CHAPTER NINE

BREEDING BIOLOGY

9.1 Introduction

The wolf is a highly social animal and these social bonds are firmly revealed by the fact that the members of a pack remain together. The entire pack cares cooperatively for the breeding female and the pups.

One of the reasons why such strong ties exist between different members of a pack is the long association of pups and parents and/or foster parents when they raise them. This period of socialization is very important in developing such contacts which result in strong bonds among litter mates and other members of the pack. The younger animals also stay in close contact to each other during denning and post-denning periods.

Most of ecological investigations on wolf breeding have been done in captivity (Cheney 1982; Fentress and Ryon 1982; Harrington et al. 1982; Lentfer and Sanders 1973, Lyons et al. 1982; Paquet et al. 1982; Zimen 1982). Due to their extensive movements and elusiveness it is very difficult to observe mating behaviour of wolves in the wild particularly when radio-transmitters are not fitted to the animals. As a result of which little has been recorded on the behaviour of the Indian Wolf. This chapter describes limited information regarding pre-denning, denning and post-denning behaviour of the Indian Wolf.
Ecological information was gathered on its breeding habits and then interpreted and correlated with the conditions and circumstances prevailing in the study area.

Wolves attain sexual maturity at the age of 22 months or when they are almost two years old (Raush 1967a, Rabb et al. 1967, Mech 1970, Murie 1944, Pullianinen 1965). Sometimes they show breeding activity after one year of age (Mech 1970). However, Lentfer and Sanders (1973) reported that males may not show breeding activity even at the age of 22-months. Gestation period of wolves is reported to be 62±3 days (Brown 1936; Woolpy 1968).

Usually the top-ranking male and female i.e., alpha male and alpha female or in other words the dominant wolves are the only members of the pack which breed. Rarely two females breed in a pack.

Multiple litters are known to occur infrequently (Murie 1944). Paquet et al. (1982) recorded concurrent pregnancies in wolves at the Washington Park Zoo, Portland, Oregon. In the absence of adults, sometimes ten months old wolves are known to mate and produce pups in captivity (Medjo and Mech 1976, Zimen 1976), but in the presence of adults, they do not breed until almost two years old.

I found that the wolf at Nannaj mates during October-November and gives birth during December-January. Published account of literature on wolves reveals that the Indian Wolf is the only race that breeds during winter compared to the temperate wolves that breed during summer. There is no information available on the mating behaviour of the Indian Wolf either in captivity or in wild populations.
9.2 Methods

The study area was searched for dens during December-January each year and those areas where wolves were sighted consecutively for 2-3 days were scanned in particular. Once an active den was located, observations on wolves were taken at dens and rendezvous sites. A hide was constructed approximately 300 m from the den to observe activities of the adults as well as the pups. A thatched hut constructed in one of the Sanctuary plots was also used to observe wolves.

Once the wolves were used to my presence, the hide was gradually moved closer. They were habituated by following them for a period of about eight months. The same route was used to reach up to the hide and return from it. Wolf tracks along paths and animal trails, and repeated defecation along particular paths provided some information about their movement during their denning season.

On some occasions, observations were curtailed to minimize disturbance. However, it was possible to record few observations on wolf behaviour at dens and rendezvous sites. As the number of observations were limited and descriptive, it was not possible to do statistical analyses.

The dens were examined after they were vacated and abandoned by the wolves. All important measurements of the dens viz., diameter, width, height and length were recorded during this time. A stick was used for this purpose. The approximate length of each den was found out by putting the head in (whenever possible) through the main entrance and inspecting it from within with the help of a focusing
search light. I crawled into one of the dens (den #3) up to one meter which was partially dug by the local people (probably shepherds since the general public is usually afraid of wolves).

Interior of the dens, activity sites and trails leading to the dens have been described in results. Direct observations of wolves were made mostly at their rendezvous or post-denning activity sites because usually it was not possible to approach wolves and maintain contact with them at sites other than the rendezvous and denning sites.

The activities of the pack were recorded at the dens and rendezvous sites to describe the relationship of the pack members with these sites throughout the year i.e., pre-breeding, breeding and nursing periods.

Mortality was assessed from the number of pups seen at denning sites in the beginning and when they left the dens.

The alpha male was aggressive whenever I encountered him at close quarters (20-35m). The alpha male always reacted in defense on such occasions and charged at me whereas the alpha female always moved away silently along with other pack members or alone as the case may be. Besides the coat colour and markings, such cues on the behaviour were also used to identify them from the rest of the packmates.
9.3 Results

During 1991-1992, some of the pack members were observed to restrict their movement around a particular area for 2-3 weeks before the pups were born. Similarly one of the two wolves (probably the female) was seen around the den for one month during 1993-1994.

The dens were burrows in the ground or ridges along percolation tanks. Wolves either constructed/excavated the den(s) or they merely enlarged the holes of other animals such as Common Indian Fox *Vulpes bengalensis* and Monitor Lizard *Varanus bengalensis*. Wolf tracks leading to den entrances were seen around the denning sites from all sides.

9.3.1 Mating activity

On October 11, 1992 two wolves were seen together for 20 minutes. One wolf was observed sniffing genitals of the other and both individuals were rubbing their heads with each others body. This activity lasted for six and half minutes intermittently. However, no mounting was observed.

9.3.2 Selection of the denning sites (Location)

All the dens were located on slightly elevated areas near some water source. Selection of little raised area for the den could possibly be (i) to have a view of the surrounding areas from the den and (ii) for better drainage or both these factors.
Three dens were located under rock boulders in Solapur district on the hills. The description of dens seen during the Wolf survey in Solapur is summarized in Table 9.1. The soil under these rocks was soft and porous which could easily be dug by wolves. All dens were more or less located towards the centre of the territory. Generally, the dens were located near a water source. The distance of the den from the water source varied from 0.18 km to 2.48 km.

9.3.3 Pre-denning activity

Three pack members were seen first time at den #1 on 13 December 1991. The den was in a Reinforced Concrete Cement (R.C.C.) pipe (Appendix-A). The alpha female littered in this den during December 1991 as wolf tracks leading into or radiating out of the den entrance were seen around this area during the entire month of December.

The pack did not breed in my study area in 1992 probably because of the drought. In 1993, the alpha male and the alpha female were sighted in Shambar plot on December 24 (06:15 H). One of the individuals disappeared after 2 minutes at the same spot. Later upon investigating the area, a den was found (den #2) in the plot. Shambar plot is the largest and best protected grassland plot of the Sanctuary. The alpha female did not litter in this den and it was discarded by wolves because of the disturbance by labourers working at a distance of 100m from the denning site.

During late December 1993, the wolves were again seen for 12 days consecutively in Shambar plot. On January 4, 1994, the alpha male came running towards me
Table 9.1 Description of dens seen during wolf survey in Solapur with important habitat parameters

<table>
<thead>
<tr>
<th>Range</th>
<th>Dimensions</th>
<th>Habitat characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malshiras</td>
<td>105 x 40</td>
<td>Located along slope in open area under an acacia tree (1)</td>
</tr>
<tr>
<td>Malshiras</td>
<td>108 x 29</td>
<td>Located under a rock boulder, plantation, in use as tracks seen (1)</td>
</tr>
<tr>
<td>Sangola</td>
<td>90 x 35</td>
<td>Located under a rock boulder, under a tree, in use as bones seen inside</td>
</tr>
<tr>
<td>Sangola</td>
<td>82 x 28</td>
<td></td>
</tr>
<tr>
<td>Sangola</td>
<td>100 x 29</td>
<td>Located in an open area, grassland (2)</td>
</tr>
<tr>
<td>Sangola</td>
<td>78 x 21</td>
<td></td>
</tr>
<tr>
<td>North Solapur</td>
<td>55 x 55</td>
<td>Located in an open area, grazing land (1)</td>
</tr>
</tbody>
</table>

HxV= Horizontal diameter x Vertical diameter (cm)

Figures within parantheses is number of den openings
aggressively when I was about 25m from a den which I discovered later. The alpha female turned away quietly whereas the male continued barking at me for five minutes and stopped when I was about 50m from the den. The alpha female littered in this den.

9.3.4 Denning habits

The wolves start preparing dens weeks before parturition. A gravid female begins remaining near the den about three weeks before giving birth (Mech 1970). The bitch confines herself to the den about a day before the birth of the young (Schonberner 1965). The fox burrows are sometimes excavated and enlarged by wolves. The Indian Wolf has been observed to behave similarly in Velavadar National Park (Jhala 1991). When wolves enlarged the fox burrows, there were usually two to three main entrances to the den and there were more aeration chambers into the den. Seven dens of the fox which I examined in the study area had 4-8 burrows. The burrows used to enter into or exit from the den were much larger than the aeration burrows. The dens are sometimes renewed for reuse year after year (pers. obs.).

During 1994, while rearing pups, I found that the alpha pair used four dens. The wolves were observed making two dens simultaneously and later during the same time they were found using four dens simultaneously shifting pups from one to the other owing to disturbance. The den constructed first was not at all used by the wolves because of labourers working near it. The distance between first and second den was 1.5 km, between second and third 540 metres, third and fourth 300 metres.
The second and fifth were located within the core areas of the Sanctuary whereas the remaining three were outside the protected plots in the grazing land with heavy livestock grazing pressure and several stone quarries.

The Reinforced Concrete Cement (R.C.C.) pipes were used by Nannaj Pack for denning both during 1991-92 and 1993-94 (Fig. 9.1). The Gangewadi Pack also used R.C.C. pipe outside the protected plots in 1992-93, four pups were seen in this area. The R.C.C. pipes are laid in percolation tanks to regulate the flow of water from these water reservoirs during rainy season. Since the area is drought prone, water is stored in these tanks during monsoon and used for irrigation and for cattle in the winter till it lasts.

The relationships between the dens and first and second rendezvous sites, dens and water sources are listed in Table 6.11 (see Habitat use and preference).

9.3.5 Structure of the dens

Four dens were constructed and used by the pack during 1993-94 when the young were born whereas only one den was used during 1991-92. Another den used only for few days was the same den where the pups were raised in 1991-92 whereas the remaining were burrows in the ground.

The description of the different dens with their internal burrows system is given below and their location, habitat types and slopes have also been summarized in Table 9.2. All dens found during the study period from beginning to end are...
Table 9.2 Location of different dens with elevation, slope and major habitat features at the study site

<table>
<thead>
<tr>
<th>Den #</th>
<th>Year</th>
<th>Location</th>
<th>Elevation</th>
<th>Exposure and Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Den-1</td>
<td>1991-92</td>
<td>Adjacent to Mardi-2 Plot (125 m)</td>
<td>324 m</td>
<td>South-facing slope, crop fields 80 m from the den</td>
</tr>
<tr>
<td>Den-2</td>
<td>1993-94</td>
<td>Shambar Plot</td>
<td>402 m</td>
<td>Southwest-facing slope, grassland, plantation strip 91 m from the den</td>
</tr>
<tr>
<td>Den-3</td>
<td>1993-94</td>
<td>Near Mardi-2 Plot at the ridge of the percolation tank, under Prosopis tree (78 m)</td>
<td>387 m</td>
<td>Ridge facing East-west, grazing land</td>
</tr>
<tr>
<td>Den-4</td>
<td>1993-94</td>
<td>Adjacent to Mardi-2 Plot (125 m)</td>
<td>324 m</td>
<td>South-facing slope, crop fields 80 m from the den</td>
</tr>
<tr>
<td>Den-5</td>
<td>1993-94</td>
<td>Mardi-2 Plot</td>
<td>389 m</td>
<td>East-facing slope, grassland</td>
</tr>
</tbody>
</table>

* Both these dens represent the same den which was used by wolves during 1991-92 as well as 1993-94. The had been in use for the past 9-10 years (second-hand information)
numbered from Sr. no. 1 to 5 (Table 9.2). The interior channel system of each den is illustrated in Appendices A, B, C, and D. The sketches show the number of entrances to the particular den and the underground burrow system.

DEN #1: The den used during 1991-92 was with one burrow measuring 15m in length and 0.51m in diameter. It was an artificial den, made of R.C.C. pipe lying in the percolation tank (Fig. 9.1). The pipe was used to regulate the flow of water from the percolation tank during the rainy season. The pipe was straight having uniform diameter terminating into a bulge of 1.5 x 1.5m. Five pups were born and reared in den #1 during 1991-92.

DEN #2: This den was located in Shambar plot and also had only one entrance. The den was 2.6m long and was located on an elevated land (Fig. 9.2). The width of the entrance was 0.54m and the vertical height was 0.69m. The channel of the den after a distance of 1.25m turned slightly to the right and terminated into the main chamber called 'nursery chamber'. The latter was little larger than the diameter of the main burrow. There was another burrow about 0.38m wide on the left of the main burrow at 1.25m from the den entrance.

DEN #3: The den was originally a burrow of the Common Indian Fox which was excavated and enlarged by the wolves. There were two large entrances and one medium size entrance and four smaller aeration holes. So the den had three entrances and passageways. The alpha female gave birth to six pups (?) in this den, before shifting them to other dens.
Fig 9.1 Den #1 in the Reinforced concrete cement pipe used during 1991-1992

Fig 9.2 Den #2 located in the grassland plot during 1993-1994
One large and one medium-size entrances joined the tunnel of the main entrance at a distance of 0.85 m and 1.75 m respectively. The main burrow after going into the ground at a distance of 1.56 m turned right and terminated in an enlarged chamber which measured approximately 1 x 1 m. The newborn pups were probably kept in this slightly enlarged chamber. The total length of the den was 2.85 m.

It was located under a *Prosopis juliflora* tree of roughly 4.5 m height (Fig. 9.3). The roots that passed through the burrow were cut open by the wolves.

**DEN #4**: This was the same den used by wolves during 1991-92 (Fig. 9.1 and Appendix-A).

**DEN #5**: The den was excavated by wolves after giving birth to young in den #2. There were two openings in this den, one much larger than the other (Appendix D). The smaller opening of the den was located on the Trench-Cum-Mound (T.C.M.) wall (Fig. 9.4) of the Mardi-1 plot at Akolakati. The den was situated 80 m from a non-metalled road and was exposed to disturbance.

The larger opening of the den was 0.27 m wide and the vertical height was 0.95 m. The burrow of the larger opening after a distance of about 40 cm turned slightly upward and then tangentially toward right side (facing south) into the TCM wall and ending in an enlarged bulging. At about 0.23 m from the angle of turning towards right, the main burrow of the den led into another channel (0.3 m wide) on the left hand side (please see Appendix-D). The smaller opening was located on the T.C.M. wall and was found to end in an enlarged chamber of the main tunnel. It probably
Fig. 9.3 Den #3 located on the ridge of a percolated tank during 1993-1994

Fig. 9.4 Den #5 located adjacent to the trench cum mound wall of a grassland plot during 1993-1994
served as an aeration device rather than as an exit or entrance into the den. The total length of the den was 2.75m. It was located 175m from the water source.

Den #2 and 5 were located in the hard, rocky ground and possibly because of this these dens were comparatively shorter in length than the other.

All the dens were located in elevated and well drained areas. All but one (den #3) were close to water source (<0.5 km). Den # 1 was about 0.15 km from the water source. The distance of dens from water source ranged from 0.15 to 0.55 km except for den # 3 which was 0.92 km from water.

The maximum distance between two dens constructed simultaneously during 1993-94 was 2.33 km. The dens were closer to the first and second rendezvous sites.

9.3.6 Litter size

Average litter size in the North American wolves has been recorded as 6.5 (Mech 1970) and 6.0 to 14.5 (Carbyn et al. 1993). Promberger et al.(1996) have reported the litter size in the Carpathian Wolf Canis lupus as eight. The average litter size of the Indian Wolf was found to be five with a range of four to six. The average litter size available for a single pack during three and half years study was found to be 5.5. These numbers represent the pups seen after they had left their natal dens or during the time when they used to make short visits around the den. The mortality within the dens is unknown.
9.3.7 Activity at whelping dens

During late winter and early summer, the pack focussed its activities around homesites (dens and rendezvous sites). So the homesites become the focal point of activities of the pack during these periods.

In 1991, the pack was observed at den during mid-December and in 1993 during late December. The pups were observed at den as late as February 10, 1992 and February 24, 1994. Pups are known to begin eating meat and leave the den for short spans when they are about three weeks old (Mech 1970). Till this time they suckle mothers' milk.


Pups stay within their natal dens approximately for two months (Mech 1970). They remain in dens for this period if not disturbed by humans. During both the breeding years, I observed that the dens were abandoned by pups before they spent two months within them due to human disturbance.

After 25 January 1994, the pups were observed regularly coming out of the den and going to a distance of about 10 m from the den entrance, when there was no disturbance. On 25 January 1994, the alpha female came out of the den at 18:28 H
followed by five pups. All were smelling ground while moving on the ridge of the percolation tank where the natal den was situated. The alpha female went down and up the ridge towards the entrance of the den twice followed by pups. The litter mates played amongst themselves for 10 minutes along the slope of the percolation tank. During play activity, they ran and bit each other.

On 26 January 1994, the pups came out of the whelping den at 18:30 H, when the alpha male went and stood near the den. The young ones were observed playing for five minutes and vanished into the den in no time upon hearing an alarm call of the Common Indian Fox.

The young pups were extremely sensitive during their short visits outside the den. They used to run towards den after hearing any kind of sound. For instance, sound of vehicles on the road (about 300m away), calls by Great horned owl *Bubo bubo* or Peafowl *Pavo cristatus*, galloping sound of Blackbuck and whistling by shepherds.

During 1991-92, all pack members (seven) were found together most frequently during nursing and post-nursing periods. This was due to participation in hunting by different pack members. The main activities of the pups during their short trips outside the whelping dens after 3-4 weeks of their age till they left them were suckling and playing among themselves. The playing activities initiate the concept of socialization and social order during this early stage of development in the pups.
On two occasions, the pups attempted to nurse twice but the female rebuffed them by jumping sideways. The pups used to come out of the den during the evening hours which could probably be because of the low temperature in the morning since they were sighted only twice outside the den during morning hours.

On 2 February 1994, when the pups had already been shifted to den #3 (Please refer to den shifting), the alpha male came to the den at 18:00 H and four pups came out immediately from the den. They started licking muzzle of the male and all went under the body of the male and attempted to suckle when the male jumped to the side and ran away. One pup also followed the alpha male for short distance but soon joined his companions, going into the den. A few days later similar interaction occurred between pups and the alpha male.

The alpha members were vigilant while coming to the den. Whenever the parents came to the den, they did not enter it to bring the pups out but instead they used to stand near the den for some time, waiting for the pups to come out.

During the breeding year 1991-92, the alpha male and the alpha female were found guarding the den more often than the helpers or auxiliary members of the pack ($X^2=35.44, P<0.01, d.f.=1$).

The alpha male was seen more often guarding dens than the alpha female ($X^2=26.9, P=<0.01, d.f.=1$) during 1993-94.
On seven occasions in two months (January-February), I saw wolves carrying a goat or sheep inside the den.

With an increase in age of the pups they spent more time outside the den. The maximum duration for which pups were observed around dens before they had abandoned them was 22 minutes. The average duration of observation of the pups was 10.8 minutes (range=3-22, N=12).

The wolves did not pay any attention to Blackbuck passing by or grazing around the den. Twice a solitary Blackbuck was also seen grazing near den which was not paid any attention or disturbed by the wolves. The wolves did not kill any Blackbuck or livestock adjacent to the den except for one road killed female Blackbuck that was brought near den #3 (Kumar 1996).

9.3.8 Relationships between adults and den sites

The adults as well as the auxiliary members were not seen using the dens after they were vacated by the pack during February in both the breeding years. In other words, the pack was not using the dens like other canid species such as Common Indian Fox, Jackals *Canis aureus*, which use the dens for resting also during pre-breeding and pos-t-breeding periods (pers. obs.).

On 12 April 1994, two pups were seen coming out of the den #5 at 13:15 H. They were found using den #5 four times at different occasions in May 1994. This could be due to high temperature (41° to 45°C) during these months which forced them to
go into the dens for resting. After coming out of the den, the pups went straight to
the waterhole located in the same plot, 0.92 km from it. In North America, captive
adult wolves have been observed digging dens in summer and using them to get
away from heat but no wild pups are seen using dens after originally abandoning
them (L. D. Mech 1997, pers. comm.).

The wolves had been using Den #1 in Nannaj for the last 15 years intermittently.
Similarly in North-central Minnesota, Fuller (1989) has reported a female of a
radiomonitor pack using the same den consecutively for six years. Radiocarbon
dating of bones found at a den on Ellesmere Island in the Canadian Arctic
Archipelago suggested its use by wolves over a period of 700 years or more (Mech

The alpha male and the alpha female were found near the whelping den more
frequently than other members of the pack. In other words, helpers spent less time
than the alpha members near dens during the nursing period.

9.3.9 Communication between adults and the pups
Among the parents, on most of the occasions the alpha male (n=44, Total number
of observations = 64) used to come to the den in the evening (usually after sunset)
and rarely in the morning. Observing this activity was possible only during 1993-94
since only two wolves (alpha male and alpha female) were left in the territory. The
male or female used to stand near the den for few seconds for the pups to come out
of the den.
I suspect adult wolves making some low pitch sound near the den which pups could be able to perceive and join the parents. The other possibility could be the odour of the adults to which the pups were attracted. The method of vocal communication could not be identified since the observations were taken from a long distance. Moreover, the frequency of the vocal communication may be extremely low.

After coming out of the den, the pups used to lick or mouth the muzzles (as they usually do when parents return or bring food to a rendezvous site) of the individual visiting the den or go for suckling if it was the mother. The pups were found to be very sensitive to any sound or disturbance near the den. Hearing even a low pitch sound or any sign of danger or threat, they used to scurry down into the den.

**9.3.10 Protection and guarding of the whelping dens**

The adult wolves either preferred lying on the T.C.M. of Akolakati plot 25-150m from the den entrance or on the ridge of the whelping den #3. In the morning hours, one of the two adult wolves was usually not found around the den whereas they were seen sitting or lying around the den in evening hours (usually between 17:30 and 18:30 H) during 1993-94. On the other hand, they were observed sitting around the whelping den both in the morning and evening hours during 1991-92. The difference could probably be because of the presence of 'helpers' in 1991 and their absence in the pack in 1993. The term 'helper' is often used as a synonym for a non-breeding group member; but information on their helpful behaviour is inadequate. Alloparents have been known to increase the survivorship of Silver-backed jackal *Canis adustus* and probably Golden jackals *Canis aureus* (Moehlman 1979).
In carnivore societies, the guarding and defence of young ones and provisioning for
them other than one's own is common. The parents were always alert around the
den. Whenever they were sleeping or lying (or curled up in the morning) around the
den, every few seconds ($\bar{X}=42$ sec, $N=685$) they looked around particularly towards
the whelping den.

'Pie' or village dogs were seen close to the active dens four times and they were
successfully chased by the alpha pair. On one occasion, on 4 February 1994
(07:45-07:48 H and 08:00-08:03 H), the alpha pair chased two dogs standing at
about 150m from den #4. This was the most aggressive encounter among all such
observations. The wolves chased the dogs approximately for a distance of about 1
km. One of the dogs chased by the alpha male was bleeding after the encounter.
The skin was peeled off from one of the hind legs of the dog.

On 5th February 1994, the alpha pair was observed chasing a big 'pie' dog near den
#4 (07:35-07:36). The dog was overpowered by the wolves and bitten as he was
heard whimpering distressfully for a long time. The wolves returned near den after
chasing away the dog.

The crows hovering above the den were chased rightaway by the alpha pair (mostly
by the male). Similarly the kites such as *Milvus migrans* and eagles *Circaetus
gallicus* were also chased away by them from the dens or even killed (Kumar 1996).
These birds of prey come to the den apparently to have an access to the readily
available food with the wolves.
9.3.11 Development of pups

Pups are born in a helpless condition like domestic dog *Canis familiaris*. The pups are born blind and deaf and weaning occurs at about fifth week (L. D. Mech 1996, pers. comm). The alpha female was suspected to litter in the last week of December or the first week of January during 1993-94 and in the third week of December during 1991. The pups abandoned the whelping dens between 23 and 24 February in 1994 and between 12 to 15 February in 1992. The pups had very dark fur during January-February compared to adults. The coat colour became lighter by the time they abandoned the den.

The alpha female was observed regurgitating at the den on 20 January 1994 (14:20 H) when the pups must be 3-4 weeks old because they start consuming meat after they become three weeks old and also leave the den for short periods.

During 1993-94, two of the pups were found using den #5 five times after they had moved to rendezvous sites. There was differential growth in pups because two pups were much smaller than the remaining three. The pups grew at a faster rate after they started consuming meat.

During April-May the pups were observed calling at the rendezvous sites to which the adults responded by howling. They were also heard calling when separated from each other.

The pelage of the pups was observed to become darker again during July-August. By September-October, the pups or more precisely the juveniles almost attained the size of an adult. After this, the pack slowly dispersed.
9.3.12 Den shifting

The wolves do not leave and shift their dens if they are not disturbed at these sites. They were found to be quite tolerant or used to disturbance until an attempt was made to disturb the den. For instance, the labourers started working at quarries 75-100 meters from the den and they did not leave the den till they were disturbed by them at the den by throwing stones into it. The pack was extremely sensitive to any physical disturbance at the den. If not disturbed, the wolves usually use the same den each year.

Human disturbance is the major factor contributing to den shifting in the wolves and other canids. During the breeding year 1991-92, they used a single den throughout the development period of the pups. This den although located in the grazing land near crop fields (Fig. 6.3), there was no disturbance since it was not known to the people of the area particularly the livestock graziers. As soon as it was discovered by shepherds it was blocked by them by big stones.

During the second year of breeding, the alpha pair (the only two wolves left in the territory) excavated three dens more or less simultaneously and had to shift from one den to another frequently due to disturbances.

On January 30, 1994 (17:00 H), the alpha male was found sitting about 300m from den #2 for 50 minutes. At 17:50 H he left the area and returned at 18:15 H standing on the ridge where den was located whereas the alpha female was standing down the ridge and milking the pups in standing posture for three minutes. The female left and went to south of the den followed by all the six pups running behind the female in a line.
After going for about 200m distance, the pups suckled again for one minute. The male was moved last in the line about 50m apart from the last pup. After moving further for another 100m the female stopped and carried one of the pups in her mouth. The female was very alert looking around after moving ahead every few meters. She dropped and picked up the pup from the ground three times. The pup was probably the weakest among six. The pup was carried for a distance of about 0.5 km till it was dropped at den #4. The pups were heard whining very clearly during this event of den shifting.

I could not observe the shifting of pups to den #5, but it was abandoned due to the disturbance by farmers working in the crop fields adjacent to this den.

9.3.13 Disturbance at dens and rendezvous sites
Quarrying, livestock grazing, pariah dogs, movement of the people, vehicles coming to collect stones from the quarries, mining and blasting around the Sanctuary were the major disturbances which led to shifting and even abandoning of the dens by wolves.

During December 1993, the alpha pair constructed a burrow for den in the Shambar plot (den #2) but this den was not used by the wolves due to the disturbance by labourers who started working at 100m distance from the burrow.

The wolves constructed another den (den #3) located on the ridge of a percolation tank (see description of the dens). The alpha female littered in this den and
quarrying started around the den area about 75 m away but the wolves did tolerate
the disturbance till the den was located by the workers at the quarry. The pups were
shifted to den #4 (R.C.C. pipe) where the alpha female had littered during 1991-92.
During this period, when the pups were in den #4, the alpha pair constructed
another den (den #5) in a protected grassland plot of the Sanctuary. This den was
close to a 'kachcha road' and the pups had abandoned the den and moved to the
first rendezvous site by the time the graziers and the shepherds located the den.

On 7 March 1994 (07:41-07:45) two pups were seen being chased by the pie dogs
for four minutes. They were coming from the rendezvous site from where they had
been driven away by the dogs.

The den #1 was found blocked with stones in 1992 when the pups were inside the
den. Since wolves were observed around the den during denning period so the
stones were removed immediately by me. The wolves did not shift the den even
after it was blocked.

9.3.14 Aggressive behaviour around dens and rendezvous sites

When approached from close quarters, the adult wolves used to bark and run back
and forth with the tail inserted in the hind limbs. Alpha male was the only individual
in the pack that used to growl and continue giving low pitch barks for a longtime
(maximum of eight minutes). The alpha female was always found running away
from the spot. This behaviour was recorded when I went near a den or a
rendezvous site without noticing the presence of wolves.
In 1992, during April-May, the alpha individuals, charged me by barking in an aggressive manner upon approaching closely when the pack was with pups (N=2). There were seven wolves in the pack accompanied by five pups. On both the occasions, the yearlings did not bark, moved away from the alpha individuals, whereas both alpha male and alpha female continued barking for about six minutes as long as I stayed 40-50 meters from the pack. After first encounter, which was from a very close proximity, the pack eventually was not sighted for a week in the area used intensively by it during that time.

On January 06, 1994 (18:35 H) when an active den was approached without knowing that the den was in use by the wolves, the alpha male came running aggressively towards me and threatened me in defense by barking. I stayed at the spot without making any movement when he stopped 15 meters away and continued barking for eight minutes, after that I moved backwards slowly. The alpha female was not visible in the area due to insufficient light. The second incident occurred in March 1994. The pack was sitting at the rendezvous site with the pups when I approached the site without realizing the presence of wolves. The alpha male came running aggressively towards me and stopped at a distance of about 20 metres and continued growling and barking for eight minutes (Fig. 9.5). The rendezvous site-I (Fig. 6.3) was located in the protected plot of the Sanctuary. The alpha female left the spot immediately, following the pups which made the move first. The male left slowly following the same route adopted by the other members. The male was smelling the route now and then and also kept peeping behind.
Fig. 9.5 Alpha male charging near a rendezvous site.
Similarly the same pack spotted me while sitting in the hide on April 12, 1994 in one of the protected plots of the Sanctuary. The alpha male started barking immediately and the other members i.e., the pups and the alpha female (as there were no helpers or subordinate members in the pack) made a move no sooner than did the alpha male bark. The male continued barking for three minutes at the waterhole when it moved away into a plantation. This waterhole is next to a non-metalled road but since the wolves are usually quite used to disturbance, they were found to use the water source regularly despite the continuous disturbance throughout the day.

Another interesting observation of the alpha male was noticed around the den on 16 January 1994 when the pups had not emerged from the den. One labourer, working at the stone quarry, 75 m from the den #3 was passing by close to the den (less than 10 meters from it) was chased by the alpha male. The wolf attempted to bite the labourer (a defensive attack) but the bite was restricted only to his clothes. This attack by the wolf was from the back which was not noticed by the labourer. From that day, the denning site was brought to the notice of the people and the latter (den #3) was shifted to den # 4 (R.C.C. pipe).

On 24 February 1994, a Forest Guard was also charged by the alpha male near rendezvous site-1 while he was on inspection of the Sanctuary. The Forest Guard was threatened by the wolf by barking and approaching him in a stalking posture. Similarly the field assistant working with me and the Range Forest Officer were also threatened (again barking aggressively) by the alpha male on 5th May 1994 when they were moving around the resting site of wolves.
During summer (April to mid-June), the alpha male used to bark at waterhole whenever the pack with pups was spotted going into the water to relieve themselves from the heat by wetting their bodies (N=14). The air temperature varied from 41° to 43°C during this period. The alpha male was observed giving high-pitched barks in short spurts several times whenever I encountered him with pups or juveniles.

In North America, Murie (1944) has reported alpha males to be aggressive around dens in defending pups against bears. A captive male wolf has been reported to defend pups against humans (Mech 1970). Mech (pers. comm., 1997) has also observed an alpha female leading the defense of pups against a Musk-ox *Ovibus moschatus* and an alpha male leading defense against a human. However, some of my observations on the alpha male defending pups against a human extend these records.

9.3.15 Rendezvous or resting sites
After leaving the natal den, the pups move to a secluded, unsheltered area called rendezvous site. A rendezvous site is a meeting place of different members of the pack which is meant basically for pup rearing. Rendezvous sites have also been referred as "loafing spots" or resting sites (Young 1944). The pups remain at these sites till second or third week of March when they begin moving with the pack. Till this time the adults i.e., parents and/or alloparents hunt and bring food for the growing pups.
During 1992, the wolves used two rendezvous sites, both located in the grazing land outside the protected plots of the Sanctuary (Fig. 6.3). The first rendezvous site was located in an open and relatively flat area compared to the second and third rendezvous site. A babool tree *Acacia nilotica* was present at this site and the distance from the water source was less than a kilometer. The pups restricted their activities to this site till mid March when they shifted to the second rendezvous site 0.38 km away. In the hot weather, the babool tree provided excellent shade to the pups.

The second rendezvous site was located on a well elevated area along a mild slope. The pups remained at this site for a week and moved to a third site in the grassland plot (Shambar Plot). Before they started moving with the parents, they were observed for few days irregularly at this new rendezvous site. Rendezvous site-2 was located under a white acacia *Acacia leucophloea* tree. The shrub layer dominated by *Cassia auriculata* was thick.

In 1994, the pups moved between four rendezvous sites. The first rendezvous site was located in a grassland plot near den #5. In 1994, one of the rendezvous sites (rendezvous site-2) selected by the pack was located at the same place as selected during 1992 (rendezvous site-1). The similar behaviour of using the same rendezvous site for two years, if left undisturbed as happens regarding use of dens, has also been recorded while studying timber wolves in Algonquin Park (Joslin 1967).
All these rendezvous sites were lined with droppings, "dug out" beds, and trails within 10m radius. They had a characteristic odour like wolf droppings. Detailed characteristics of the rendezvous sites and their distribution is given and discussed separately in a separate chapter on habitat use and preference. The different variables on which Principal Component Analysis was performed have been discussed under habitat use and preference.

9.3.16 Activity at rendezvous sites
The area at rendezvous sites is dug out for lying down and for hiding. Once in February 1992, I found an adult regurgitating food at the rendezvous site-1 at 10:15 H. All the five pups started licking its snout when it regurgitated food. The adult wolf remained at the site for nearly 15 minutes and then left.

Similarly on 10 March 1994, the alpha female chased a fawn of the Blackbuck for about four minutes around rendezvous site-4 and during the chase it abandoned chasing the fawn and started for a Blacknaped Hare that was flushed from a bush. The alpha female could hunt down the hare in approximately two minutes time. The food was brought straight to the rendezvous site-4 and eaten by the four pups present there.

The pups remained around these resting sites for several days upto mid-March when their movement activity increased. They started going to waterholes three to four times a day with parents whereas during February they were observed going with the parents only once between 06:00 H and 07:15 H. The activities of different
packmates during their movement to the waterhole is discussed under 'Use of waterholes' (see Habitat use and preference).

By mid-March, the pups were not restricted to resting sites all the time. They were often seen wandering in the parental territory sometimes in smaller sub-groups. On three occasions, the adult wolves were seen coming to the resting site and taking the pups to the kill site. The alpha female was never observed suckling pups at the resting sites.

Another activity of the wolves at the resting site was howling. The wolves used to perform chorus howling during the evening hours usually after 18:30 H and occasionally in the morning hours. The whole pack would gather at a resting site and howl (N=46) whereas on other occasions in 1992, howling was only heard (N=34) around 'homesites'.

In 1994, the wolves were observed howling on 3 May (18:52 H) at resting site-2 for two minutes and then all the individuals started licking one another and left the site all together. They were heard howling several times when the pups were around homesites in 1994.

On 2nd March 1994, the pups were heard "whining" at rendezvous site-1 thrice in the morning to which the adults responded each time by howling. The pups joined the adults during the last "whining" call. The pups were seen rushing towards adult members right in front of me when they started fondling the pups. One of the
reasons of "whimpering" by the pups could be their separation from the litter mates or parents for a long duration.

Another major activity of the pups at rendezvous sites was playing. This activity is an important aspect of the life of a wolf. They learn dominant or submissive behaviour during this period. The play sometimes becomes aggressive and they start fighting and biting at each other.

On 12 May 1994, I observed pups playing for 30 minutes at the rendezvous site-4. The play consists of fast chases and grabbing each other. The two pups were also heard growling at each other during this play fight. During both the years, the pups were observed playing 22 times among themselves as well as with the parents at the resting sites. The other common place for performing plays were water holes. If pups spotted some prominent object, they used to play by picking it up, running and then leaving it to the ground. A schematic representation of the life-history of Indian Wolf is given in Fig. 9.6.

9.4 Discussion

The Indian Wolf at Nannaj mates during October-November and young ones are born during December-January. R. Manakadan (pers. comm., 1996) and Jhala (1991) have also recorded denning in the Indian wolf during December-January at Rollapadu Wildlife Sanctuary (Andhra Pradesh) and Velavadar National Park (Gujarat) respectively. The denning activity at the mating season of temperate wolves, on the other hand, is usually in February-March and litters are produced
Fig. 9.6. Schematic representation of the life-history of the Indian Grey Wolf in the Great Indian Bustard Sanctuary, Nannaj.
during April-May (Mech 1966a; Soper 1942), but there is variation in breeding season and denning at different latitudes both in Canada and the United States of America. Carbyn et al. (1993), Mech (1966, 1970) described the breeding season of North American wolves as late winter (February), mostly during April-May. Similarly Van Ballenberghe and Mech (1975) also recorded mating activities in the Timber Wolf in Minnesota during February. The mating activity of wolves is reported during February and March in northern Alberta (Fuller and Keith 1980) and Isle Royale Island in Michigan (Peterson 1977).

This difference in the breeding season and denning between wolves of temperate and tropical regions is due to the climatic conditions. At Nannaj, the weather during summer and the following monsoon is unfavourable for the wolves so they avoid breeding during these seasons.

The unfavourable conditions during summer such as less availability of food, water and high temperature could be deleterious to the pups. Similarly seepage during monsoon may lead to collapse of the den. Moreover, if the Nannaj wolves breed during summer as do the North American wolves and the wolves in Europe, the denning period will extend into the monsoon which may not be favourable to pups, although other proximate factors are favourable to the wolves during summer and the monsoon, because the prey species (Blackbuck) and the livestock congregate in larger flocks after it starts raining than during winter when they are more or less dispersed. Similarly, hares namely the Blacknaped hare *Lepus nigricollis nigricollis* are also common during monsoon. They feed on the fresh tender grass, which
comes up in the small ditches accumulating water for a short span. On a night's drive in July 1994, I counted 50 hares feeding on the fresh grass growth in these patches.

During both the breeding years, the study pack produced single litter, as seen elsewhere (e.g., Van Ballenberghe and Mech 1975; Haber 1977; Peterson 1977). Multiple litters are rare due to suppression of mating activity in subordinate members (Fox 1971; Schenkel 1947; Sullivan 1978, 1979; Rabb et al. 1967; Mech 1970; Haber 1977; Packard and Mech 1980; Zimen 1975), strong mate preferences and delayed sexual maturity (Packard and Mech 1980; Fox 1971; Rabb et al. 1967; Mech 1970). Because of these above mentioned within pack mechanisms, only one litter is born to a pack each year mostly by the dominant wolves of the pack. This behavioural mechanism influences strongly the population regulation of wolves.

Based on the literature available, Peterson (1977) predicted that natural selection would favour wolves that interfere with mating attempts of low-ranking (subordinate) pack members because producing several litters by a pack could reduce the chances of pup survival. On the contrary, if abundant food is available and mortality rate is also high, it is possible that multiple pregnancies could enhance pack survival (Carbyn 1980).

The wolves are well adapted to all kinds of biotic pressures. Nonetheless, they are sensitive to disturbance around the dens. In India, they are living around highly populated villages and even around towns. For instance, one male child of about
three years, was attacked and lifted by a wolf from the outskirts of Pratapgarh town in Uttar Pradesh on the night of 6/7 August 1996. This clearly shows their great adaptability to live around human beings. Moreover, if not persecuted they have a high potential to colonize and establish themselves, as has been proved by reintroduction of wolves to the Yellowstone National Park in 1995 and their subsequent colonizing the area from where they were exterminated in 1930's.