Chapter - III

POPULATION DISTRIBUTION, DYNAMICS AND STRUCTURE

INTRODUCTION

During the last century the wild ass *(Equus hemionus khur)* had a fairly wide distribution in the dry regions of North-West India and West Pakistan. They existed as far north as Jaisalmer and Bikaner in Rajasthan and Sind and Baluchistan in Pakistan (Gee 1963). The wild ass was also found in Nagar Parkar and Chacro tehsils of Tharparkar districts which adjoins the Great Rann on the Pakistan side (Roberts 1977). Today the wild ass is more or less restricted to the Little Rann of Kutch (LRK) and have strayed out more towards the south on the Surendranagar highway till Nalsarovar Bird Sanctuary located south-east of the LRK.

Status: Ali (1946) estimated the population of wild ass in the LRK to be between 3000-4000. Wynter-Blyth (1956) described the wild ass as more than abundant (approximately 4000) in LRK . Later in 1960 Ali (*in litteris* to E.P. Gee) considered the estimate of 2000 khurs in LRK given by the Range Officer of Jhinjuwada as 'probably not unreasonable'.

In 1958 and 1960, an arthropod - borne disease known as *Surra*, which is caused by *Trypanosoma evansi* killed a number of wild asses (Gee 1963). In November-December 1961, there was an outbreak of the South African Horse Sickness and some animals died during that period (Gee 1963). Gee (1963) estimated the population of wild asses to be around 870 in 1962 in LRK. The last African horse sickness outbreak in Surendranagar district was in November, 1963 (Spillet 1968). An aerial survey in 1969 gave a population figure of 362 wild ass (Forest Records). The severe droughts

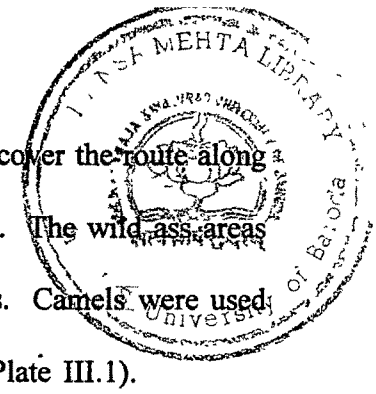
of 1968 and 1969 could also have decimated a large number of wild asses. The Gujarat Forest Department's (GFD) total count was 720 for April 1976, was 1989 for April 1983 and 2072 wild ass for March 1990.

The primary aim of this study was, however, to gather information on demographic characteristics of wild ass for rational management of the species, and to identify problems which required immediate attention. The present study (1989-92) included regular monthly and bimonthly surveys, where total numbers, sex and age of observed wild ass were also recorded.

METHODS

Wild ass were counted along a fixed vehicular route along the contours of the Rann fringe. Such surveys were conducted monthly along the southern fringe and bimonthly in the entire LRK (Figure III.1). Whenever the wild ass were sighted, the vehicle was stopped and the number of animals and their sex were recorded using a spotting scope. The habitat, activity of the herd, time of sighting and the kilometre reading of the vehicle were recorded.

The survey along the southern fringe was divided into eastern (Narali to Bajana) and western (Kuda to Tikar) parts (Figure III.1). Each part (40kms) was surveyed in a day. Therefore two days were spent every month for censusing the southern fringe. The eastern (Kharaghoda to Amrapur) and northern (Pati to Piprala) fringes, Bets Jhilandhar, Wasraj (with its five chain islands), Dhut, Pung Shedwa, Mardak and Nanda, were covered bimonthly from November 1990 to November, 1991 (Figure III.1). A period of 7-10 days were spent for this bimonthly exercise. During the surveys and vegetation transects, 43 wild ass skulls were collected from various areas of LRK.



During the monsoon (July-October), it was not possible to cover the route along the contours of the fringes as the Rann were inundated and soggy. The wild ass areas were therefore, visited using motorable trails through the villages. Camels were used when vehicular routes were not motorable during the monsoon (Plate III.1).

In the Great Rann only the Nada and Boriya Bets were surveyed once for tracks and signs of wild ass. The Border Security Force (BSF) personnel were interviewed in January, 1991 for information on wild ass sightings. Nakhatrana to the India gate (BSF point) was also covered in July-August 1991. Nalsarovar Bird Sanctuary (*Bhal* area) was surveyed in June 1991 and people in 4 villages around Nalsarovar were interviewed.

Inhabitants (old and young) of 199 villages around LRK (southern, eastern and northern fringes) were interviewed for information on presence/absence of wild ass. These villages were classified into three zones i.e. within 5km zone, 5-10km zone and >10km zone from the Rann fringe (Figure III.2).

Statistical tests used were 2 x 2 contingency table log-likelihood ratio with William's correction for continuity (G-test) for the comparison of foal:adult sex ratio and foal sex ratio; linear regression for sex ratio: group size; Spearman's rank correlation coefficient (Sokal & Rohlf 1981) to determine whether giving birth to ♂ foals had an effect on the following year's foaling rate, exponential growth rate for population trend and probit analysis for median date of birth (Caughley 1977).

RESULTS

In winters (November-February), the counts were done after 1000 hrs, the time when the wild ass come out into the open from the cover of *Prosopis juliflora* shrubs which provides protection from the severe cold winter nights. In summer, (March-June)

surveys were done earlier because of dust storms by noon hours. The habitats near the fringe had to be intensively scaled for the wild ass. The counts were comparatively poor, as most of the wild ass herds were fragmented into small groups and ranged in larger areas.

The counts were most accurate in late monsoon and early winters, when the wild ass were less widely dispersed, did not move far, and were confined to open areas. Moreover, in this season counts were much easier in the monsoon as the wild ass congregated along the fringes for mating and foaling. As the wild ass herds were localized, chances for double counting were negligible.

Distribution

The southern fringe had 11 wild ass herds which formed an isolated population. Three of these were all-male herds with 125 males (1991) and eight were family bands with 277 individuals (37♂, 162♀, 78 foals in 1991). These herds were distributed between Tikar in the west and Bajana in the east (Figure III.2). Sightings were rare in Tikar mainly due to the army firing range based in the area causing constant disturbances (Table III.1).

The Bajana/Tundi all-male herd were located at the junction of southern and eastern fringes and so had an access to the Kharaghoda breeding herd (along Eastern fringe) which was nearest to Bajana all-male herd (Figure III.3).

The eastern fringe consisted of five family herds located in Kharaghoda, Wasrajpura, Visnagar/Surrel, Kordha and Amrapur areas, and one all-male herd at Jhinjuwada. Three Bets Wasraj, Nanda and Pung had family herds only during the monsoon season. Dhut Bet had one all-male herd. Between December and June only solitary stallions were sighted on these Bets and the rest of the herds dispersed mainly

to eastern and northern fringes. However some herds did visit Wasraj and Nanda Bets at times other than monsoon season (Figure III.2).

Southern Fringe: Koparni, Enjar Kiddi, Tikar, Jesra Malwan and Sultanpur areas, had intensive salt works right along the fringe. Narali had salt works which were 2.5 kms away from the fringe. All these areas had isolated wild ass herds (totally 12).

The scrubland was interspersed with croplands in most of the southern fringe areas. During monsoon, the wild ass herds were driven away by farmers from the cropland areas towards the Rann fringe. In Koparni the wild ass herd concentrated near the Kuba tourist complex (located west of Koparni) (Figure V.9) since during the monsoon, the croplands of this village were ploughed. In Enjar and Kanachar areas the rivulets acted as barrier during the monsoon and prevented animal movement.

Along the southern fringe of LRK, the wild ass population outside the Sanctuary was mainly restricted within and >10kms zone. The southern fringe villages (n=99) reported presence of wild ass in all the three zones 0-5 kms., 5-10 kms. and >10 kms. (Figure III.2, Table III.2).

Eastern Fringe: The number of herds (6 herds) in the area was half of that found in southern fringe. Moreover in the upper half of eastern fringe (Figure III.1), the herds in Kordha, Visnagar, Amrapur and Wasrajpura areas were highly mobile and normally moved to the Bets for breeding during the monsoon. This area had three main rivers emptying into the Rann (Saraswati, Rupen and Banas) which flooded the areas in its vicinity leaving no breeding grounds for these herds (Figure III.1). The ground vegetation was very sparse which forced the wild ass to move between the Bets and eastern fringe.

The area was exposed to severe dust storms during winter and summer. In the monsoon, the area was flooded and remained soggy for long periods. Visnagar and Wasrajpura had heavy salt works.

The southern half of eastern fringe had intensive salt works. Only three herds were found in the salt work areas: Jhinjuwada, Odu/Chikasar and Kharaghoda.

The eastern fringe villages (n=49) reported wild ass presence in the 5 and 5-10 km.zones (Figure III.2, Table III.2). A gradual decrease of wild ass presence was recorded from >10 kms. zone probably because the resources were sparse.

Northern Fringe: Sightings were very few in this fringe. Solitary animals from the Bets were seen wandering in this area. In monsoon, the whole northern fringe of the Rann gets inundated and remains soggy over a long period (six months). In the Santalpur and Vainu Rann and north of Mardak Bet areas many salt works became established in the past three years (1989-92). The vegetation in the area was sparse and therefore there were rare sightings of wild ass. Nanda Bet had one breeding herd, which moved to the of scrublands of Adesar (north of Nanda Bet). In summer, severe dust storms prevailed in this area.

The northern fringe villages (n=44) reported wild ass presence in 5 and 5-10 kms. zones (Figure III.2, Table III.2). In the >10kms zone the villages were sparse and reports of wild ass presence were scanty. Piprala is the last village of LRK forming the bottle neck between LRK and the Great Rann.

Distribution Outside the LRK

The Great Rann in the Vav Taluka (Eastern part) had a breeding herd between Boriya and Nada Bets (BSF personnel, *pers.comm.* 1991). The Banni grasslands had no wild asses (Jugal Kishor, *pers.comm.* 1991).

Some wild asses had emigrated out of the Sanctuary (LRK) to Nal Sarovar Bird Sanctuary (*Bhal* area). A family band of about 25 individuals was reported in the north eastern part of Nal Sarovar - an open grassland area. These wild asses had been in this area since the past 20 years (RFO, Nal Sarovar, *pers. comm.* 1991)

Population Size

The monthly count of the wild ass herds showed high fluctuation. The best count between July and December were considered for analysis. Figure III.1, gives the details of the area surveyed for population estimate (Table III.1).

In LRK a total of 23 herds (n=753 wild ass) were counted in 1990 and 20 herds (n=702 animals) were counted in 1991. The survey remained incomplete in 1991, due to logistic reasons.

The population counts in the southern fringe in 1989 was 297, 363 in 1990 and 402 in 1991. There were 12 herds in all three year counts (Table III.3).

Population Trend

Data from various sources and Forest Department were pooled for growth rate analysis. Population figures prior to 1969 are based on *ad libitum* enumeration of herds by Salim Ali, Wynter-Blyth, E.P. Gee, J.J. Spillet, S.K. Sinha and interviews with foresters. In 1969 an aerial survey was conducted by the Forest Department and

Maharaja of Bhavnagar. In the years, 1974, 1983 and 1990 the Forest Department (Gujarat), did a total count of the wild ass.

On the whole, population counts were sporadic, because of the inconsistency in the methods used and choice of survey areas. Population estimates for periods prior to the present study are admittedly of questionable accuracy. However, these population figures were used to derive a trend. The population in LRK showed high fluctuations (Figure III.4, Table III.4), the growth rate of population varied from -0.416 to 0.145 (Table III.4,).

The LRK population showed a declining trend from 1946 to 1969.The population showed a declining trend from 1956 to 1962 [r= -0.1732 (1956-1960) and r= -0.4162 (1960-1962)]. From 1962 to 1966 the wild ass population was quite stable (Figure III.4). The 1966 estimate of 870 wild ass (Spillet 1968) was not taken into consideration as it was just a guess based on interviews. The population from 1962 to 1969 showed further decline from 870 to 362 with r=-0.1256. The population since then has been showing an increasing trend, with growth rates varying from 0.0058 to 0.1452 (Figure III.4). The growth rate from 1969 to 1976 registered a slight increase (r= 0.09823). The wild ass number of 720 in 1976 built up to 1,989 in 1983, registering a growth rate r=0.1452/annum. The overall growth of the population slowed down r=0.00584 between 1983 to 1990 (Figure III.4).

The southern fringe was surveyed by Ali (1946), Gee (1962) and Spillet in 1968 therefore more reliable population figures for wild ass are available. The southern fringe count between 1989-1991 (present study) and an interview based (forest guards) estimate of 1988 showed an increase. The population growth rate during this study from 1989 to 1991 were 0.2007 (1989-90) and 0.1020 (1990-91). The years 1989 and

1990 showed high rate of increase. The growth rate between 1988 (R.B.Zala *pers.comm.*) and 1989 showed slight decline, r= -0.0746.

There was an increase in foaling rate in 1989 (27.61%) as compared to the following years 1990 (18.73 %) and 1991 (19.4%) (Table III.4).

Population Characteristics

Reproduction: There was a pronounced seasonality in reproductive activity. Mating and foaling occurred during monsoon which is also a period of vegetative growth. During monsoon best nutrition is available when females are lactating. This is also a crucial time for the mares, as they have to overcome the stress and high energetic cost of lactation as well as for the males due to mating activities. Fluctuations of resources during this period may have serious implications on wild ass breeding success.

Mating took place from June to January with a peak in July-August-September. Foaling occurred during July to January with a peak in July-August. The median date of birth was 27th July (SD= 70.57 days) for 1989, was 15th July (SD= 27.57 days) for 1990 and for 1991 was 11th August (SD= 24 days). Maximum births were recorded in August in all the three years, 52.38% (n=21) in 1989, 45% (n=11) in 1990 and 50% (n=14) births in 1991. All births were single. Male foal were weaned at 1-2 years of age while female foal continued to remain with mares for longer periods.

Rainfall seemed to have some effect on conception as many mares did not conceive in drought years. Rainfall to a certain extent had an influence on the foaling (Table III.5). 76.09% (n=35) births were recorded during the peak rainy days, 6.52% (n=3) births recorded one week before the start of the rains and 17.39% (n=8) births recorded one week after the end of rains (Tables III.5). This was based on the records

of the intensively studied family band in Narali/Waghaki area. The births in the wild occurred at late night or early dawn.

Birth Rates: In all the three years, a good number of births were recorded along the southern fringe. i.e. 27.61% in 1989 (n=82 foals, 11 bands), 18.73% in 1990 (n=68 foals, 12 bands) and 19.4% in 1991 (n=78 foals, 12 bands) (Table III.6).

In the northern and eastern fringes and the Bets, 23.33% births were recorded for 1990 (n=91,10 family bands) and 23.66% in 1991 (n=71,7 family bands) (Table III.6).

Overall, in LRK 21.11% births were observed in 1990 (n=159, 18 family bands) and 21.225% births were recorded in 1991 (n=149, 14 family bands) (Table III.3).

Foal Female Ratio: The observed foaling rate in the three years (1989-91) varied between 78 foals:100♀ to 25 foals:100♀ with a mean for every band ranging between 42-66 foals:100♀. It is comparable with foaling rate observed in feral ponies, burros and feral horses which ranges between 38% to 95% (Hammand 1960; Boyd 1979; Keiper 1979; Eberhardt *et al.* 1982; Garrot *et al.* 1990) among females more than three years of age. The mean foaling rate in the southern fringe was 65.72:100♀ in 1989 which dropped to 41.74:100♀ in 1990 and 44:100♀ in 1991.

The foal:♀ ratio of individual herds varied from 0.222 foals/♀ to 1 foal/♀ (Table III.6).

The foal:♀ ratio for the entire LRK in 1990 was 0.426227 foal:♀ (foal=159, ♀=373, 18 family bands). In 1991 it was 0.44879 foal:♀ (foal=149,♀=332, 14 family bands) (Table III.3).

As the mean herd size increased, the mean foal:♀ ratio also increased but the relationship was not significant (r=0.25483, P<0.05, n=14) (Figure III.5). No correlation was obtained between the births of male foals in a herd in 1990 with that of foals born per ♀ in 1991 (r_s =0.036, P>0.05, n=7). The births of male foals did not seem to have any effect on the following year's foaling rate.

Foal Sex Ratio: The foal sex ratio of LRK population of 1990 was 1.016♂:1♀. This did not differ from an even sex ratio ($Gadj_{1990}$ =0.0078, df=1, P>0.05, n=127 foals) (Table III.6). The sex ratio in southern fringe population of 1990 was 0.73♂:1♀ ($Gadj_{1990}$=1.41, df=1, P>0.05, n=57 foals), and in 1991 was 1.15♂:1♀ ($Gadj_{1991}$=0.64995, df=1, P>0.05 n=75 foals). The eastern fringe and Bets population of 1990 also indicated an even sex ratio 1.33♂:1♀ (*Gadj*=1.42, P>0.05,df=1,n=70 foals).

The foals were sexed within a month or two after their birth. The majority of herds (58.33%, n=12) showed an even sex ratio at birth; the remaining herds (16.66%) indicated preponderance of males while 25% favoured a female biased ratio (Table III.6). The pooled sex ratio indicated parity at birth.

Adult Sex Ratio: The sex ratio of eastern fringe and Bets was 0.28♂:1♀ which was biased towards females ($Gadj_{1990}$=89.8645, df=1, P<0.001, n=272) and in 1991, the sex ratio was 0.34♂:1♀ ($Gadj_{1991}$=58.712, df=1 P<0.001, n=227). Southern fringe population count had an even sex ratio in 1990 was 0.799♂:1♀ and in 1991 was 1♂:1♀. ($Gadj_{1990}$=3.687, df=1, P>0.05, n=297).

The overall adult sex ratio for LRK in 1990 was 0.508♂:1♀ (G*adj*=61.426766, P<0.001. n=567) and was 0.659♂:1♀ (G*adj*=23.3183, P<0.001, n=551) in 1991 which was biased towards females.

Foal:Adult Sex Ratio: On comparing foal and adult sex ratio, a significant difference was observed in the LRK population of 1990 (G*adj*=12.0623, P<0.001, df=1).

The eastern fringe and *Bets* population of 1990, also indicated a significant difference (G*adj*=30.3892, df=1, P<0.001) in the sex ratio of the foal to that of the adults.

The southern fringe population indicated that there was no difference in the sex ratio of the foal and the adults in both the years, 1990 and 1991 population samples ($Gadj_{1990}$=0.1021, df=1, P>0.05) and ($Gadj_{1991}$ =0.528, df=1, P>0.05).

Herd Sex Ratio: The sex ratio obtained in individual herds varied from 0.02♂:♀ to 0.38♂:♀ in 1990 and 0.05♂:♀ to 0.38♂:♀ in 1991 (Table III.7).

Mortality: During the study 19 carcasses were found of which six were of foals (Table III.8). One wild ass found dead on Mardak Bet near the water source, was bleeding from its nape region; trails of jackals and mongoose were observed near the caracass. For the rest of the cases it was difficult to ascertain the cause of death as the bodies had decomposed. Wolf predation on wild ass has not been recorded. Moreover, wolf density in the area was low (Nita Shah *unpublished*). Stray dogs were observed chasing foals and adults during the monsoon season in the Narali study area (n=6).

Males had a high mortality rate in LRK. Out of a total of 43 skulls found during 1989-91, 71.43% skulls were of males, 9.52% females and 19.05% remained

unidentified. In the southern fringe, 80% skulls (n=15) were of males and in the eastern fringe and Bets, 68% (n=25) were of males.

DISCUSSION

Distribution

The wild ass population was concentrated along the fringes. The villagers reported that decades ago animals rarely strayed away from the fringe. However, recent surveys indicated an increase in the population outside the Sanctuary (LRK). Due to an increase in the population of the fringe area, the wild ass emigrated and established themselves in the agricultural areas, interspersed with fallow, saline and barren rocky patches. The increase in irrigation facilities and the year round availability of water and food in these areas could have also affected the emigration.

In 1974, when the first census was conducted by the Gujarat Forest Department (GFD), no animal was observed beyond 0-5 kms zone from the Sanctuary fringe. According to the villagers along the southern fringe - the wild ass population was restricted within the 5km zone from the southern fringe.

In the southern fringe, agriculture lands and croplands have increased to a greater extent compared to the northern and eastern fringes. As a result wild ass have become localized, and to a certain extent dependent on crops. They have emigrated to areas >10 kms from the southern Rann fringe. This fringe is richer in resources than the other fringe areas and therefore has a higher density of wild ass (11 herds). The droughts recur frequently in LRK, but the southern fringe is comparatively less affected by droughts than the northern and eastern fringes.

The study indicated that the end of monsoon and beginning of winter is the best time for population counts. During the monsoon the area is soggy and slushy so

mobility is difficult. Therefore, early to late winter count can be considered the best period, as the whole Rann is accessible by December-January.

Rate of Increase

The variation in population estimate for an area could be caused by (a) large and erratic movement of the all-male herds (b) emigration and immigration of animals outside the Sanctuary. (c) variation in herd productivity, influenced by resource availability and drought (discussed later).

There is a possibility that the recent surveys have underestimated the population as animals are dispersed in the neighbouring areas.

Reproduction

The gestation period in captivity is estimated to be around 370 days ranging from 342 to 397 days (Malhotra 1989). The females are seasonally polyestrous. The oestrous period lasts for 7-8 days in captivity (Malhotra 1989) Postpartum oestrous is reported in the equines (Ginther 1979; Berger 1986). Horses have the most variable gestation period among ungulates (Hafez 1980).

Population Growth Rate

The wild ass population in LRK showed a declining trend from 1946 to 1969 (Figure III.4). There was a sharp decline between 1960 to 1962 which could be attributed to the epidemics mentioned earlier (1958-1963) and consecutive droughts (1968 and 1969) or probably an overestimation of earlier wild ass numbers. Although Ali (1946) stated earlier that 'no epidemics appear to be known among the wild asses, there was a drastic decline in the wild ass population in 1956 to 1963 due to outbreaks

of the epidemics, *surra* and African horse sickness. Gee (1963) estimated the population as 870 in his 1962 survey and felt this low figure may be due either to an earlier exaggeration of their numbers, or to the epidemics.

The population showed a further decline from 1962 to 1969. The drought in 1967 and 1968 might have reduced the population which survived the long spell of epidemics prior to the droughts.

The population of wild ass since 1969 showed an increasing trend. The growth rate showed a slight increase from 1969 to 1976 following good rainfall years, although 1972 to 1974 was a drought period and the population may not have built up as expected (Figure III.4). Wild ass number increased rapidly since 1976 probably due to good rainfall years from 1975 to 1985. The growth of the population slowed down between 1983 to 1990. There was a drought in 1987 and scanty rainfall in 1991. Besides other factors, the growth of the population was influenced by the amount of rainfall.

It is likely that in a drought year some mares may skip conception. The present study indicated that such trends existed. The 1987 drought may have caused some mares to skip conception, though no detailed data set for 1988 was available. In 1988 with good rains, the mares which had skipped conception the previous year, might have conceived and foaled in 1989 which could explain the high foaling rate in 1989.

If the increase in population continues, the dispersal of these animals into the adjoining crop dominated areas would increase. The area had a very low density of wolves apart from which there is no other potential predator (Nita Shah *unpublished*). Man as predator (hunting/poaching) played an insignificant role due to religious and cultural beliefs prevalent in the area.

Compared to other equids from predator free systems the growth rate is higher than that reported for Burros *(E. asinus)* and feral horses (Table III.9 and III.10) which were 0.18 to 0.29/annum (Ohmart et al. 1975 in Norment & Doughlas 1977; Wolfe 1980; Eberhardt *et al.* 1982; Dunn 1984, Berger 1986; Garrot & Taylor 1990). Such rapid build up is possible in predator free areas, Eberhardt *et al.* (1982), Berger (1986) and Garrot & Taylor (1990) provided evidence that feral horse populations can attain high growth rates. Thus the observed high rates of increase in expansion phase of wild ass is not unwarranted.

Birth Rate

It was difficult to distinguish non-breeding and subadult females from breeding mares. The birth rate in this study is considered as the number of foals/mares (adult and sub-adult♀) constituting the herd. The foaling rate differed between herds. The herd age structure and resource availability, seem to play an important role. The foaling rate varied from 1989 to 1991, and was highest in 1989 (Table III.6). Rainfall seemed to be the prime determinant of rate of conception and thus may have affected foaling. 1987 was a drought year with only 25.43 mm rainfall (in study area), and the year 1988 had a good rainfall 405.17mm (in study area).

The condition of individuals appeared to be affected by weather as had been recorded for both tropical and temperate ungulates (Klein 1968; McCullough 1969; Grubb & Jewell 1974; Joubert 1974; Sinclair 1977; Penzhorn 1984; Berger 1986). It is not advantageous to have a regular breeding season if the resources are irregular and unpredictable as young born during a drought are unlikely to survive (Delany & Happold 1979). The heaviest mortality in Hartmann zebra population (*Equus zebra hartmanne*) during drought occurred amongst the newly born young foals and pregnant

mares. The mares died during a severe drought probably due to lactation drain and food shortage (Joubert 1974; Penzhorn 1984; Berger 1986). Wild ass deaths in significant numbers were not recorded in 1987 and 1988. There is a possibility that some mares and foals may have succumbed.

It is difficult to observe density dependent effects in an area with varying conditions given the short study span as compared to the animal's life cycle. These effects can be observed in the future if the present trend of positive population growth is maintained in LRK; with no extrinsic factors interfering such as drought and disease which are the two reasons given by Berger (1986) for lack of clear concordance expected between population density and recruitment.

Sex ratio

The 1990 and 1991 population count of Little Rann indicated female biased sex ratio. The reasons for disperate sex ratio are (a) higher mortality of males, (b) problems of counting wide ranging bachelor herds and (c) emigration of males.

The higher mortality of males other than foals indicates susceptibility of males to injuries caused in maintaining hierarchy, territory and or harem. The counting of males in different surveys showed wide variations (Table III.3) due to their large range of movement. Emigration of males outside the area was likely.

Table III.1: Family Bands and All-Male groups along Fringes and Bets in Little Rann of Kutch.

Herd Locality	Band Type	Salt works present*/absent-
Southern Fringe		
Tikar	Rare	*
Jogadh/Bodu *Talav*	All-Male	*
Kiddi	FH	*
Enjar	FH	*
Koparni	FH	*
Kuda	FH Unstable group	-
Narali/Nimaknagar	FH	-
Jesra	All-Male	-
Krishnanagadh/Kanachar	FH	-
Degam	FH Unstable group	-
Sultanpur	FH Unstable group	*
Bajana/Tundi	All-Male	-
Eastern Fringe		
Kharaghoda	FB	*
Odu/Chikasar	FB	*
Jhinjuwada/Jhilandher	All-Male	*
Wasrajpura	FB	*
Visnagar/Surrel	FB	*
Kordha	FB	-
Amrapar	FB	-
Bets		
Wasraj	FB	*
Pung	FB	-
Dhut/Dhutari	All-Male	-
Nanda	FB	-

Table III.2: Presence of wild ass based on reports from various villages in the three zones from the Rann fringes.

Villages Interviewed		Zones Showing % Presence of Wild Ass Based on Reports & Interviews		
Fringes	**# Villages**	**0-5kms**	**5-10kms**	**>10kms**
Southern	99	100 (23)	72.7 (33)	100 (43)
Eastern	49	100 (10)	100 (11)	3.57 (28)
Northern	44	61.54 (26)	50 (10)	12.5 (8)

Values in *parentheses* indicate the # of villages.

Table III.3: Distribution of wild ass herd in Little Rann of Kutch Based upon Best counts.

Locality	1989 T ♂ ♀ f	1990 T ♂ ♀ f	1991 T ♂ ♀ f
Southern Fringe			
Jogad	20 20	17 17	37 37
Kiddi	14 1 8 5	22 2 14 6	26 2 14 10
Malaniyad	1 1	1 1	1
Enjar	22 1 15 6	37 7 21 9	24 3 16 5
Koparni	33 2 18 13	44 5 23 16	41 7 23 11
Kuda	16 3 8 5	52 7 36 9	1 1
Narali	54 7 26 21	32 5 19 8	53 3 37 13
Jesra	12 12	34 34	29 29
Krishnanagad	34 4 16 14	55 12 30 13	66 4 40 22
Sultanpur	- - - -	14 3 8 3	51 17 29 15
Degam	52 3 20 18	22 5 13 4	14 9 3 2
Bajana	39 39	33 33	59 59
Eastern Fringe & Bets			
Kharaghoda	-	37 6 24 7	45 4 31 10
Odu-Chikasar	-	29 7 18 4	1 1
Jhinjuwada	-	38 14 19 5	27 3 18 4
Visnagar	-	29 - 22 7	6 - 3 3
Kordha	-	14 2 6 6	1 1
Amrapur	-	21 1 8 8	15 1 11 3
Wasraj Bet	-	39 1 22 14	25 1 20 4
Dhut Bet	-	24 20 3 1*ui*	11 11
Pung Bet	-	129 2 70 35 22*Yrling*	129 24 66 39
Nanda Bet	-	29 4 20 5	37 8 21 8
Shedwa Bet	-	1 1	1 1
Mardak Bet	-	-	1 1
Taranagar	-	-	1 1

Table III.4: Population growth rate in Little Rann of Kutch from 1946 to 1990.

Time period Yr.I - Yr.II	Population in Year I	Population in Year II	Rate of Increase (r)
1946 - 1956	5000	4000	-0.0223
1956 - 1960	4000	2000	-0.1732
1960 - 1962	2000	870	-0.4162
1962 - 1969	870	362	-0.1256
1969 - 1976	362	720	0.09823
1976 - 1983	720	1989	0.1452
1983 - 1990	1989	2072	0.00584

Sources: Salim Ali (1946), Gee (1963), Spillett (1968), Aerial census (1969), Gujarat Forest Department (1976), (1983), (1990).

Time Period Yr.I - Yr.II	Population in Year I	Population in Year II	Rate of Increase (r)
1988 - 1989	320	297	-0.0774
1989 - 1990	297	363	0.2007
1990 - 1991	363	402	0.1020

Southern fringe population growth rate during the present study (1989-1992).

Table III.5: Births recorded from the intensively studied family band in Narali/Waghaki areas along the southern fringe.

Rainfall	**1989 Births**	**1990 Births**	**1991 Births**	**Total Births**	**Per cent**
One week before the start of Rains	2	1	-	3	6.52
Peak rains	17	9	9	35	76.09
Beyond one week after rain ends	2	1	5	8	17.39

Table III.6: Total percent births and foal:♀ ratio in different herds in LRK.

Band Locality	**% Foals**	**Foals: 100♀**	**Foals**	**Foal: 100♀**	**% Foals**	**Foal: 100♀**
Southern Fringe	1989		1990		1991	
Kiddi	35.71	62.50	27.27	42.85	38.46	71.42
Enjar	27.27	40.00	24.32	42.857	20.83	31.25
Koparni	39.39	72.22	36.36	69.56	26.82	47.82
Kuda	31.25	62.50	17.31	25.00	-	-
Narali	38.88	80.77	25.00	42.11	26.00	35.13
Krishnanagadh	41.18	87.50	23.63	43.33	33.33	55.00
Sultanpur	-	-	21.43	37.50	29.41	51.72
Degam	34.62	90.00	18.18	30.77	14.28	66.66
Eastern Fringe & Bets						
Kharaghoda	-	-	18.92	29.17	22.22	32.36
Odu-Chikasar	-	-	13.79	22.22	-	-
Jhinjuwada	-	-	13.16	26.32	14.82	22.22
Visnagar	-	-	24.14	31.82	50.00	100
Kordha	-	-	42.86	100	-	-
Amrapur	-	-	38.09	100	20.00	27.27
Wasraj Bet	-	-	35.90	63.64	16.00	20.00
Pung Bet	-	-	27.13	50.00	30.23	59.09
Nanda Bet	-	-	17.24	25.00	21.62	38.09

Table III.7: Sex ratio of Individual herds sex ratio of wild ass in Little Rann Of Kutch.

Herd Locality	Herd Sex Ratio ♂:♀ 1989	Herd Sex Ratio ♂:♀ 1990	Herd Sex Ratio ♂:♀ 1991
Southern Fringe			
Kiddi	0.333	0.143	0.143
Enjar	0.067	0.333	0.188
Koparni	0.125	0.217	0.304
Kuda	0.125	0.194	-
Narali	0.091	0.263	0.0811
Krishnanagadh	0.143	0.4	0.100
Sultanpur	-	0.375	0.241
Degam	0.15	0.3846	-
Eastern Fringe & Bets			
Kharaghoda	-	0.25	0.129
Odu-Chikasar	-	0.3889	-
Visnagar	-	0.0454	0.333
Kordha	-	0.333	-
Amrapur	-	0.125	0.0909
Wasraj Bet	-	0.1363	0.05
Pung Bet	-	0.0285	0.3636
Nanda Bet	-	0.2	0.3809

Table III.8: The deaths recorded in Little Rann of Kutch (1989-1991).

Month/Year	Locality	#/Sex/Age	Cause of Death	Remarks
Jan/1989	Malwān	1/-/-	Poached (?)	
May/1989	Pung bet	1/-/subadult	Unknown	
Feb/1989	Dhut bet	1/-/adult	Poached	Reported
- /1990	Jesra	1/♂/adult	Unknown	Reported
Feb/1990	South. Fringe	1/-/adult	Due to respiratory failure	Veterinary report
Feb/1990	Ghantiyari tal Pipri	1/♂/adult	Caught in slush	Reported
Feb/1990	Wasraj bet	1/-/adult	Unknown, had swelling on legs	Reported
July/1990	Waghaki	1/-/foal	Unknown	Sighted
July/1990	Boriya bet (Great Rann)	1/-/foal	Unknown	BSF personnel
July/1990	Waghaki	1/-/foal	Eaten by pariah dog	Shepherds
Nov/1990	Kuda	1/♀/adult	Unknown	Sighted
Nov/1990	Mariham tal Narali	1/♀/adult	Unknown	Sighted
Oct/1990	Dehri Narali	1/-/foal	Unknown	Sighted
Mar/1991	Between Pung and Mardak	1/-/foal	Unknown	Sighted
July/1991	Mardak	1/-/adult	Unknown, body intact, hind portion eaten	Found 200 m from water hole
July/1991	Piprala	1/-/adult	Shot in leg and head died in 4 days	Reported by villagers
Nov/1993	Kanachar	1/-/foal	Bleeding from anal region	Dhaval Desai
Feb/1993	Bajana & Malvan	1/♂/adult	Caught in slush	Mr.Bajania Forester
March/93	Waghaki	1/♂/adult	Died- old age	Mr.Chandu Degama Guard

Table III.9: Adult Native and Feral Equid Sex Ratio (♂/♀) In Predator Free System.

Species & Location	Sex Ratio	Source
Horses		
Sable Is.	1.32 (211)	Welsh 1975
Pryor Mts.	0.54 (35)	Feist & McCullough1975,1976
Grand Canyon	0.79 (68)	Berger 1977 & unpublished
Stone Cabin,Nevada	0.89 (238)	Green and Green 1977
Assateague Is.	0.37 (116)	Keiper 1979
Jicarilla	0.45 (55)	Nelson 1980
Sundre, Canada	0.84 (107)	Salter and Hudson 1982
Asses		
Western Arizona	0.75 (58)	Seegmiller 1977
Ossabau Is.	0.89 (86)	McCort 1979
Little Rann of Kutch	0.66 (551)	Present study
Mountain Zebras		
Mountain Zebra National Park	0.89 (103)	Penzhorn 1975

Table III.10: Sex Ratio in Burros.

Species & Location	Sex Ratio	Source
Ferral Burros		
Black Mts., Arizona	2:1	Mc Michael, 1964
Panamint Mts., California	1:1	P. Moehlman, 1974
Chemehvevi Mts., California	1.3:1	Woodward, 1976
Bill Williams Mts., Arizona	0.85:1	Seegmiller, 1977
Wildrose Canyon, California	2.1:1	Norment & Douglas 1977
Bandelier National Monument, Mexico	0.754:1	Morgart, 1978
Havasu Resource Area, Colorado River Valley, California-Arizona	1.22:1	Walker & Ohmart 1978
Butte Valley, Death Valley National Monument, California	1.34:1	White, 1980
Colorado River Valley, California-Arizona	0.76:1	Seegmiller & Ohmart 1981
Death Valley National Monument, California	0.97:1	Dunn, 1984

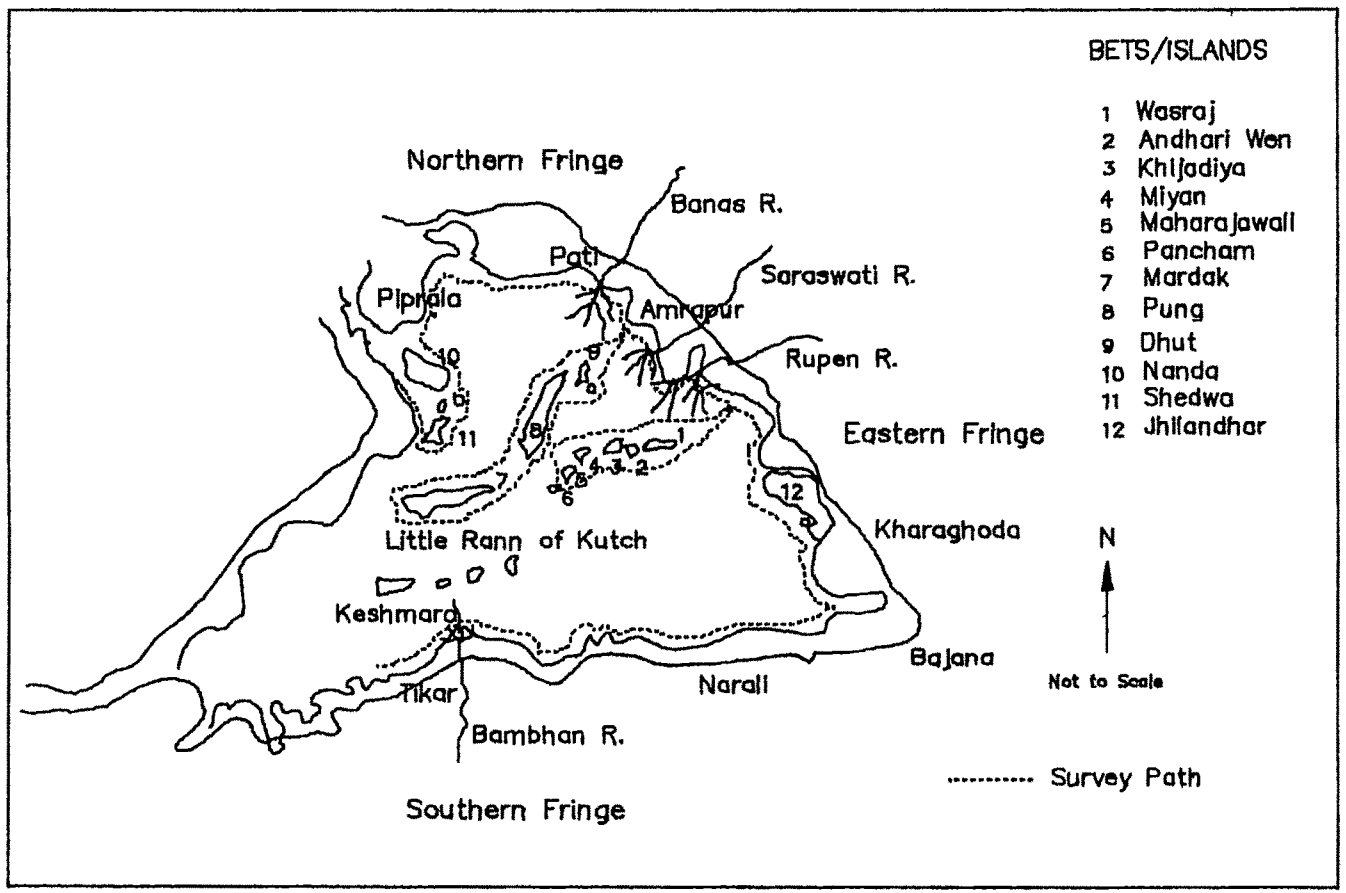


Figure III.1 : Survey Paths for Population Distribution Study in Little Rann of Kutch (1989–90)

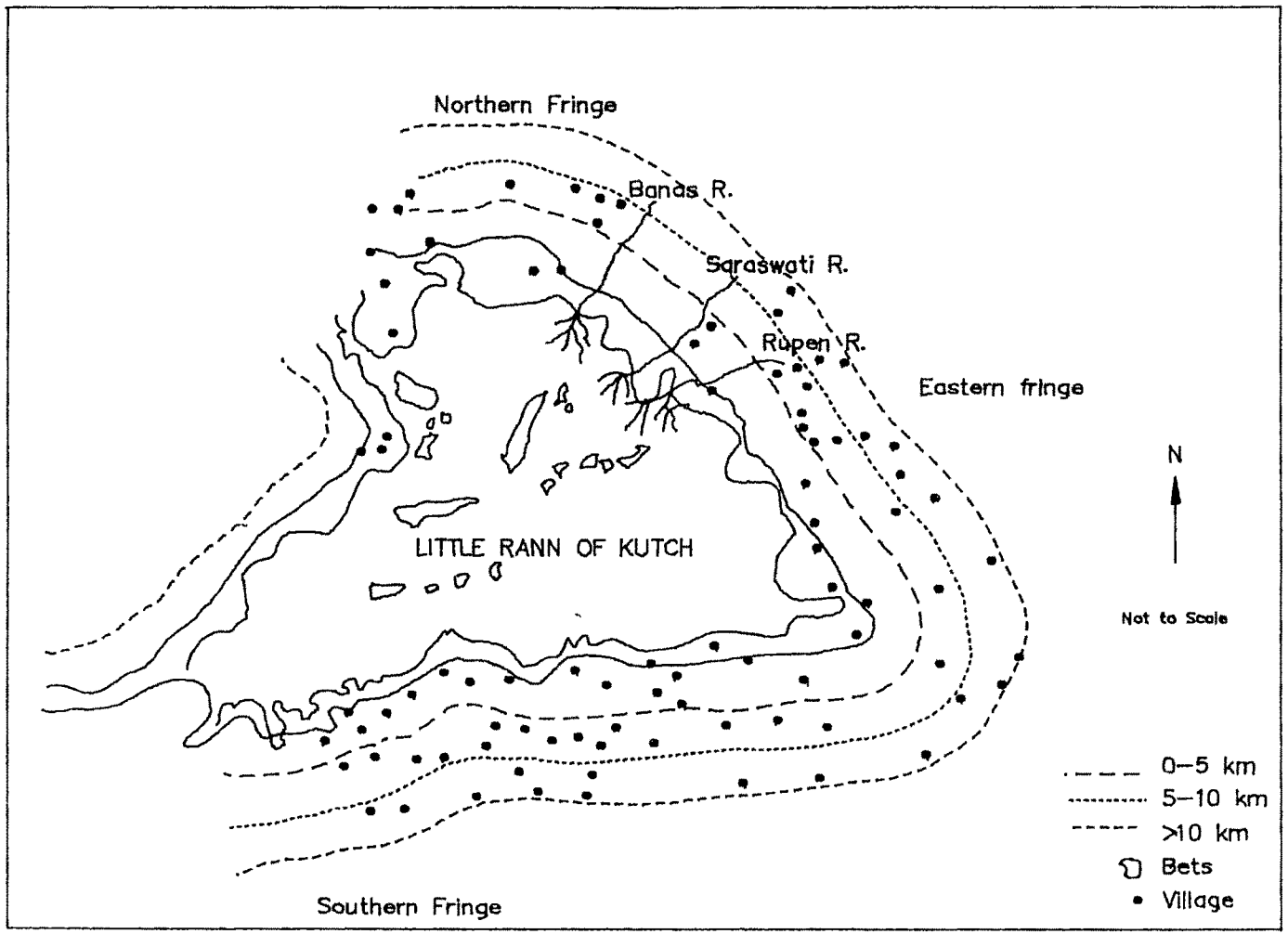


Figure III.2 : Village Zones Around Little Rann of Kutch

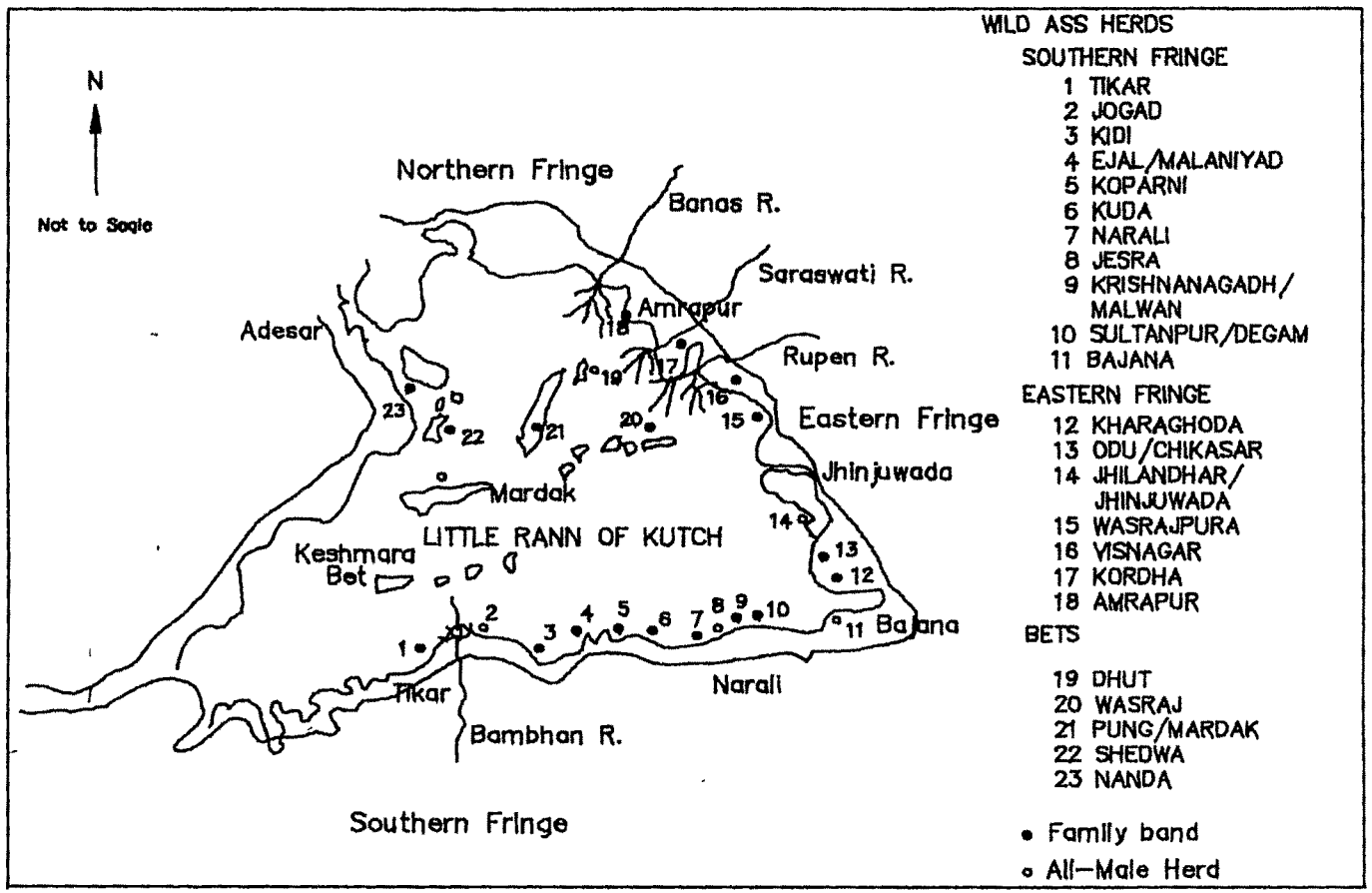


Figure III.3 : Wild Ass Distribution in Little Rann (1990–91)

Figure III.4: Wildass population trend
in Little Rann of Kutch.

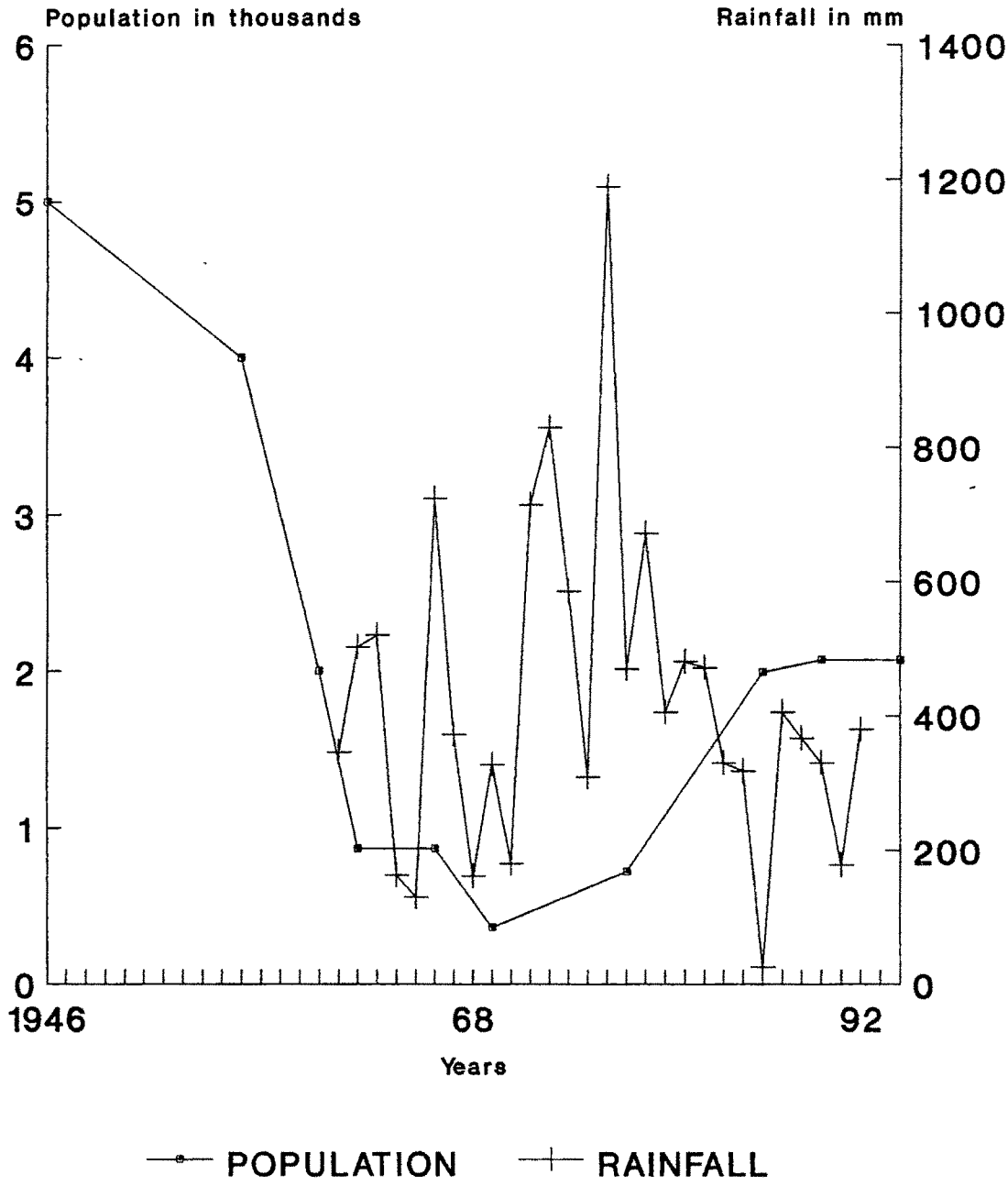
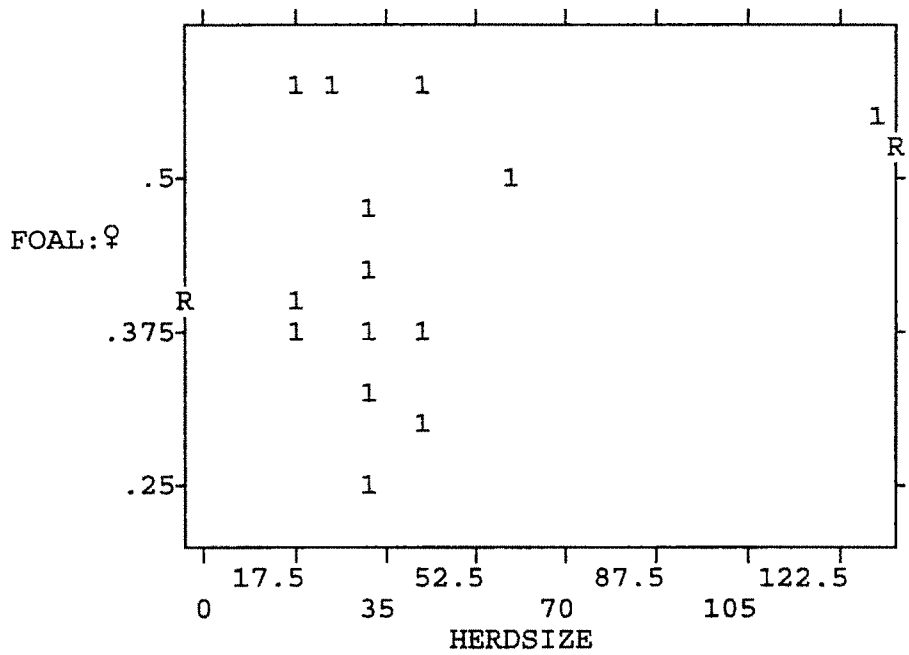


Figure III.5: Correlation between Herdsize and Foal:♀



Correlation = 0.25483, R Squared = 0.06494, S.E. of Est = 0.11145, Sig. = 0.3793, Intercept (S.E.) = 0.39584 (0.05248), Slope (S.E.) = 0.00100 (0.00109)

Plate III.1 The survey team