Chapter - IV

HABITAT USE AND ACTIVITY PATTERN OF WILD ASS

INTRODUCTION

In the last two decades a number of field studies have been carried out on the behaviour of feral mustangs, ponies, burros (*Equus asinus*), feral horses (*Equus caballus*), zebras, African wild ass and Mongolian wild ass have added considerable insight into the daily and seasonal activity patterns of the equines (Feist 1971; Tyler 1972; Mohelman 1974; Ohmart *et al.* 1975; Smuts 1975; Pratt 1976; Klingel 1977; Norment and Douglas 1977; Keiper 1979; McCort 1980; White 1980; Ohmart 1981; Penzhorn 1982b; Dunn 1984; Berger 1986; Douglas and Hiatt, 1987; Duncan 1992; Feh *et al.*,in press).

However, their is paucity of information on the habitat use and activity pattern of the Asiatic wild asses and Indian wild ass (*Equus hemionus khur*) in particular. The increasing human pressure and the problem of crop depredation by wild ass emphasized the need to study this aspect in details.

The present study is an attempt to assess habitat preference in different seasons and the causes of seasonal variation in the habitat use. The objective was to develop a strategy for managing resources during the crunch period as well as to resolve to a certain extent the farmer - wild ass conflict. A sound knowledge of habitat requirements of animal is imperative for the formulation of management policies.

METHODS

Habitat Use

The habitat use analysis was done at two levels: selection of habitats within the study area and intensity of use of these habitats within the home range. The two levels of analysis indicate how home ranges are selected and within the selected habitat what is their intensity of use.

The vegetation transects laid within the study area were overlaid on the home ranges and seasonal habitat use was analyzed. The scan data, casual sightings and telemetric records were considered for habitat use calculation. Habitat use was analyzed seasonally for the dominant stallion KM, ostracized stallion JJ, all-male herd BH, and the yellow collared mare YC for one year data set and three years data for family band MH. The radio collared mare's data was analyzed for day (0600-1700 Hrs) and night (1800-0500 Hrs) separately. Care was taken to account for statistical independence of each sighting. The scrub low was merged with Rann grassland and scrub medium with scrub dense to get statistically acceptable sample size for testing preference.

The vegetation transects laid within the study area were overlaid on the home ranges (Figure IV.1). The habitats were visually interpreted on the SPOT multispectral linear array (MLA), on 1:50,000 scale. The main habitats were identified based on the vegetation transects laid in the study area were scrubland (low, medium/dense categories), cropland/fallow land and Rann (Plate IV.1). Random points were generated, using the random numbers table to calculate proportion of habitats available (Snedecor and Cochran 1967; Marcum and Lofstgaarden, 1980) from the SPOT MLA satellite imagery. The percentage constituted by various habitats were, scrublow 41.58%, medium/dense 4.30%, cropland/fallow land 22.44% and Rann 31.68% in the intensively studied area.

Activity Pattern

The basic assumption was that the family band and all male herd selected for activity pattern study were representative of the population. These two would cover two major social units. Thus activity pattern data of specific herds were collected to determine the daily activity patterns and how these vary between the seasons.

The main activities considered for analysis are defined below:

Feeding: which includes grazing, browsing and walking between the feeding bouts.

Resting: when the animal stands and when rest in sternal or lateral recumbency.

Movement: walks, trots or runs are included.

Other activities: It included social activities, such as flehmen, courtship behaviour, mounting, vocalization, allo and auto grooming, nursing, foal-play, bitting, micturition, defecation and drinking activities.

There were 449 hours activity recorded in 1989-1990 for family band and all-male band. Group scan at 10 minutes interval (Altmann 1974) was conducted from dawn to dusk on MH and BH thrice every month. The collared mare YC was monitored for 24 hrs., twice every month (i.e.full moon-lit and new moon nights) for a period of 11 months. The activity collar provided the information about the activities of the individual in form of low and high frequency beeps.

The daily individual activity proportion was considered for every scan day. Mean proportion of an activity in season = Sum of proportion of an activity for each scan day/number of scan days per season.

In cases where full day scans were not possible due to the animals getting lost in the scrub thickets, then the mean was calculated for every hour and pooled for the day (only in two day scans such situation had occurred).

SPSS/PC (Norusis 1984) was used to perform analysis. The analysis procedure described by Neu *et al.* (1974) was used with modification indicated by Loftsgaarden (1980) and Byers *et al.* (1984). Multiway ANOVA was used to analyze habitat use by different animals in three seasons. Wilcoxon matched pair test was done to compare activity of yellow collared mare between day and night.

RESULTS

Activity Pattern

The comparison was done between family band (MH) and all-male herd. The time spent in four activities differed in both herds (F=77.58, df=3, P=0.0001) while there was no difference in activity pattern in three seasons, viz. summer, monsoon and winter (F=0.0111, df=2,P=0.989) (Figures IV.2, IV.3). The interactions between activity, animals and seasons was not significant (F=6.388, df=11, P=0.950).

Time spent feeding was least during winter, 22.4% by the family band and 14% by all- male herd. In summer family band spent 31.2% and all-male herd spent 29.9% time foraging, which showed slight increase. The family band and all-male herd spent 30-35% time feeding during monsoon. The dominant stallions spent less than 10% time feeding during day time in monsoon as it was the breeding season. Consequently family band and all male herd spent more time resting during day in winter than that of the summer or monsoon (Figures IV.2, IV.3). The family band spent 15% time moving with marginal differences between seasons. The all-male herd spent less time (16.7%) moving than that of summer (20.73%) and winter (24.06%).

Annually the family band spent 27.67% and all-male herd 23.59% of the day time feeding. The activity was consistent throughout the year in all three seasons, with resting being predominant (Figures IV.2, IV.3). The animals of family and all-male

herds spent most of their day time resting, it was during the night that these animals became more active.

The yellow collared mare-YC (member of family band) was more active during the night (Wilcoxan, Z=1.91, df=15, P =0.05). The casual sightings of wild ass and interviews with farmers also indicates that wild ass are more active during night.

Habitat Use

There was a significant difference (F=36.287, df=9, P=0.0001) in all the four factors: habitat, animals, seasons and utilization. The interaction between utilization and availability of resources of different habitats in different seasons showed a significant variation (F=3.841, df=4, P=0.024), but resource use among different animal in three seasons remained the same (F=0.492, df=8, P=0.215).

Out of the 23 species of ground vegetation recorded in the the intensive study area, at least eleven species were eaten by the wild ass, this was through direct observations.

During the monsoon, all the direct observations on the Rann grassland and >70% of the wild ass dung comprised of **Cyperaceae** family mainly comprising of annuals like *Scirpus* spp. and *Cyperus* spp. By winter, large per cent of the dung comprised of crops. By late winter and summer dried annuals like *Aristida* spp. *Chloris* spp. *Eragrostis* spp. and the perennial grasses *Aeluropus spp.*, *Sporobolus spp* and *Desmostachya* spp. together with some crops formed a part of their diet (Table IV.1). *Prosopis juliflora* was the only shrub or tree, the pods of which made up a large component of their diet during the peak summer.

Habitat Use by Family Band (MH): The habitat use of this herd was monitored for three years (1989-92). MH showed selection of habitats comprising home range as well as intensity of their use within home range in all three years (Tables IV.2 to IV.7).

Summer: The selection of habitats within study area indicated preference of scrub low in all three years (1989-90 to 1991-92), while in 1990-91 and 1991-92 scrub medium/dense was also preferred ($X^2_{1989\text{-}90}$=45.69, $X^2_{1990\text{-}91}$= 126.1, and $X^2_{1991\text{-}92}$=120.37, P<0.0001). The intensity of use within home range differed for different habitats. In 1989-90 fallow land was preferred, (X^2=138.26, P<0.0001) in 1990-91 scrub medium/dense was preferred (X^2=139.28, P<0.0001) and 1991-92 all habitats were used in proportion to availability (X^2=3.97, P=0.0001) (Tables IV.2 to IV.7).

Monsoon: In monsoon the entire area is lush green with annual grasses, forbs and sedges. The selection of home range in study area indicated preference for Rann in 1989-90 (X^2=61.24, P<0.0001), scrub low in 1990-91 and 1992 ($X^2_{1990\text{-}91}$=36.92 and $X^2_{1991\text{-}92}$=73.59, P<0.0001). The intensity of use in home range indicated scrub low was preferred in all three years while scrub medium/dense was also preferred in 1990-91 ($X^2_{1989\text{-}90}$=33.259, $X^2_{1990\text{-}91}$=78.98 and $X^2_{1991\text{-}92}$=54.2, P<0.0001)

Winter: In winter of 1989-90 and 1991-92 family band showed preference for scrub low ($X^2_{1989\text{-}90}$=116.28 and $X^2_{1991\text{-}92}$=94.94, P<0.0001) while in 1990-91 all habitats were used in proportion to availability. The intensity of use within home range indicated preference for scrub low in 1989-90 and 1990-91 ($X^2_{1989\text{-}90}$=314.52 and $X^2_{1990\text{-}91}$=74.98, P<0.0001). In 1991-92 no preference was shown for different habitats (X^2=2.55, P>0.05) (Tables IV.2 to IV.7).

The overall habitat use of each season in different years showed consistency with scrub low being a highly preferred habitat. There was a difference in habitat use in different season. It was scrub low and medium which were the most preferred habitats in all three seasons.

Habitat Use by a Dominant Stallion (KM): KM showed selection of habitats comprising the home range within study area, in summer (X^2=46.88, df=4, P<0.001), winter (X^2=46.3289, df=4, P<0.001) and monsoon (X^2=35.534, df=4, P<0.001). Scrub low and scrub medium/dense was preferred in all the three seasons (Table IV.8).

The intensity of use of these habitats within the home range differed in different seasons. In summer scrub medium/dense was preferred (X^2=2565.07, df=2,P<0.001), in monsoon scrub low and scrub medium/dense was preferred (X^2=91.729, df2, P<0.001), while in winter scrub medium/dense was preferred (X^2=1525.629, df=2, P<0.001) (Table IV.9).

Habitat Use by an Ostracized Male (JJ): JJ showed selection of habitats comprising the home range in study area, in summer (X^2=32.34, df=5, P<0.001) and winter (X^2=39.965, df=5, P<0.001), while in monsoon all habitats were used in proportion to availability (X^2=10.10, df=5, P>0.05) (Table IV.10).

The habitat use within the home range differed in three seasons. In summer all habitats were used in proportion to availability (X^2=7.3, P>0.05) in monsoon and winter, scrub low was preferred ($X^2_{monsoon}$=7.68, df=2, P<0.05, X^2_{winter}=23.34, df=2, P<0.001) (Table IV.11).

Habitat Use by All-Male Herd (BH): The home range selection was similar in summer and monsoon while in winter Rann was preferred. For all three seasons selection of habitats comprising home range was observed (X^2_{summer}=112.48, df=4, P<0.0001, $X^2_{monsoon}$=54.867, df=4, P<0.0001, X^2_{winter}=125.49, df=4, P<0.0001) (Table IV.12).

The habitat use within the home range differed in all the three seasons. During summer scrub dense and cropfields were preferred (X^2=289.32, df=3, P<0.0001), in monsoon cropfield was preferred (X^2=41.02, df=3, P<0.0001), while in winter scrub low was preferred (X^2=98.56, df=1, P<0.0001) (Table IV.13).

Habitat Use by Collared Mare (YC): YC showed selection of home range in all the three seasons ($X^2_{monsoon}$=124.89 df=4, X^2_{winter}=51.31, df=4, X^2_{summer}=221.92, df=4, P<0.0001). The habitat comprising the home range did not show any difference in different season. Scrub low and scrub medium/dense was preferred or used in proportion to available in all the three seasons (Table IV.14) during the day time. The day time habitat use of the mare within the home range showed preference for cropland during summer (X^2=127.43, df=3 P<0.0001), in monsoon all the habitats were used in proportion to availability (X^2=3.28, df=1, P>0.05). In winter scrub medium/dense was preferred (X^2=15.15, df=1, P<0.0001) (Table IV.15).

The night habitat use within study area indicated scrub low and scrub medium/dense were preferred in all three seasons ($X^2_{monsoon}$=137.07, X^2_{winter}=245.97, X^2_{summer} =199.73, P<0.0001) (Table IV.16). The night habitat use showed significant difference in all three seasons in summer YC showed a preference for cropland (X^2_{summer}=44.54, df=3, P<0.0001), in winter scrub low was avoided (X^2_{winter}=22.15, df=2,

P<0.0001) while, in monsoon Rann was not utilized ($X^2_{monsoon}$ =37.38, df=3, P<0.0001) (Table IV.17).

The night and day use showed variation in habitat use. During day-time cropfield was not at all used in monsoon and winter while it was during the night only that this habitat was used (Tables IV.15, IV.17).

DISCUSSION

The wild ass occupy the Rann, *Bet* and the vegetative zone interspersed by croplands. Choice of different habitats differed in three seasons. The *Bet* animals showed seasonal movement between fringe and bets. Though their habitat use pattern was more or less similar to the herds occupying the fringe.

Activity Pattern

The activity pattern remained consistent (Figures IV.2 and IV.3) throughout the year. The seasonal climatic changes did not seem to have any effect on diurnal activity pattern. There was no difference in per cent time spent feeding activity during summer, which is a resource poor period. The wild ass spent least time feeding in day time during winter, as they depredate crops by night. The wild ass mainly feed during the night hours. The animals in the Little Rann have adapted to be more active during the night to maximize the resource intake in the vegetation-agriculture interface. The equids feed mainly during day time (Pratt *et.al.* 1986), but the wild ass in LRK are adapted to feed mainly by night.

The interview of villagers bordering the study area indicated that the wild ass were frequenting the cropfields by the night in all the three seasons either to depredate on crops (Plate IV.2) or for water during the summer.

Seasonal Habitat Use

The choice of different habitats differ in three seasons. Wild ass showed a strong selection in habitat comprising the home range as well as the intensity of use of habitats within the home range. Low density scrubland was the most preferred habitat by different wild ass groups. The medium and high density scrubland were of importance during the summer and winter as it provided thermal refuge and food.

In monsoon, scrub medium/dense habitats provide foaling cover for gravid mares. The open patches within the scrub medium cover were used for the same. One confirmed sighting and three evidences of births were recorded in the study area.

The cropfields and fallow land were frequented throughout the year. In monsoon and winter, crops were available in the area (Table IV.1).In summer crops were available only in the irrigated lands. The most crucial resource is water during summer and the home ranges were mainly restricted around the water sources. The distance from water is a prime determinant of the use of habitat by most of the free ranging equids. The wild ass require to drink at least once in 24 hours. Most observations of drinking during the winter and summer was by the late night hours or early dawn. Pods of the *P. juliflora* form a major component of diet of the wild ass during summer, as most of the ground becomes devoid of vegetation due to trampling by cattle.

The wild ass habitat requirement can be summarized as forage, water, safe breeding cover and thermal cover (especially during extreme winter), the pattern of habitat use observed in the present study may be explained in terms of animal's changing requirements for these resources at different seasons.

Table IV.1: Food Species of Wild Ass.

Species	Monsoon	Winter	Summer
Cyperus spp	+	-	-
Echinochloa colonum	+	-	-
Scirpus spp	+	-	-
Chloris spp	-	+	+
Eragrostis spp	-	+	-
Dactyloctenium spp	-	+	+
Desmostachya spp	-	+	+
Aeluropus lagopoides	-	+	+
Aristida spp	-	-	+
Suaeda nudiflora	-	-	+
Sporobolus spp	-	-	+
Blumea spp	-	+	-
P.juliflora pods	-	-	+
AGRICULTURAL CROPS			
Pennisetum typhoides	-	+	+
Sorghum bicolor	-	+	+
Vigna radiata	-	+	-
Vigna aconitifolia	-	+	-
Triticum aestirum	-	+	-
Gossipium herbaceum	-	+	-

+ observed direct/indirect evidences.
- no records.

Table IV.2: Habitat Use by Family Band (MH) within study area (1989-90).

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrub low	126	0.416	37.426	67	0.416	0.626	0.863	P
Scrub dense	13	0.043	3.861	4	0.043	0.000	0.100	E
Fallowland	14	0.046	4.158	1	0.046	0.000	0.040	A
Cropland	54	0.178	16.040	0	0.178	0.000	0.000	Null
Rann	96	0.317	28.515	18	0.317	0.091	0.309	A
$z = 2.5799$		$x^2 = 45.6907$						
MONSOON								
Scrub low	126	0.416	90.653	103	0.416	0.385	0.560	E
Scrub dense	13	0.043	9.353	10	0.043	0.009	0.082	E
Fallowland	14	0.046	10.073	3	0.046	0.000	0.034	A
Cropland	54	0.178	38.851	0	0.178	0.000	0.000	Null
Rann	96	0.317	69.069	102	0.317	0.381	0.555	P
$z = 2\ 5799$		$x^2 = 61.2444$						
WINTER								
Scrub low	126	0.416	69.446	133	0.416	0.716	0.877	P
Scrub dense	13	0.043	7.165	12	0.043	0.020	0.123	E
Fallowland	14	0.046	7.716	1	0.046	0.000	0.021	A
Cropland	54	0.178	29.762	0	0.178	0.000	0.000	Null
Rann	96	0.317	52.911	21	0.317	0.060	0.192	A
$z = 2\ 5799$		$x^2 = 116.2795$						

P = Preferred; E = Equal; A = Avoided

Table IV.3: Habitat Use by Family Band (MH) within home range (1989-90).

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrublow	67	0.744	52.856	49	0.744	0.553	0.827	E
Scrubdense	4	0.044	3.156	5	0.044	0.000	0.146	E
Fallowland	1	0.011	0.789	11	0.011	0.048	0.262	P
Rann	18	0.200	14.200	6	0.200	0.002	0.167	A
$z = 2.499$		$x^2 = 138.2637$						
MONSOON								
Scrub low	103	0.472	70.872	105	0.472	0.606	0.794	P
Scrubdense	10	0.046	6.881	7	0.046	0.004	0.090	E
Fallowland	3	0.014	2.064	0	0.014	0.000	0.000	Null
Rann	102	0.468	70.183	38	0.468	0.165	0.342	A
$z = 2.499$		$x^2 = 33.259$						
WINTER								
Scrub low	133	0.796	140.168	100	0.796	0.475	0.662	A
Scrubdense	12	0.072	12.647	62	0.072	0.262	0.442	P
Fallowland	1	0.006	1.054	11	0.006	0.017	0.108	P
Rann	21	0.126	22.132	3	0.126	0.000	0.041	A
$z = 2.499$		$x^2 = 314.5149$						

Table IV.4: Habitat Use by Family Band (MH) within study area (1990-91).

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER Scrub low	126	0.416	55.723	92	0.416	0.583	0.790	P
Scrub dense	13	0.043	5.749	24	0.043	0.094	0.265	P
Fallowland	14	0.046	6.191	5	0.046	0.000	0.080	E
Cropland	54	0.178	23.881	0	0.178	0.000	0.000	Null
Rann	96	0.317	42.455	13	0.317	0.031	0.163	A
z = 2 5799		x^2 = 126.1015						
MONSOON Scrub low	126	0.416	55.723	82	0.416	0.503	0 721	P
Scrub dense	13	0.043	5.749	7	0.043	0.003	0.102	E
Fallowland	14	0.046	6.191	5	0.046	0.000	0.080	E
Cropland	54	0 178	23.881	0	0.178	0.000	0.000	Null
Rann	96	0.317	42.455	40	0.317	0.197	0.400	E
z = 2.5799		x^2 = 36.9161						
WINTER Scrub low	126	0.416	35.347	44	0.416	0.378	0.657	E
Scrub dense	13	0.043	3.647	8	0.043	0.012	0.176	E
Fallowland	14	0.046	3.927	2	0.046	0.000	0.066	E
Cropland	54	0.178	15.149	0	0.178	0.000	0.000	Null
Rann	96	0.317	26.931	31	0.317	0.230	0.499	E
z = 2 5799		x^2 = 24.0239						

Table IV.5: Habitat Use by Family Band (MH) within home range (1990-91).

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrub low	92	0.687	155.85	101	0.687	0.362	0.527	A
Scrubdense	24	0.179	40.657	107	0.179	0.389	0.554	P
Fallowland	5	0.037	8.47	12	0.037	0.016	0.090	E
Rann	13	0.097	22.022	7	0.097	0.002	0.060	A
$z = 2.499$		$x^2 = 139.281$						
MONSOON								
Scrublow	82	0.612	135.239	171	0.612	0.703	0.844	P
Scrubdense	7	0.052	11.545	30	0.052	0.078	0.193	P
Fallowland	5	0.037	8.246	3	0.037	0.000	0.033	A
Rann	40	0.299	85.970	17	0.299	0.032	0.122	A
$z = 2.499$		$x^2 = 78.9765$						
WINTER								
Scrub low	44	0.518	65.741	111	0.518	0.800	0.948	P
Scrubdense	8	0.094	11.953	13	0.094	0.035	0.170	E
Fallowland	2	0.024	2.988	1	0.024	0.000	0.027	E
Rann	31	0.365	46.318	2	0.365	0.000	0.043	A
$z = 2.499$		$x^2 = 74.9765$						

Table IV.6: Habitat Use by Family Band (MH) within study area (1991-92).

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER Scrub low	126	0.416	31.188	53	0.416	0.571	0.842	P
Scrubdense	13	0.043	3.218	18	0.043	0.113	0.367	P
Fallowland	14	0.046	3.465	4	0.046	0.000	0.120	E
Cropland	54	0.178	13.366	0	0.178	0.000	0.000	Null
Rann	96	0.317	23.762	0	0.317	0.000	0.000	Null
MONSOON Scrublow	126	0.416	75.683	123	0.416	0.586	0.765	P
Scrubdense	13	0.043	7.809	13	0.043	0.022	0.121	E
Fallowland	14	0.046	8.409	2	0.046	0.000	0.031	A
Cropland	54	0.178	32.436	0	0.178	0.000	0.000	Null
Rann	96	0.317	57.663	44	0.317	0.160	0.324	E
$z = 2.5799$		$x^2 = 73.5918$						
WINTER Scrub low	126	0.416	39.089	82	0.416	0.784	0.961	P
Scrubdense	13	0.043	4.033	8	0.043	0.011	0.159	E
Fallowland	14	0.046	4.343	2	0.046	0.000	0.060	E
Cropland	54	0.178	13.752	0	0.178	0.000	0.000	Null
Rann	96	0.317	29.782	2	0.317	0.000	0.060	A
$z = 2\ 5799$		$x^2 = 94.9415$						

Table IV.7. Habitat Use by Family Band (MH) within home range (1991-92).

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrub low	53	0.707	9.187	10	0.707	0.490	1.049	E
Scrubdense	18	0.240	3.12	1	0.240	0.000	0.254	E
Fallowland	4	0.053	0.693	2	0.053	0.000	0.393	E
z = 2 3899		x^2 = 3.975084						
MONSOON								
Scrub low	123	0.676	94.615	135	0.676	0.925	1.003	P
Scrubdense	13	0.071	10.000	3	0.071	0.000	0.052	A
Fallowland	2	0.011	1.538	1	0.011	0.000	0.025	E
Rann	44	0.242	33.846	1	0.242	0.000	0.025	A
z = 2.499		x^2 = 54.201						
WINTER								
Scrub low	82	0.872	43.617	47	0.872	0.856	1.024	E
Scrubdense	8	0.085	4.255	2	0.085	0.000	0.109	E
Fallowland	2	0.021	1.064	0	0.021	0.000	0.000	A
Rann	2	0.021	1.064	1	0.021	0.000	0.000	A
z = 2.499		x^2 = 2.5254						

Table IV.8: Habitat Use by Dominant Stallion (KM) within study area.

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected propor-tionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrub low	126	0.416	29.525	57	0.416	0 681	0.925	P
Scrub dense	13	0.043	3.046	1	0.043	0.000	0.050	E
Fallowland	14	0.046	3.281	0	0.046	0.000	0.000	Null
Cropland	54	0.178	12.653	0	0.178	0.000	0.000	Null
Rann	96	0.317	22.495	13	0.317	0.065	0.302	A
$z = 2.5799$		$x^2 = 46.8843$						
MONSOON								
Scrub low	126	0.416	43.663	50	0.416	0.350	0.602	E
Scrub dense	13	0.043	4.505	3	0.043	0.000	0.071	E
Fallowland	14	0.046	0.851	0	0.046	0.000	0.000	Null
Cropland	54	0.178	18.713	0	0.178	0.000	0.000	Null
Rann	96	0.317	33.267	52	0.317	0.369	0.621	P
$z = 2.5799$		$x^2 = 35.5349$						
WINTER								
Scrub low	126	0.416	47.406	78	0.416	0.572	0.797	P
Scrub dense	13	0.043	4.891	3	0.043	0.000	0.065	E
Fallowland	14	0.046	5.267	0	0.046	0.000	0.000	Null
Cropland	54	0.178	20.317	0	0.178	0.000	0.000	Null
Rann	96	0.317	36.119	33	0.317	0.180	0.399	E
$z = 2\ 5799$		$x^2 = 46.3289$						

Table IV.9: Habitat Use by Dominant Stallion (KM) within the home range (1989-90)

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrub low	57	0.803	163.775	109	0.803	0.451	0.618	A
Scrub dense	1	0.014	2.873	88	0.014	0.348	0.514	P
Rann	13	0.183	37.352	7	0.183	0.004	0.065	A
$z = 2.3899$		$x^2 = 2565.0725$						
MONSOON								
Scrub low	50	0.476	57.619	84	0.476	0.594	0.794	P
Scrub dense	3	0.029	3.457	17	0.029	0.065	0.216	P
Rann	52	0.495	59.924	20	0.495	0.085	0.246	A
$z = 2.3899$		$x^2 = 91.7296$						
WINTER								
Scrub low	78	0.684	80.737	38	0.684	0.219	0.425	A
Scrub dense	3	0.026	3.105	71	0.026	0.494	0.709	P
Rann	33	0.289	34.158	9	0.289	0.018	0.135	A
$z = 2.3899$		$x^2 = 1525.629$						

Table IV.10: Habitat Use by Ostracized stallion JJ within the study area.

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER Scrub low	126	0.416	51.564	71	0.416	0.458	0.687	P
Scrub dense	13	0.043	4.320	2	0.043	0.0	0.045	E
Fallowland	14	0.046	5.729	6	0.046	0.0	0.098	E
Cropland	54	0.178	22.099	0	0.178	0.0	0.0	Null
Rann	96	0.317	39.287	45	0.317	0.251	0.474	E
z = 2.5799		x^2 =32.340						
MONSOON Scrub low	126	0.416	12.475	14	0.416	0.232	0.702	E
Scrub dense	13	0.043	1.287	0	0.043	0.0	0.0	Null
Fallowland	14	0.046	1.386	1	0.046	0.0	0.118	E
Cropland	54	0.178	5.347	0	0.178	0.0	0.0	Null
Rann	96	0.317	9.505	15	0.317	0.264	0.736	E
z =2.5799		x^2 =10.104						
WINTER Scrub low	126	0.416	44.911	53	0.416	0.367	0.615	E
Scrub dense	13	0.043	4.634	0	0.043	0.0	0.0	Null
Fallowland	14	0.046	4.990	1	0.046	0.0	0.033	A
Cropland	54	0.178	19.248	0	0.178	0.0	0.0	Null
Rann	96	0.317	34.218	54	0.317	0.376	0.624	P
z =2.5799		x^2 =39.965						

Table IV.11: Habitat use by Ostracized Stallion (JJ) within home range (1989-90).

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrublow	71	0.573	41.798	39	0.573	0.388	0.680	E
Scrub dense	2	0.016	1.177	3	0.016	0.000	0.099	E
Fallowland	6	0.048	3.532	0	0.048	0.000	0.000	Null
Rann	45	0.363	26.49	31	0.363	0.280	0.569	E
$z = 2.4999$		$x^2 = 7.3079$						
MONSOON								
Scrublow	14	0.467	14.467	22	0.467	0.515	0.905	P
Fallowland	1	0.033	1.033	0	0.033	0.000	0.000	Null
Rann	15	0.500	15.500	9	0.500	0.095	03485	A
$z = 2.3899$		$x^2 = 7.6820$						
WINTER								
Scrub low	53	0.491	72.63	102	0.491	0.598	0.780	P
Fallowland	1	0.009	1.370	1	0.009	0.000	0.023	E
Rann	54	0.500	74.00	45	0.500	0.214	0.394	A
$z = 2.3899$		$x^2 = 23.34191$						

Table IV.12: Habitat Use by All-Male Herd within the Study Area.

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrub low	126	0.416	80.673	147	0.416	0.678	0.837	P
Scrub dense	13	0.043	8.323	12	0.043	0.017	0.106	E
Fallowland	14	0.046	8.964	10	0.046	0.011	0.093	E
Cropland	54	0.178	34.574	0	0.178	0.0	0.0	Null
Rann	96	0.317	61.465	25	0.317	0.067	0.191	A
z = 2.5799		x^2 = 112.4832						
MONSOON								
Scrub low	126	0.416	92.733	129	0.416	0.493	0.664	P
Scrub dense	13	0.043	9.568	10	0.043	0.009	0.081	E
Fallowland	14	0.046	10.304	8	0.046	0.004	0.068	E
Cropland	54	0.178	39.743	0	0.178	0.0	0.0	Null
Rann	96	0.317	70.653	76	0.317	0.259	0.423	E
z =2 5799		x^2 = 54.8657						
WINTER								
Scrub low	126	0.416	34.099	9	0.416	0.021	0.199	A
Scrub dense	13	0.043	3.518	0	0.043	0.0	0.0	Null
Fallowland	14	0.046	3.789	0	0.046	0.0	0.0	Null
Cropland	54	0.178	14.614	0	0.178	0.0	0.0	Null
Rann	96	0.317	25.980	73	0.317	0.801	0.979	P
z = 2 5799		x^2 = 125.4931						

Table IV.13: Habitat use by All-male herd (BH) within the home range (1990-91).

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrub low	147	0.758	70.469	29	0.758	0.192	0.432	A
Scrub low	12	0.062	5.753	30	0.062	0.201	0.444	P
Cropland	10	0.052	4.794	32	0.052	0.221	0.467	P
Rann	25	0.129	11.985	2	0.129	0.000	0.059	A
$z = 2.4999$		$x^2 = 289.3283$						
MONSOON								
Scrub low	129	0.578	54.955	47	0.578	0.366	0.623	E
Scrub dense	10	0.045	4.260	9	0.045	0.020	0.170	E
Cropland	8	0.036	3.408	14	0.036	0.056	0.238	P
Rann	76	0.341	32.377	25	0.341	0.150	0.376	E
$z = 2.4999$		$x^2 = 41.0246$						
WINTER								
Scrub land	9	0.110	6.366	30	0.110	0.370	0.664	P
Rann	73	0.890	51.634	28	0.890	0.336	0.630	A
$z = 2.2399$		$x^2 = 98.56305$						

Table IV.14: Day Habitat Use by Collared Mare YC within the study area.

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrub low	126	0.416	46.574	72	0.416	0.526	0.760	E
Scrub dense	13	0.043	4.805	32	0.043	0.176	0.396	P
Fallowland	14	0.046	5.175	7	0.046	0.003	0.122	E
Cropland	54	0.178	19.960	1	0.178	0.0	0.032	A
Rann	96	0.317	35.485	0	0.317	0.0	0.0	Null
z = 2.5799		x^2 = 221.9238						
MONSOON								
Scrub low	126	0.416	69.030	125	0.416	0.667	0.839	P
Scrub dense	13	0.043	7.122	20	0.043	0.55	0.186	P
Fallowland	14	0.046	7.670	0	0.046	0.0	0.0	Null
Cropland	54	0.178	29.584	0	0.178	0.0	0.0	Null
Rann	96	0.317	52.594	21	0.317	0.06	0.193	A
z = 2.5799		x^2 = 124.8999						
WINTER								
Scrub low	126	0.416	17.050	35	0.416	0.711	0.996	P
Scrub dense	13	0.043	1.759	6	0.043	0.004	0.289	E
Fallowland	14	0.046	1.894	0	0.046	0.0	0.0	Null
Cropland	54	0.178	7.307	0	0.178	0.0	0.0	Null
Rann	96	0.317	12.990	0	0.317	0.0	0.0	Null
z =2.5799		x^2 = 51.3148						

Table IV.15: Habitat use by Collared mare (YC) within day home range.

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrub low	72	0.643	25.714	8	0.643	0.049	0.351	A
Scrub dense	32	0.286	11.429	11	0.286	0.106	0.444	E
Cropland	8	0.071	2.857	21	0.071	0.336	0.714	P
z = 2.3899		x^2 = 127.42638						
MONSOON								
Scrub low	125	0.753	51.205	51	0.753	0.624	0.876	E
Scrub dense	20	0.120	8.193	12	0.120	0.066	0.287	E
Rann	21	0.127	8.602	5	0.127	0.000	0.149	E
z = 2.3899		x^2 = 3.27863						
WINTER								
Scrub low	35	0.854	29.024	21	0.854	0.431	0.804	A
Scrub dense	6	0.146	4.976	13	0.146	0.196	0.569	P
z = 2.2399		x^2 = 15.159804						

Table IV.16: Night Habitat Use by Collared Mare YC within the study area.

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER Scrub low	126	0.416	73.188	122	0.416	0.603	0.783	P
Scrub dense	13	0.043	7.551	33	0.043	0.112	0.263	P
Fallowland	14	0.046	8.132	15	0.046	0.031	0.140	E
Cropland	54	0.178	31.366	1	0.178	0.0	0.020	A
Rann	96	0.317	55.762	5	0.317	0.0	0.061	A
z = 2 5799		x^2 = 199.7313						
MONSOON Scrub low	126	0.416	61.129	107	0.416	0.633	0.823	P
Scrub dense	13	0.043	6.307	24	0.043	0.085	0.242	P
Fallowland	14	0.046	6.792	4	0.046	0.0	0.62	E
Cropland	54	0.178	26.198	0	0.178	0.0	0.0	Null
Rann	96	0.317	46.574	12	0.317	0.023	0.140	A
z = 2.5799		x^2 = 137.0689						
WINTER Scrub low	126	0.416	51.149	74	0.416	0.488	0.716	P
Scrub dense	13	0.043	5.277	35	0.043	0.180	0.390	P
Fallowland	14	0.046	4.683	13	0.046	0.034	0.177	E
Cropland	54	0.178	21.921	1	0.178	0.0	0.029	A
Rann	96	0.317	38.970	0	0.317	0.0	0.0	Null
z =2.5799		x^2 = 245.9727						

Table IV.17: Habitat Use by Collared Mare (YC) within night home range (1990-92).

Habitat Categories	Total area	Relative area	Expected usage	Observed usage	Expected proportionate usage	Lower Confidence Limit	Upper confidence limit	Intens-ity of use
SUMMER								
Scrub low	122	0.693	18.023	5	0.693	0.000	0.386	A
Scrub dense	33	0.188	4.875	9	0.188	0.113	0.579	E
Cropland	16	0.091	2.364	11	0.091	0.181	0.665	P
Rann	5	0.028	0.739	1	0.028	0.000	0.133	E
$z = 2.4999$		$x^2 = 44.5486$						
MONSOON								
Scrub low	107	0.728	21.837	17	0.728	0.340	0.793	E
Scrub dense	24	0.163	4.898	7	0.163	0.040	0.426	E
Fallowland	4	0.027	0.816	6	0.027	0.017	0.383	E
Rann	12	0.082	2.449	0	0.082	0.000	0.000	Null
$z = 2.4999$		$x^2 = 37.3387$						
WINTER								
Scrub low	74	0.602	21.057	8	0.602	0.059	0.398	A
Scrub dense	35	0.285	9.959	17	0.285	0.284	0.688	E
Cropland	14	0.114	3.984	10	0.114	0.103	0.468	E
$z = 2.3899$		$x^2 = 22.15938$						

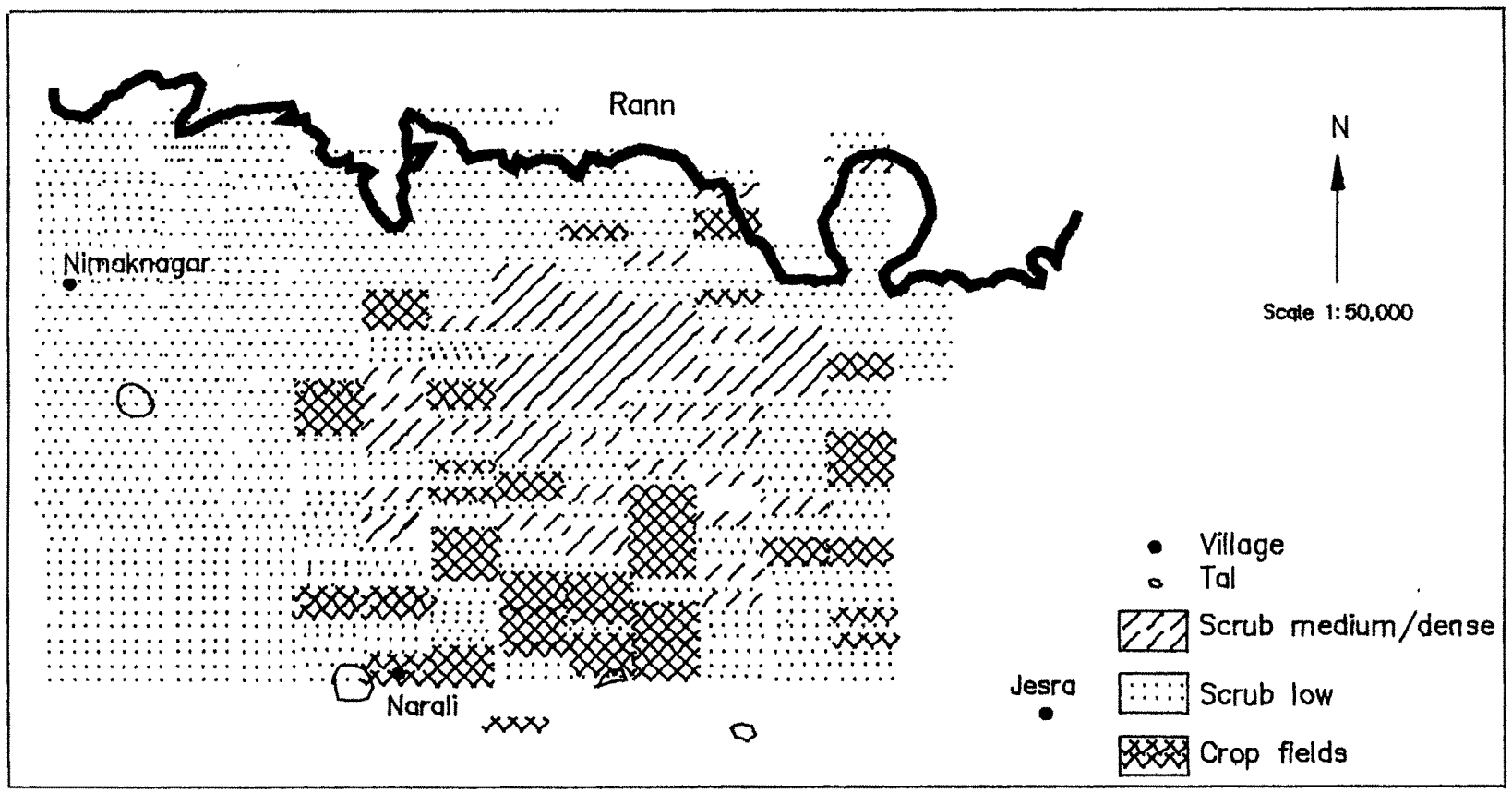

Figure IV.1: Habitat map of Narali

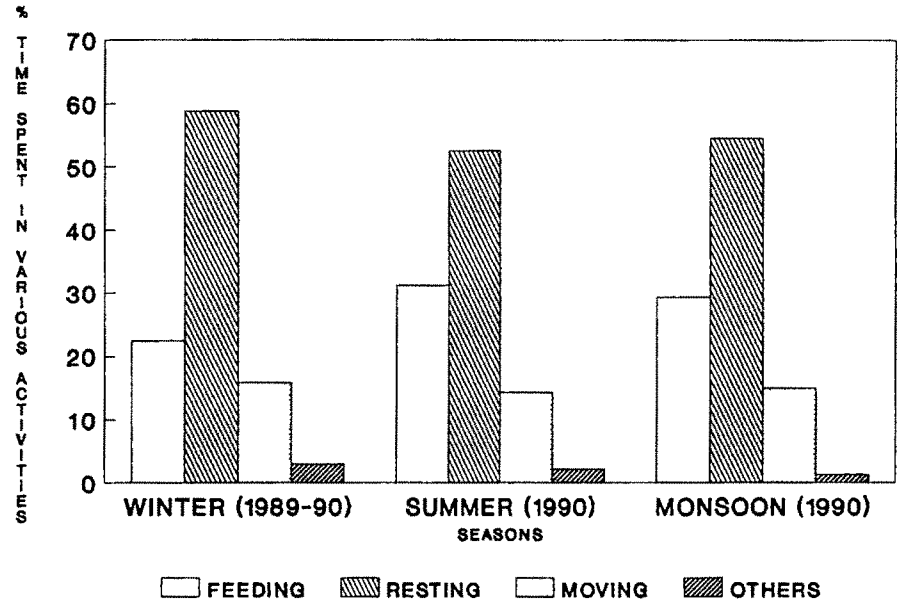

Figure IV.2; Activity pattern of family band in Narali during 1989-1990.

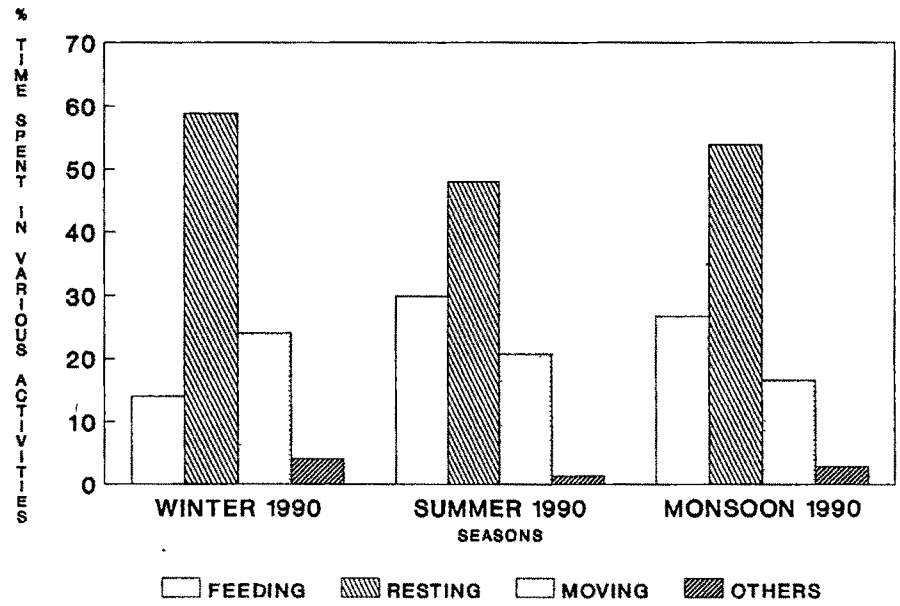

Figure IV.3: Activity pattern of all-male herd in 1990,in Narali.

Plate IV.1 Spot Satellite Imagery of the study area.

LEGEND: Red - Vegetation (scrubland).
Yellow - Fallowland.
Blue - Rann.
White - Grassland (saline).

Plate IV.2 Wild Ass in cropland.