals per km²). The grazing land sites differed, Site-1 having higher density in comparison to the second site.

In monsoon, the grassland Site-1 had maximum number of individuals (226/km²) followed by grazing land Site-1 having density of 144/km². The abundance of Blackbuck was low at grassland Site-2, grazing land Site-2 and the plantation. The prey was abundant in grassland and plantation habitats than in grazing land during summer.

The herd-size varied between the habitats and between the seasons. It was found that the Blackbuck congregate in large herds during the monsoon because of the forage availability in the form of fresh grass growth. On the other hand, they break into smaller units during the dry summer season and spread over a vast area. The herd-size classes of 9-16 and 17-32 individuals were seen more frequently than any
other class in all the seasons whereas sightings of herds comprising more than 200 individuals were low. The higher frequency of occurrence of the smaller herd-size classes in all the seasons is perhaps to prevent overgrazing which results because of immense competition for food amongst large number of individuals.

Large herds were sighted in open areas whereas smaller groups in the plantation which may have been evolved as an anti-predator strategy. Smaller groups may be able to remain undetected in the plantation cover. On the other hand, in an open grassland, the probability of spotting a predator by a large herd and thus becoming alert for self-defence is more than in the area with more vegetative cover. Nevertheless, wolves manage to locate sick individuals from large herds too and chase them off from the herds.

The Nannaj Pack had seven individuals in 1991 which increased to 12 in 1992. There were two more packs adjacent to the Nannaj Pack. Gangewadi Pack was present 20 km (linearly) northeast from the centre of the territory of Nannaj Pack. Another pack named Mohol Pack was present in Mohol area, 25 km (linear distance) west of the territory of Nannaj pack. The Nannaj Pack did not breed during 1992-93 which was a drought year. The sex ratio of the wolf population was biased towards males in 1991 while equal in 1992 and 1993. The sex ratio of the 1994 population was not known.

The wolf is present in all sub-divisions of Solapur. Solapur district supports a
minimum population of 53 and maximum of 85 wolves. Much of the range is inhabited by low pack-sizes. The largest pack-size comprised of 12 wolves and smallest of two individuals. This is because of the high human populations in such areas and disturbance. Moreover, the natural prey base and livestock (goats and sheep) are also low in these areas.

The wolf has disappeared from some areas during the last one and half decades mainly due to decline in prey base and irrigation facilities which have resulted in intensive agriculture.

There was a fluctuation in average pack size during non-breeding and breeding periods but it was statistically non-significant (Mann-Whitney U Test, U=10, P=0.16). The average pack size during breeding and non-breeding seasons varied from 1.5 to 4.7 individuals.

Two dead wolves were recovered in 1992: one in September which probably died because of rabies and another in October that was killed by shepherds. No mortality in pups was recorded after they left the dens and were six to seven months old.

Principal Component Analysis on the habitat variables revealed that the vegetative cover, abundance of Blackbuck and distance to water source are the important parameters to wolves in selecting particular patch of the Sanctuary as a rendezvous site.

The result of chi-square statistics rejected the null hypothesis that the wolves use
each habitat type in relation to its availability in the study area. There was a significant difference (P<0.05) in usage of the habitat types. The plantations and grasslands were used more than expected in summer (P<0.05). Grazing land was avoided in all the seasons. During monsoon and winter, the scrubland and plantation habitats were used in proportion to availability whereas grassland was preferred. Wolf use of rendezvous sites was maximum at those patches of scrubland where vegetative cover was 20-30%. In 1992, the pack used two rendezvous sites whereas during 1994 the pups moved over four rendezvous sites. The latter had a characteristic odour of droppings and kill remains. The first rendezvous site was closer (0.13 km) to the natal den than the second (1.7 km).

There was a seasonal difference (Kruskal-Wallis test, H=8.32, P=0.016) in waterhole usage by wolves. During summer, they were usually sighted around waterholes in the Sanctuary whereas in other seasons they used other water source(s) outside the Sanctuary.

Usually the wolves used to single out an injured or sick Blackbuck and chase it. They were found to prefer visceral parts first followed by rump and then limbs and neck region. The average everyday consumption rate and kill interval of wolves were found to be 1kg wolf\(^{-1}\) and 3.65 days respectively. Consumption rate of wolves was not correlated with pack size (r\(_s\)=0.16, P=0.07).

Predation pressure upon Blackbuck by wolves was significantly (U=461, P=0.01)
higher than on livestock during the non-breeding period of wolves. The wolves had a strong selection for male Blackbuck ($U=42, P=0.01$) despite the higher availability of female individuals in the population. 36% of the Blackbuck killed by wolves were located close to the plots of the Sanctuary at a distance of 10-100 metres. Most of the kills when there was no disturbance to the wolves, were utilized by them completely. The wolves harvested about 4% of the biomass of Blackbuck (56,058.5 kg) available to them in the Sanctuary. Thus wolf predation on Blackbuck will help maintain the population of Blackbuck rather affecting it by removing the oldest, injured and sick individuals from the population.

During the denning period and till the pups are 5-6 months old, the wolves prey mostly on livestock especially goats and sheep. The wolves killed significantly more number of goats than sheep ($X^2=14.25, \text{d.f.}=1, P<0.001$) inspite of the higher availability of the latter. The linear distance of diurnal wolf kills of livestock from the protected plots of the Sanctuary varied from 0.01-1.25 km ($\bar{X}=0.3$ km). 63% of the kills were found at a distance of 1-4 m from a bush or some other vegetation which implies that most of the victims must have been ambushed by wolves.

The Nannaj Pack bred twice during the study period. A single litter was produced in both the years. During 1991-92, the wolves used only one den whereas during 1993-94 they shifted dens five times because of human disturbance. All the dens were located in elevated and well drained areas. The alpha male was seen more frequently guarding dens than the alpha female ($X^2=26.9, P<0.01, \text{d.f.}=1$).
1991-92 when helpers were present in the pack, alpha male and female were often seen around the den. The alpha male was more aggressive around dens than alpha female. The wolves used to howl frequently at the rendezvous sites and another activity at these sites was social play.