

**Understanding conflicts and conservation of Indian  
wild ass around Little Rann of Kachchh,  
Gujarat, India**

Technical Project Report



Supported by



2009-10

**Citation:** Dave, C.V. (2010) *Understanding conflicts and conservation of Indian wild ass around Little Rann of Kachchh, Gujarat, India*. Final technical report submitted to Rufford Small Grant Program, UK.

## **Acknowledgement**

I am grateful to the Rufford Small Grant Foundation for the financial support to this program. My sincere thanks to Prof. Norman Owen-Smith (University of the Witwatersrand, Johannesburg), Dr. Illias Karmiris (Aristotle University, Greece) and Dr. Sabyasachi Dasgupta (Garhwal University, Srinagar) for recommending my first ever research and conservation proposal for the funding. I am thankful to volunteers/friends namely, Meraman and his wife Arti, Lana Byal, Manish Mayur, Chirag Prajapati, Dharmendra Shah and Dharmendra Patel for active involvement in the field and back up activities. My special thanks to Dr. Y.V. Bhatnagar, NCF, Mysore, Dr. Y.V. Jhala, WII, Dehradun, Dr. S. P. Goyal, WII, Dehradun Dr. B. Jethwa, GEERF, Gandhinagar, Dr. Vijayakumar, GUIDE, Bhuj, Dr. H. Kamat, Gujarat University, Ahmedabad, Dr. B. Gohil, Bhavanagar University and Dr. J.S. Jalal, Nainital University for constant encouragement, guidance and support. I thank my friend Dr. Kerry Nicholson for report editing and final proof checking. I also thank field staff of Gujarat Forest Department for their help during field data collection. I am thankful to my parents and family members for constant motivation. Last but not least, my heartiest thanks to the people of this harsh landscape for warm welcome and co-operation during field work.

## Summary

Wild ass population has gradually increased from less than four hundreds in late sixties to more than four thousands in 2009. Increase in the wild herbivore populations following better protection and management (wild ass, nilgai and wild pigs) as well as change in farming practice have resulted in to intensified crop raiding incidences. Since Rann landscape is saline low land which remains submerged during monsoon and early winter months, part of the wild ass population moves out into the surrounding agricultural landscape. Such seasonal movement coupled with the dispersal of increased wild ass population is causing conflict with agropastoral community. The current project was proposed to study the pattern and amplitude of the conflict to safeguard the dispersal in former range. For that, the intensive study area was selected near a narrow chicken neck between little and Greater Rann of Kachchh.

Major project activities were to assess the status of the wild ass population in the corridor area in northern part of Little Rann of Kachchh; prevailing conflict scenario; crop raiding pattern and magnitude; peoples perception about wild ass and other wildlife species; and factors affecting the safe dispersal of Indian wild ass. Major findings of the project are: a) urgent need for a conflict mitigation program to tackle the growing concerns of farmers; b) major obstruction to wild ass movement between Little to Greater Rann of Kachchh are railway line and four-lane highway hence, several all weather underpasses should be provided; c) crop damage by wild ass was restricted maximum up to 1 km from fringe and therefore if provided fencing to crop fields within this distance would reduce the crop raiding incidences.

Along with the field research, a series of conservation awareness workshops for school children and villagers were organized in several villages in the fringe area connecting Little and Greater Rann of Kachchh. This initiative was to sensitize local community if taken further would definitely help the wild ass conservation in particular and wildlife in general.

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## 1.0 Introduction

The issue of crop depredation and subsequent conflicts arising between human-wild herbivore populations in recent times is a growing concern of wildlife managers in India (Prater 1980; Rajpurohit & Mohnot 1988; Sukumar, 1994). A number of attempts have been made to document and quantify the crop depredation by wild herbivores in different parts of the country (Sukumar, 1990; Studsrød, & Wegge, 1995). The crop raiding issues by the Indian wild ass has recently increased because of natural dispersal of increasing populations into adjacent agriculture landscape (Shah 1998, 1999, 2004; Singh, 2000). Although several efforts were made to estimate wild ass population and some ecological aspects of the Little Rann of Kachchh (Ali, 1946; Gee, 1963; shah, 1993; Singh *et al*, 1999), issues related to quantification and mitigation of human-wildlife conflicts have not been addressed comprehensively.

The major concern pertaining to the long term conservation of the last surviving population of wild ass are: a) human-wild ass conflict resulting from crop raiding incidences and b) issues related to the safe dispersal for wild ass to the former distribution range. Wild ass has been implicated for extensive crop damage in agriculture landscape around Little Rann of Kachchh



(Shah, 1993). In addition to wild ass, other two wild herbivores nilgai and wild pig are also causing extensive crop depredation in the landscape. However, substantial increase in the populations of latter species i.e. nilgai and wild pigs over entire state of Gujarat has resulted into extensive crop damage everywhere including the area along the potential corridor between Little and Greater Rann of Kachchh as well. Since there are three wild ungulates i.e. wild ass, nilgai and wild pig, operating in this corridor area, amplitude of



the damage would obviously higher compared to other parts of the state. Such high crop damage subsequently causes antagonism of local community towards large herbivores.

Although reestablishment of the geographic range of Indian wild ass is essential and desirable, no effort has been made to mitigate subsequent conflict arising in area adjacent to potential habitat corridors. An attempt was made through this program to understand the pattern and magnitude of wild ass conflicts around potential corridor area along with initiation of conservation awareness program in the study area.

## 2.0 Background

Indian wild ass (*Equus hemionus khur*) is one of the five species of genus *Equus* which are vulnerable to extinction. Indian wild ass is 'endangered' according to IUCN red data book and is in the Schedule-I of the Wildlife (Protection) Act, 1972. Following strict



implementation of protection measures to curb illegal hunting and poaching, the population has increased ten fold since 1969 to c. 4000 over 30 years. The population of this endemic equid is dispersing in the adjacent agropastoral landscape and hence this results in crop raiding incidences and subsequent

conflicts with local communities. The situation is deteriorating rapidly due to increased developmental activities such as major irrigation projects and subsequent shift to cash crops coupled with the rapid invasion of the exotic scrub *Prosopis juliflora*. The small scale agropastoral activities in this arid landscape are prone to high uncertainties and risks in form of uncertain rainfall, poor ground water quality, drought and pest attack; and therefore crop damage by dispersing wild ass population may be perceived as a major factor for human-khur conflict. Since the last pocket of *khur* population is vulnerable to epidemics (such as 'Surra' which caused drastic decline in their population in late sixties)

and natural calamities (as severe drought and flooding is common in this landscape), their dispersal in adjacent potential sites is crucial and hence, desirable.

### **3.0 Study area: a unique landscape of the Little Rann of Kachchh**

The entire landscape of the Little Rann of Kachchh (LRK) is a unique expanse of flat barren land dotted by islands with vegetation bordered by a number of agropastoral and fishing villages is located in the north-western region of Gujarat near the mouth of Gulf of Kachchh. The landscape of little Rann of Kachchh is a proposed biosphere reserve which encompasses approximately 6500 km<sup>2</sup> of low land saline desert dotted with small patches of uplands of which 4841 km<sup>2</sup> is famous Indian Wild Ass Sanctuary that harbours the last surviving population of the Indian wild ass (Singh *et al.*, 1999).



The Rann is unique in the sense that it has the characteristics of both desert and wetland and therefore supports unique assemblages of flora and fauna. During monsoon, several small ephemeral rivers drain their water into the Rann and at the same time saline sea water enters from Gulf of Kachchh which together makes this entire low land area a vast shallow wetland dotted with number of islands locally called 'Bet'. The wetland gradually recedes during winter and summer months and subsequently turns into dry saline desert. This vast flat terrain interspersed with numerous green patches of upland creates unique habitats for Indian wild ass.



### **3.1 Intensive study area: *Chicken-neck area between Little and Greater Rann of Kachchh***

The present study focused on a corridor connecting little and Greater Rann of Kachchh, north to Little Rann of Kachchh (Fig.-1). The intensive study area included the agropastoral landscape along the narrow strip of low land saline desert connecting two vast arid land masses. The western side of the corridor is in Kachchh district while eastern side is in the district of Patan in state of Gujarat. The corridor is a key to the long term persistence of the last surviving population of the critically endangered Indian wild ass. It connects to the former geographic range of the species up to Sind in Pakistan and Thar Desert of Rajasthan in Northeast (IUCN 2009). The area is experiencing ever increasing developmental activities coupled with shift in socioeconomic status of the local community that has resulted into the human-wild ass conflict. The area needs an urgent attention of the conservation organizations and management authorities to resolve human - wild ass conflict.

### **3.2 Socioeconomic scenario**



The landscape of the Little and Greater Rann of Kachchh is low land saline desert which remains partially submerged during monsoon and early winter months.

Therefore it is inhospitable for human habitation. But fringe area of this saline low land of LRK is occupied by 108 villages having 52600 families (CESC, 2008). Along the fringe area, a number of developmental and infrastructural activities are coming up. Besides, the traditional and conventional agriculture practices are shifting towards intensive, commercial and mechanised farming (Sinha & Goyal, 2006) However, many of the local communities are still dependent on subsistence farming and small scale

animal husbandry. Some marginal communities are involved in salt extraction and seasonal fishing. Human population residing in the study area are some sub-communities of Hindus, Muslims and Jains. In agriculture, major crops are Juwar and Bajra –staple food of the locals as well as patchy cultivation of pulses, oil seeds and cotton (Sinha, 1993).

#### **4.0 Research and conservation approach**

The present study attempted to generate comprehensive information based on various issues of human - wild ass conflicts in this human dominated landscape along the corridor between Little and Greater Rann of Kachchh. It identified the hotspots for agroecology - wild ass conflicts, peak season for crop raiding, vulnerable stages of different crops; nature of loss; and quantify the magnitude of crop raiding in terms of damage in proportion to total field size and total monetary loss to the farmers.

Apart from ensuring successful dispersal of *khur* population, this initiative would lead into further efforts in maintaining ecological and genetic connectivity with present metapopulations in Patan and Banaskantha districts in long term. Such strategies can be adopted in other areas with similar conditions. During



serial awareness programs main aim was to reduce antagonistic attitude of local community especially farmers towards wild ass in particular and wildlife in general. Other main target during awareness campaign was school children so as to prepare next generation to realize the importance of wildlife and their conservation.

Overall, an attempt has been made to understand the intensity and spatial extent of conflict which may subsequently guide management authorities to tackle the conflict issue. If human-wild ass conflict is mitigated appropriately, it can bring various

stakeholders closer and strengthen the present and future conservation programs initiated by conservation agencies.

#### 4.1 Involvement of local community and volunteers:



Historically this landscape is known for their ethical support for wildlife conservation. During the reconnaissance study all villages (n = 15) on the fringe area of the Rann between little and Greater Rann of Kachchh was visited more than once. Rapport was developed with the community heads and leaders for the

execution of this program. Though a formal questionnaire was designed, continuous informal discussions with villagers, especially farmers helped in modifying and refining the questionnaire format to understand the conflict situation. Many enthusiastic villagers helped in field data collection and brought their fellow villagers to provide information on crop raiding issues. Overall, the local community is very co-operative and easy to work with.

During the intensive ecological data collection, many local youth joined the field work and assisted in data collection. Besides local youth, this program was supported by



several enthusiastic volunteers from state universities and colleges. I received volunteer involvement of one international and four Indian young professionals. Interactions and

consultations with people working in similar issues elsewhere or other issues in the same landscape helped in successful execution of the project. With the help of volunteers, professionals and local community, I was able to collect the data required for the program.

## 5.0 Aims and objectives

The present study was carried out in the intensive study area of northern corridor between Little and Greater Rann of Kachh:

- To estimate the relative abundance of wild ass and other wild ungulates using seasonal line transects.
- To assess the crop damage caused by wild ass and other wild ungulates
- To assess the nutritional implications of spatio-temporal patterns of conflict by analysing nitrogen and phosphorous content in dung
- To assess the prevailing attitude of local community towards wild ass and other wildlife.
- To make effort in the direction of conservation awareness in local community.

## 6.0 Methods

Population demography and abundance of Indian wild ass were assessed seasonally on systematic line transects (n=8) (Burnham *et al* 1980) and through opportunistic sightings (n = 54 and n = 48 during summer and post monsoon, respectively).



Densities of wild ass and nilgai populations were estimated for the fringe area dotted with agriculture lands in the potential corridor between little and Greater Rann of Kachchh. During the summer (May-June 2009) and the post monsoon (October-November 2009) line transects (n=8 in summer, n=8 in post monsoon) were sampled using magnetic compass, range finder and binoculars in revenue area adjacent to fringe area of corridor.

Transects were sampled during early morning hours when most of the ungulates are foraging. Whenever, any wild animal was sighted, group size, sighting angle, distance and if possible age-sex of each group member recorded. Analysis for population density was carried out using DISTANCE 5.0 (Thomas *et al*, 2002). Group size, population structure, sex ratio etc. were assessed from transect data as well as opportunistic sightings (Jhala, 2003). GPS locations of all wild ass and other wild ungulates sightings obtained from line transects, vehicular survey and random observations during summer are plotted on Google™ map to generate a distribution map.



To assess the habitat use and spatial distribution of wild ass in particular and other wild herbivores in general several vegetation parameters were assessed on circular plots (n = 62) sampled on line transects (10m radius for woody vegetation and 1m radius for ground vegetation). These circular plots were sampled at a regular interval of 200 m on

each line transect. Additionally, indirect evidences of wild and domestic animals were recorded on the same sampling plot. Indirect evidences included dung, hoof mark or scrape marks.

To understand the nutritional implications of spatio-temporal patterns of conflict, fresh dung samples of wild ass were collected for subsequent assessment of nitrogen and phosphorus (McInnis *et al*, 1983; Dahlquist & Knoll, 1978; DeBolt, 1980). There is a strong positive correlation between diet quality and faecal quality (Cook *et al*. 1994 ; Grant *et al*. 1995 ; Wrench *et al*. 1996, 1997; Stuth *et al*. 1999). Faecal profiling is a useful tool for determining overall diet quality however, for this study the content of two important macro elements nitrogen and phosphorous were analyzed from faecal matter.

Prevailing attitude of local peoples towards wild ass and other wildlife species along with their socioeconomy were assessed through formal and informal meetings questionnaire surveys and interviews of villagers in fringe area of little and Greater Rann of Kachchh.

To assess the magnitude and intensity of the conflict arising from the crop raiding by large herbivores in the potential corridor between little and Greater Rann of Kachchh, a formal questionnaire survey was conducted in all the villages in the intensive study area. Though the questionnaire was designed a priori based on our research



objective, informal discussion with farmers, village and community leaders through out the study helped in appropriate modifications.

## **7.0 Results and observations**

Most line transects for wild ungulate density estimation traversed through scrubland that was interspersed with agriculture landscape. Twenty three and 20 bands of wild ass were sighted during 21 and 22 km effort on eight different line transects that were sampled twice during summer and in post monsoon.

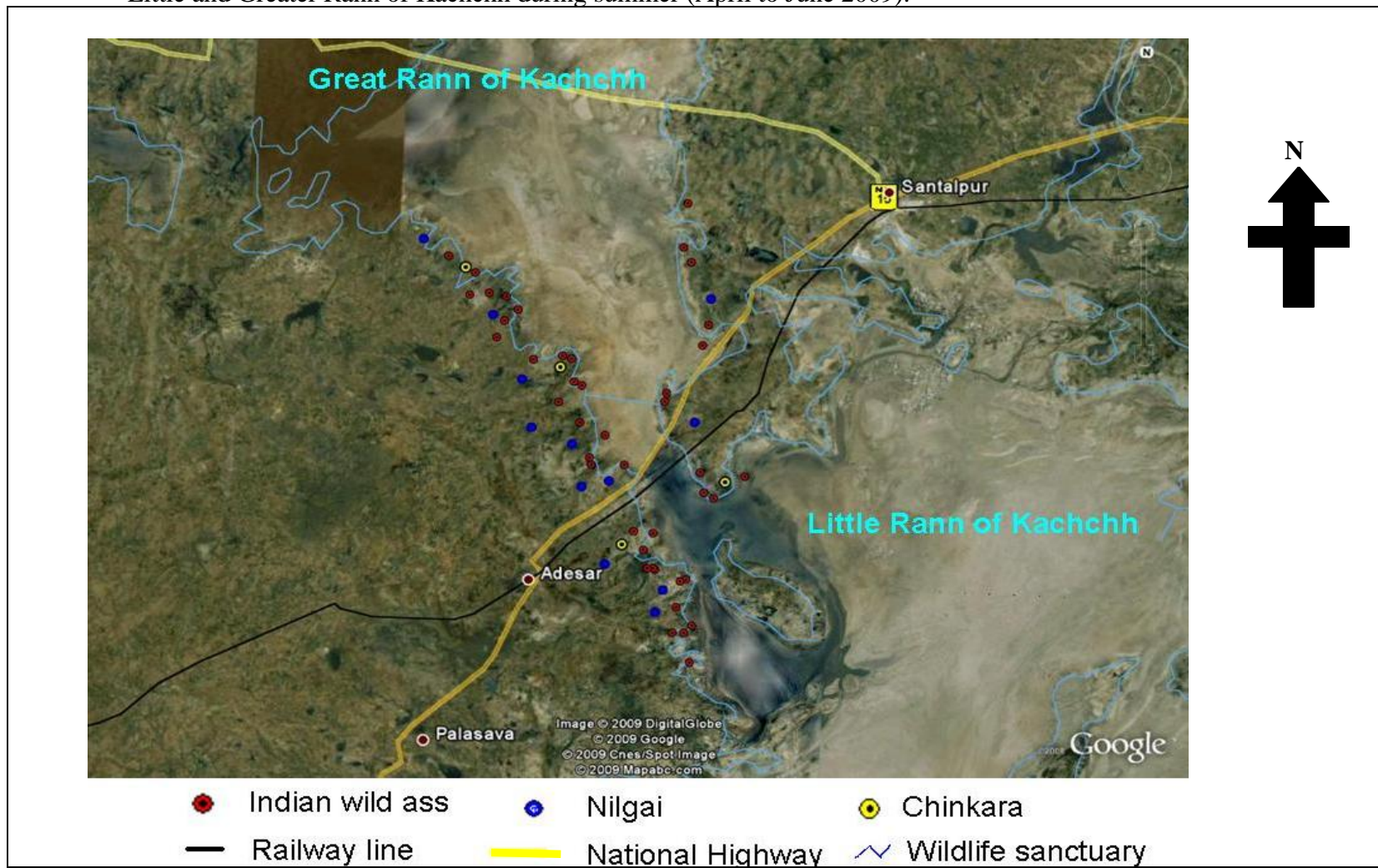
No other ungulates were observed in sufficient numbers for analysis using DISTANCE, therefore densities were only estimated for wild ass and nilgai (Table-1).

### **7.1 Distribution and density of wild asses and other wild ungulates during summer**

The Fig.-1 shows the distribution of the wild ass bands along with other wild ungulates in the corridor area adjacent to agriculture landscape during summer.



**Figure-1:** Sighting locations of Indian wild ass and other wild herbivores in the adjacent revenue landscape of corridor area between Little and Greater Rann of Kachchh during summer (April to June 2009).



Estimated average density of wild ass was  $4.1 \pm 1.9$  individuals per  $\text{km}^2$ , while group density was much lower ( $0.69 \pm 0.17$  per  $\text{km}^2$ ). The encounter rate for wild ass was 0.85 sighting per km and it ranged from 0.55 to 1.32 (95% CI). Compared to wild ass, nilgai density was lower ( $4.4 \pm 2.1$ ).

**Table-1:** Densities, group densities, cluster sizes and encounter rates of wild ass and nilgai in the study area during summer and post monsoon 2009.

Species	Season	Estimated Cluster size $\pm$ (SE)	Group Density		Animal Density		Encounter rate (sightings/km walk)
			D $\pm$ (SE)	% CV	D $\pm$ (SE)	% CV	
Wild ass	Summer (n=23)	<b>6.9</b> $\pm$ 1.2	<b>0.69</b> $\pm$ 0.17	24	<b>4.7</b> $\pm$ 1.5	30.84	0.85
	Post monsoon (n=22)	<b>7.0</b> $\pm$ 1.03	<b>0.81</b> $\pm$ 0.23	28.7	<b>5.6</b> $\pm$ 1.8	32.36	1.03
Nilgai	Summer (n=16)	<b>4.4</b> $\pm$ 2.1	<b>0.87</b> $\pm$ 0.22	28.3	<b>3.7</b> $\pm$ 1.6	33.22	0.56
	Post monsoon (n=14)	<b>4.1</b> $\pm$ 0.66	<b>1.04</b> $\pm$ 0.21	20.72	<b>4.3</b> $\pm$ 1.1	26.2	0.61

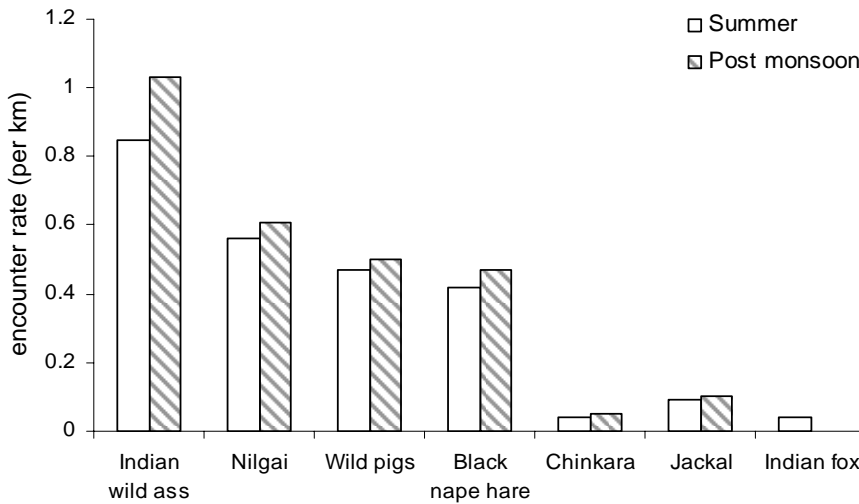
Other than wild ass and nilgai few sightings of chinkara (*Gazella gazelle*), jackals (*Canis aurus*), black naped hares (*Lepus nigricollis*) and Indian foxes (*Vulpes bengalensis*) occurred during transect sampling. Therefore encounter rates of these species were computed (Fig.-2).

## 7.2 Densities of wild ass and other wild ungulates during post monsoon

Eight line transects (seven of previous season and one new transect) were sampled once during months of October and November 2009. On line transects, 22, 14, 11 and 1 groups of wild ass, nilgai, wild pig and chinkara were encountered, respectively.

Estimated average density of wild ass was  $5.6 \pm 1.8$  individuals per  $\text{km}^2$ , while group density was  $0.81 \pm 0.23$  per  $\text{km}^2$  indicating larger groups (Table-1). The encounter rate for wild ass was 1.03 sighting per km and it ranged from 0.67 to 1.57 (95% CI). Compared to wild ass, nilgai density was lower ( $4.3 \pm 1.1$ ). The average group sizes were  $7.0 (\pm 1.03)$  and  $4.1 (\pm 0.66)$  for wild ass and nilgai, respectively.

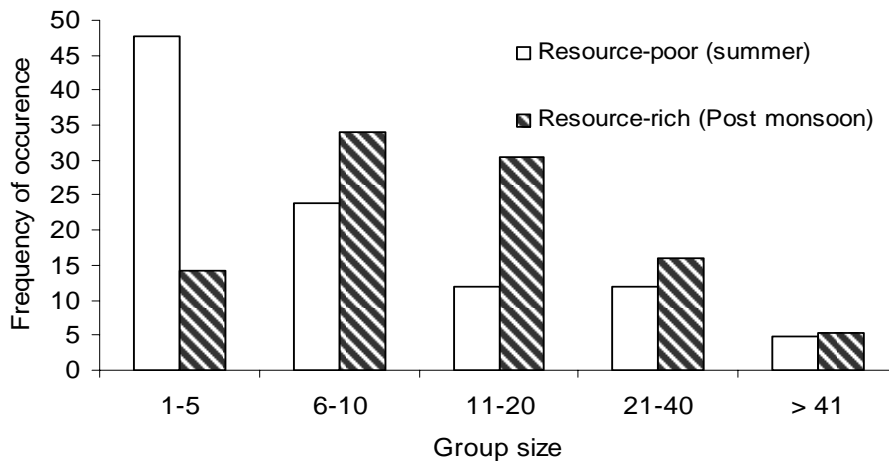
**Figure-2:** Encounter rates of several wildlife species encountered on line transects in the corridor area between Little and Greater Rann of Kachchh during summer and post monsoon 2009.



### 7.3 Group sizes of wild asses during summer and post monsoon

During summer season, which is a resource pinch period in this arid landscape, Indian wild ass was observed to move around in smaller band (group) size (1-5 individuals) (Fig.-3). Out of 42 direct sightings, 20 observations involved less than five individuals. Most of these sightings occurred while they were foraging. Only during two sightings, more than 40 individuals were seen together. Larger bands were observed in the open saline flats, and individuals were mostly engaged in social interactions and resting.

**Figure-3:** Seasonal occurrence of various group size classes of Indian wild ass in the corridor area between Little and Greater Rann of Kachchh during summer and post monsoon 2009.



During post monsoon season, when the entire landscape remains inundated, wild asses either stay on seasonal islands i.e. *bets* or on the fringe area. Since calving season of most of the wild herbivores in arid and semi arid landscapes synchronises with resource availability (Clutton-Brock et al. 1989; Ims 1990, Ogutu et al. 2010), all these species i.e. wild ass, nilgai, wild pig and chinkara found in relatively larger groups in post monsoon compared to summer (Fig.-3).

### **7.5 Wild ungulate distribution: comparison of summer and post monsoon**

Indirect evidences of wild ass, nilgai and chinkara were found more during summer compared to post monsoon season; whereas, during post monsoon, cattle and wild pig signs were found more unlike other three species i.e., wild ass, nilgai and chinkara (Fig.-4).

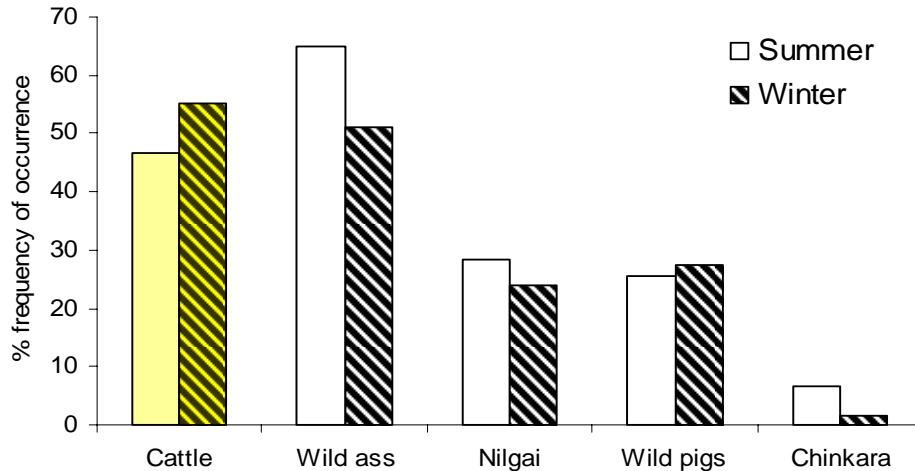
The possible reason for this could be a) washing off older signs after rains, on and seasonal dispersal over wider area following better resource availability b) most of the



cattle population migrate to other part of the state after monsoon and return after first rains and therefore they were not there in summer hence more cattle signs in latter season, or c) in case of wild pigs, more signs were recorded in post

monsoon as due to their habit of digging out roots and tubers which leaves prominent signs behind even in hard substratum. Such food items were in sufficient abundance during monsoon and post monsoon.

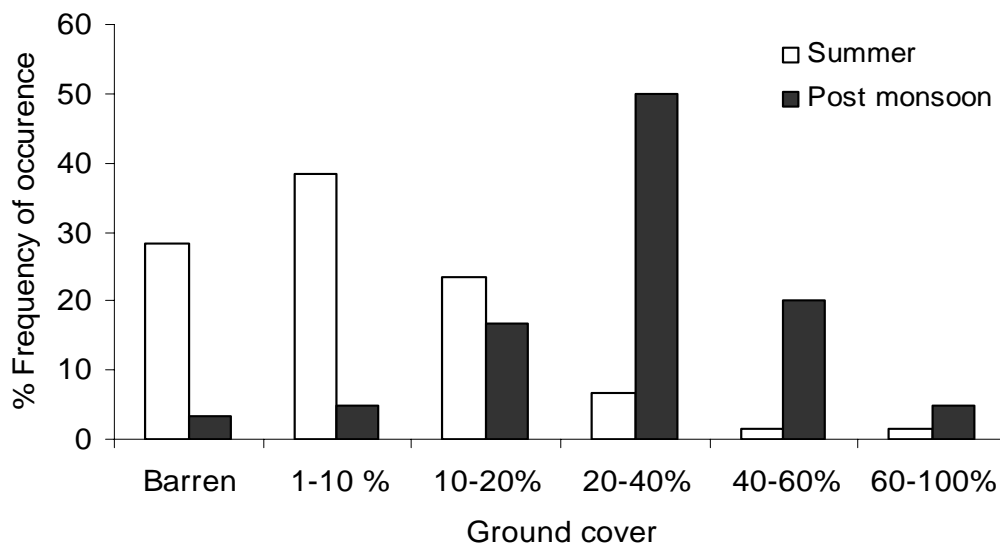
**Figure-4:** Percent frequency of occurrence of indirect evidences in terms of dung and hoof marks during summer and post monsoon seasons in the corridor area between Little and Greater Rann of Kachchh during summer and post monsoon 2009.



### 7.6 Resource availability in the corridor area during resource crunch season

During summer sampling, out of 60 ground cover plots, 54 plots recorded less than 20% herbaceous ground cover, as all the agriculture and pasture lands were either completely grazed or harvested.

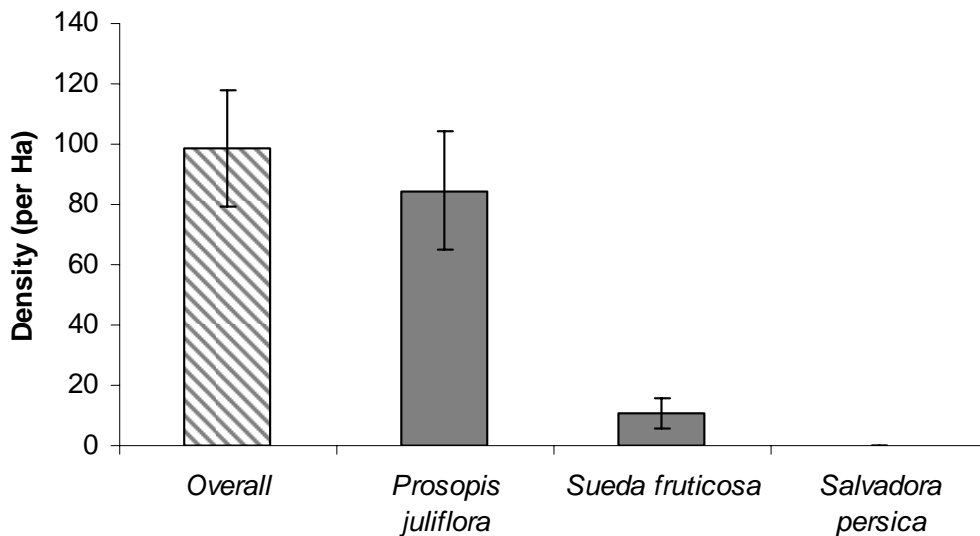
**Figure-5:** Percent herbaceous ground cover in the corridor area between Little and Greater Rann of Kachchh during summer 2009.



Whereas, during post monsoon, pasture and fallow land herbaceous ground cover mostly ranging from 20 to 60 % percent. However, due to excessive domestic herbivores in addition to wild herbivores, areas close to villages and human habitation were almost barren indicating heavy grazing pressure.

Among palatable grass species (palatable to livestock and presumed to be the part of wild ass diet) were *Aristida sp* and *Cynodon dactylon*. With rare presence of *Dicanthium annulatum* in small patches. Among woody vegetation, an invasive exotic scrub *Prosopis juliflora* was predominantly present in almost all plots with woody vegetation (Fig.- 6). Indian wild asses were often seen feeding upon pods of *P. juliflora*. Native woody species *Sueda fruticosa*, *Salvadora persica* and *Salvadora oleoides* were observed in some plots.

**Figure-6:** Overall and species wise shrub densities in the corridor area between Little and Greater Rann of Kachchh. (n=60).



### 7.7 Surface water availability in the fringe area during peak summer

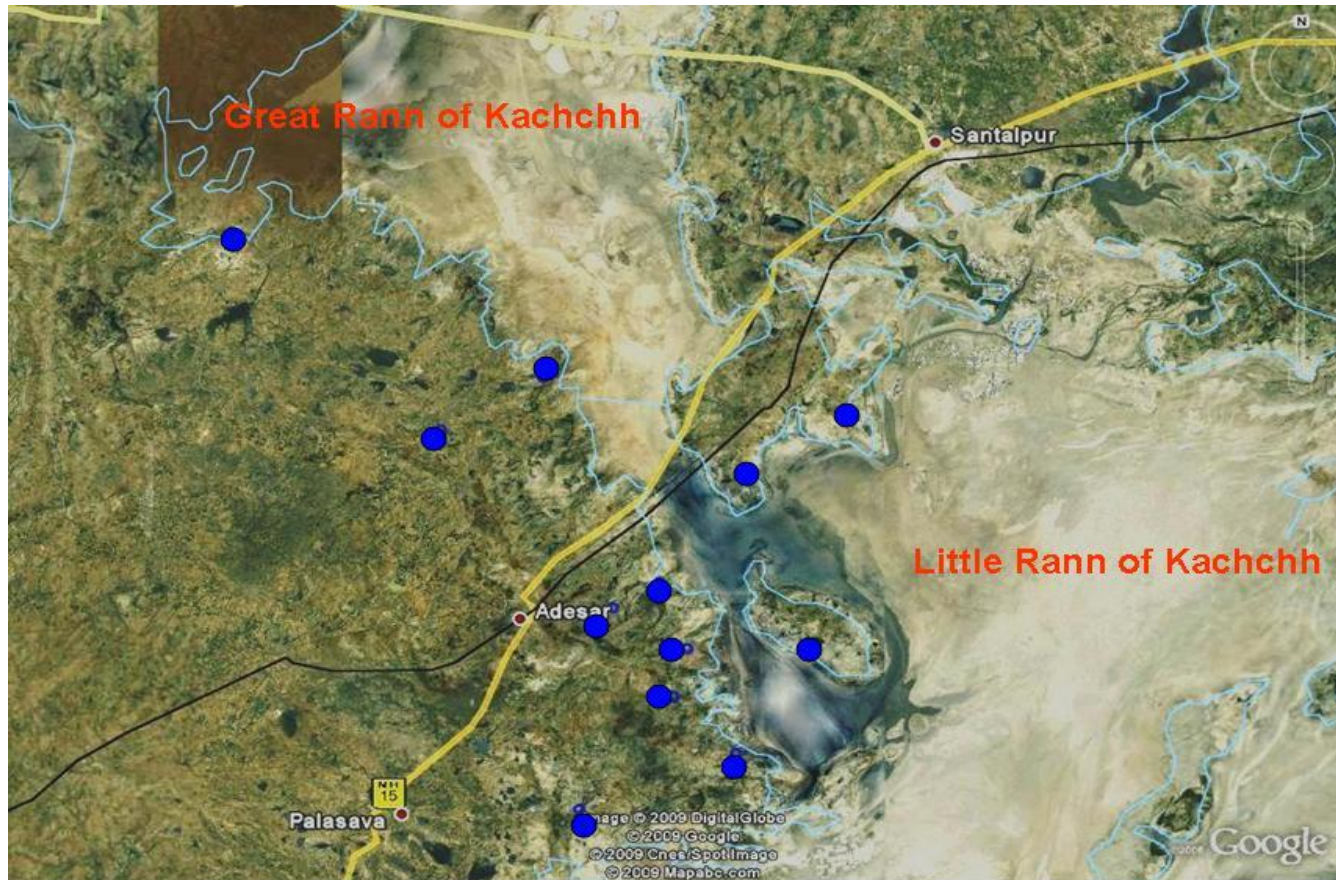
In arid and semi arid landscapes, environmental stochasticity through patchy resource availability determines the wildlife distribution. Other than food, water is an important resource in such arid landscape. All most all natural water holes were rapidly drying up during peak summer months and very few (total 13) water holes with surface water

available to wild ass were left (Fig.-7). Despite being muddy and saline, wild ass were observed using such waterholes whereas, the signs of other wildlife around these waterholes were scarce. Besides, these natural waterholes, Forest Department has made provision of artificial waterholes in the fringe area Fig.-7a. However, few artificial water holes were observed used by Indian wild ass. Fig.-7b shows the distribution of natural waterholes during late summer season.



**Figure 7a:** Artificial water holes in the fringe area of Little Rann of Kachchh.

**Figure-7b:** Location map of the natural waterholes during late summer season in the corridor area between Little and Greater Rann of Kachchh.



- |  |  |
|--|--|
|  Water points |  Wildlife sanctuary |
|  Railway line |  National Highway   |

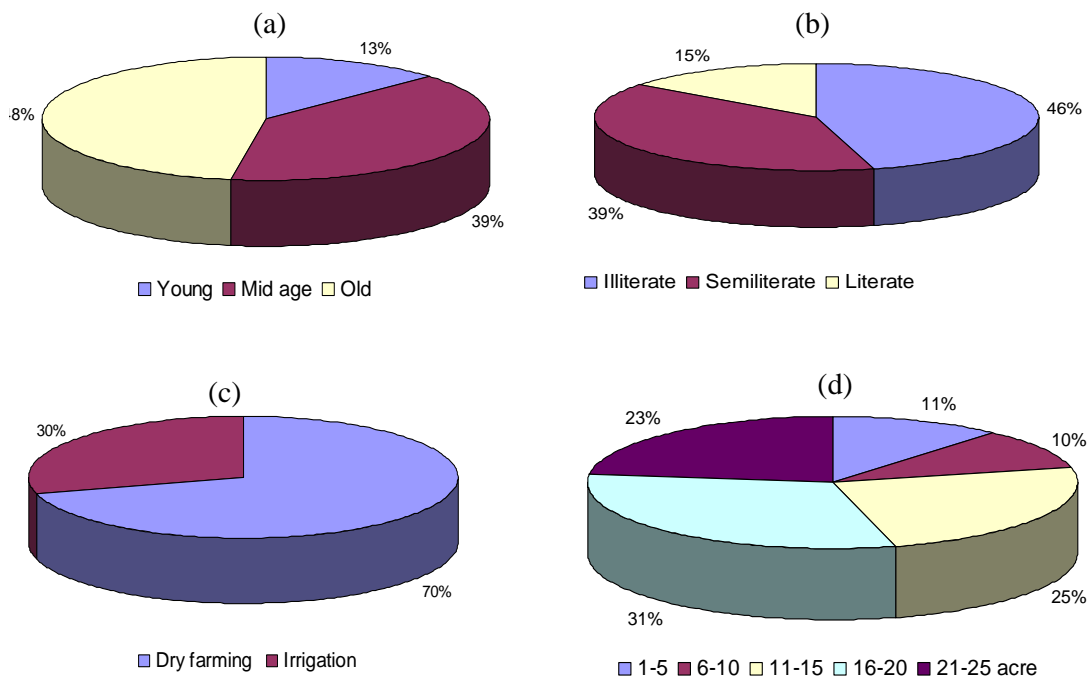


## 7.8 Wild ass conservation and the issue of herbivore-agriculture conflict

The result reported here is the output of the questionnaire survey targeted to 4 to 5 random farmers in each village as well as information gathered during onsite assessment of crop raiding in various villages in the fringe area.

During questionnaire survey, 62 and 73 respondents were interviewed during summer and post monsoon, respectively. They were subjected to the same set of questions (Annexure-I). Although all the respondents belonged to agriculture community, they were from diverse cultural back ground, age groups (Fig-8a), education level (Fig.-8b) diet (Fig.-8c) and land ownership (Fig-8d).

**Figure-8:** Age group (a), literacy (b), mode of irrigation (c) and land holding (d) among the respondent to questionnaire survey in the corridor area between Little and Greater Rann of Kachchh.



**Figure-9:** Crop raiding incidences within 1 km and beyond in the intensive study area of corridor between Little and Greater Rann of Kachchh during post monsoon season of 2009.



Two questions with possible optional answers were asked (See Annexure-I) to understand their attitude towards wild ass conservation in light of crop raiding incidences and cause of conflict according to them. The optional answers were four

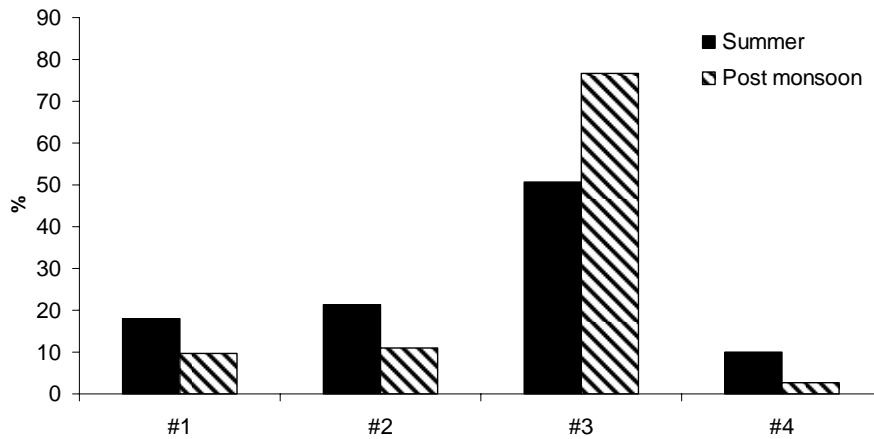
statements ranging from “species needs to be strictly protected” to “species needs to be removed”. The results of both the surveys are more or less similar where they showed their concerns over chronic crop raiding issues incurring substantial financial loss (Fig.-10). Subsequently they were asked to pinpoint one or more than one cause/s of increased crop raiding issues. Many of them (27.8 % & 39.3 % in summer and post monsoon, respectively) felt that spread of invasive



exotic scrub *P. juliflora* is providing shelter to most of the wild herbivore populations and hence the spread of *P. juliflora* is the primary reason behind increased crop raiding issues. However, during post monsoon season, almost half of the respondents (44.9 %) considered ‘increased wild ass population in the area as a primary cause of increased crop raiding issues’. The logical explanation to the major shift in people’s response (from 24.1 % to 44.9 % for considering increased wild ass population as the primary cause of conflict) could be because of recent damage (within past 2-3 days) by any of the wild herbivores on their crop field or in neighbourhood.

Water logging in Rann landscape drives out wild ass in surrounding agriculture landscape which subsequently causes increased sighting of wild ass bands in crop fields close to fringe area. Twenty percent respondents came up with more than one reason for conflict arising from increased crop raiding incidences. But in all cases primary cause was either spread of *P. juliflora* or increased wild ass population or both.

**Figure-10:** Perception of the local community of corridor area between Little Rann and Greater Rann of Kachchh for the presence of wild ass in vicinity.



- #1-A species needs to be strictly conserved and causes no damage and no conflict.
- #2-Their number has increased but causes tolerable damage and causes no conflict.
- #3-Species causes damage but if mitigated, conflict can be avoided.
- #4-The damage is intolerable and species needs to be removed from area immediately

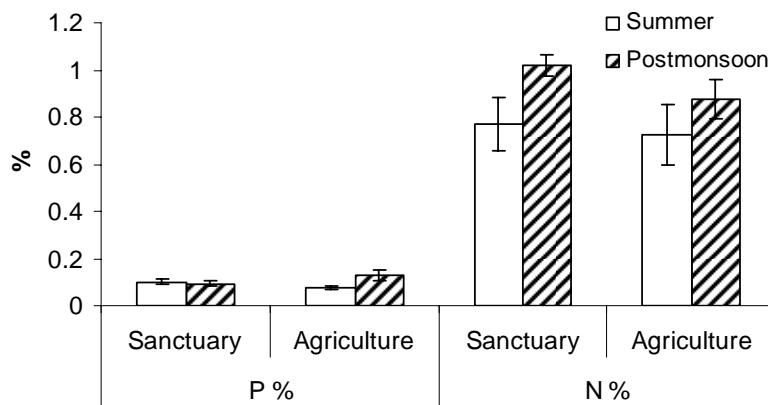
Overall, people’s perception for wildlife in general and wild ass in particular was positive as assessed during informal discussions. However, their apprehension over crop raiding issues during formal questionnaire survey was very clear (Fig.-10). It shows that though they are historically conservationist community, recent increase in economic loss due to increased crop raiding issues coupled with gradual socioeconomic change, has caused a negative shift in their conservation belief. The negative shift in the people’s attitude towards wildlife could be the reason of gradual fragmentation of agriculture land and mechanised cash crop farming slowly replacing the traditional subsistence farming (cereal crops).

### 7.9 Dung sample analysis

To understand the nutritional implications of crop raiding by wild ass dung samples were collected from the agriculture fields and sanctuary area before and after monsoon. Samples were analyzed for nitrogen (N) and phosphorus (P) content using standard laboratory techniques (AOAC, 1987). Fig.-11 shows the comparative account of percent nitrogen and phosphorus content in dung samples for resource rich and poor seasons i.e. post monsoon and summer respectively. Crude protein content (4.5 to 6.4 %) as well as Phosphorus content (0.09 to 1.3 %) in wild ass dung during both seasons was comparable with similar studies on Asiatic wild ass in Negev desert

of Israel (Hanley & Ward, 2006) and on Black rhinoceros in comparison of domestic horse in captivity (Clauss *et al.* 2007). During summer, N and P content were relatively low but not significantly different from post monsoon season (Fig.- 11). Hence, these macro elements can not be implicated for crop raiding by wild ass. Another attempt was made to understand the difference in dietary protein and phosphorus between cropland and sanctuary area. However, there was no difference found between sanctuary and agriculture areas in N or P content in either seasons i.e. summer or post monsoon. It is important to note that daily movement of some of the wild ass bands may overlap both, cropland and sanctuary areas and therefore, dung of such individuals may not reflect the diet from respective site.

**Figure-11:** Percent nitrogen (N) and phosphorus (P) content in wild ass dung during summer and post season. Samples were collected from the corridor area between Little and Great Rann of Kachchh.



### 7.10 Crop raiding by Indian wild ass and other herbivores for various crops and seasons

The landscape is experiencing an economic boom because of recent development of infrastructure and infusion of mechanised farming along with surface water harvesting for irrigation, availability of chemical fertilizers and



hybrid seed varieties. Hence, farmland remains occupied for extended period of time by long duration crops like oil seeds and cash crops such as cotton and cumin.

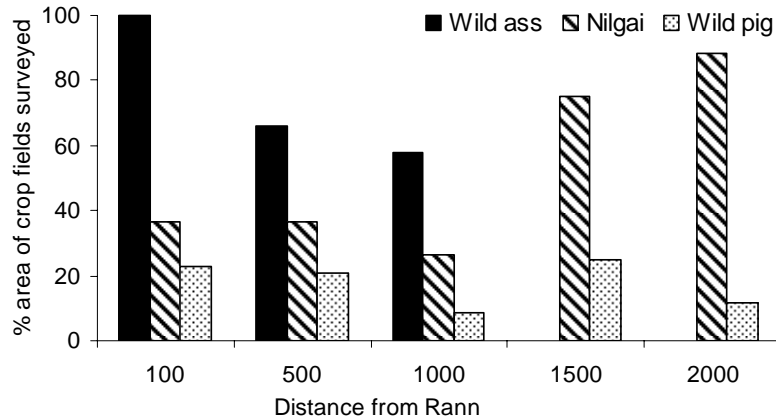
Onsite assessments of crop raiding incidences were compiled and categorized: for three crop types (i.e., cash crop, millet and oilseeds-pulses); distance from Rann fringe; growth stages of crop (i.e., initial, middle and final); and farmland size. A simple graphical representation of observed crop raiding in relation to crop types, animal species responsible for damage, mode of irrigation, distance of farm from Rann landscape, growth stage of crops and farm size is shown in following charts.

**Figure-12:** Percent of agriculture field area with different crop types being damaged by nilgai, wild ass and wild pig during post monsoon season (August to November 2009) in the study area between Little and Greater Rann of Kachchh.



Among all crops, pulses and oilseeds are most susceptible crops to be damaged by wild herbivores as each of these three species were damaging this crop type by 25 % (Fig. 12). However, these crops contribute little to overall cropping pattern of this landscape. The damage caused by wild pig was much more wide spread and problematic than wild ass and nilgai since millet crops are major source of food grains and fodder for livestock in this landscape. Damage caused by wild ass was reported between 15 to 25 % of the crop land in the area for all different crop types.

**Figure-13:** Percent of agriculture field area being damaged by nilgai, wild ass and wild pig in different distance from Rann categories during post monsoon season (August to November 2009) in the study area between little and Greater Rann of Kachchh.

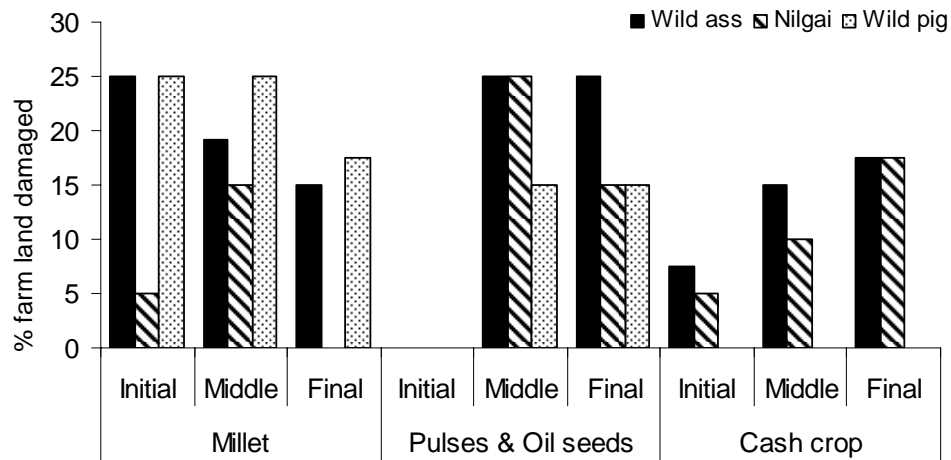


All three species of wild herbivores caused extensive damage in crop fields within 1 km from Rann. The damage by wild ass was evident up to 1 km only whereas nilgai and wild pigs caused damaged up to 2 km from Rann (which was the farthest distance surveyed for crop raiding) (Fig.13). Crop damage by nilgai was extensive and was reported up to 2 km. However, damage by nilgai in areas close to Rann fringe was apparently less. As it seems that in areas closer to Rann fringe respondents blamed wild ass for all crop damages despite of nilgai and wild pig presence. The damage caused by wild pig was reported widely but intensity of damage was less (Fig.-13) which could be happened because either, a) nilgai and wild ass are easily detected during crop raiding, or b) indirect signs are misidentified in the presence of other two large herbivores.

Three crop stages were identified to assess the intensity of damage at different growth periods. Overall, millet crops that occupy most of the agriculture land during monsoon were affected by large herbivores at all three growth stages (Initial stage i.e., tender crop, Middle stage i.e. crop at full vegetative growth, Final stage i.e. crop waiting to be harvested). Cash crops such as cotton, castor and cumin are least affected among all varieties of crops. These crops received more damage during final harvesting phase and they were mostly raided by nilgai and wild ass (Fig.14). Oilseeds and pulses were sown in relatively smaller area and well protected compared

to other crops. These crops were more vulnerable to damage by large herbivores during intermediate stage. Another interesting observation was that wild ass was more generalist and damaging crop at all growth stages compared to nilgai and wild pigs.

**Figure-14:** Percent of agriculture field area being damaged by Nilgai, Wild ass and Wild pig in different growth stages of various crops during post monsoon season (August to November 2009) in the study area between little and Greater Rann of Kachchh.



## 8.0 Workshops for conservation awareness

A series of conservation awareness workshops for villagers and school children were conducted in the different villages bordering Rann landscape of Rapar Taluka of Kachchh. We selected eight villages for conducting workshop viz. Nanda, Bhura Vandh, Juna Fulpara, Nawa Fulpara, Sukhpur, Venusar, Fatehgarh and Sanva. Before conducting the workshop, we consulted local village heads to organize such an event.



Interactive discussions were carried out with participants. The major thrust of the discussion



was the conservation importance of this endangered species and possible solutions to the crop raiding issues. Interestingly, in villages with marginal communities women participated actively compared to other villages with main communities. During workshops,

educational material viz. posters and stickers were distributed among the local community. T-shirts were distributed to



some enthusiastic local volunteers and to school children who participated in the school level competitions on drawing and essay writing about conservation of wild ass in particular and wildlife in general.

## 9.0 Observations and suggestions

Population abundance of Indian wild ass in the potential corridor between little and Greater Rann of Kachchh is good ( $4.7 \pm 1.5 \text{ km}^{-1}$  in summer &  $5.6 \pm 1.8 \text{ km}^{-1}$  in post monsoon). However, a significant part of local community has shown their concern over chronic crop raiding by wild ass and other wild herbivores and no management initiatives by the government to either compensate the financial loss incurred by crop depredation or subsidize the fencing material to protect the crop. Nevertheless, most of the local people still hold conservationist value and do not retaliate by any means. Safe dispersal would definitely get affected if conflict is not appropriately managed and mitigated as apprehension is growing rapidly. Other than crop raiding, major hurdle for safe dispersal of wild ass is a four-lane highway and a railway line passing east-west through the landscape leaves little scope for crossing by any major wildlife species. Upcoming of a major irrigation canal parallel to railway line and highway would further hinder the movement of wild ass between little and Greater Rann of Kachchh.

To safeguard the long term conservation of this endangered equid:

- a) A compensation scheme needs to be devised and implemented to content the aggravation of traditional conservationist farming community.
- b) Test the efficacy of various fencing designs against large herbivores and subsequently provide the fencing material at a subsidized rate
- c) A detailed study of the food habits of wild ass and other sympatric wild ungulates i.e. nilgai and wild pigs for this landscape to understand the nutritional contribution by different crops.
- d) Evaluate the role of *P. juliflora*, an invasive exotic mesquite in degrading available foraging grounds of wild ass and in changing the dietary composition (as most of the dung samples collected in summer had substantial amount of *P. juliflora* seeds).
- e) Evaluate the design of artificial water holes so as wild animals use them without showing any repellence.
- f) Provision of more waterholes in the fringe area so wild ass need not to visit village ponds or irrigation tanks which eventually keeps wild ass away from crop lands and prevents any disease transmission from domestic animals to wild ass.

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## Appendix

**A questionnaire survey to understand the socio-economy of the people, role of wild ass in crop damage and common perception for wild ass conflict in the potential corridor area between Little and Greater Rann of Kachchh**

**Date:** \_\_\_/\_\_\_/\_\_\_

- **Location:**

Name of village: \_\_\_\_\_ Administrative Block: \_\_\_\_\_

Type of Crop: \_\_\_\_\_ Mode of irrigation: \_\_\_\_\_

Distance from Little Rann of Kachchh (LRK): \_\_\_\_\_ km. Direction: \_\_\_\_\_

Distance from Greater Rann of Kachchh (GRK): \_\_\_\_\_ km.

Direction: \_\_\_\_\_

GPS location of agriculture farm: \_\_\_\_\_ N \_\_\_\_\_ E

- **Personal Information:**

Name: \_\_\_\_\_ Age: \_\_\_\_\_ Gender: \_\_\_\_\_ Education: \_\_\_\_\_

No of family members: \_\_\_\_\_ Literacy in family: \_\_\_\_\_

- **Socio-economy Information:**

Occupation: \_\_\_\_\_

Occupational involvement: **Self / Adult family members / Entire family**

Diet: **Veg. / Non- Veg.**

- **Crop type and farming pattern**

Total land area: \_\_\_\_\_ acre

Crop pattern: a) Winter: \_\_\_\_\_

b) Summer: \_\_\_\_\_

c) Monsoon: \_\_\_\_\_

Mode of irrigation: a) Present \_\_\_\_\_

b) Past \_\_\_\_\_

c) Future plans: \_\_\_\_\_

Investment on farming: \_\_\_\_\_ Rs./Acre Mode: **Loan/Self**

Max income crop: \_\_\_\_\_ Labour intensive crop: \_\_\_\_\_ Crop stays standing for long duration: \_\_\_\_\_

Crop producing maximum palatable by-products for herbivores: \_\_\_\_\_

- **Crop damage assessment**

Crop damage or depredation by large herbivores: YES/NO

.....if NO then reason \_\_\_\_\_

.....if YES then,

1) Pattern: **Regular/Random**

2) Periodicity: **Daily/Weekly/ Monthly/ Seasonally/ Drought or Flood time**

3) Name of large wild mammalian species

present: \_\_\_\_\_

4) Name of wildlife species responsible for damage (in descending order) :

\_\_\_\_\_

5) Type of damage by wild ass: Trampling \_\_\_\_\_% Feeding  
\_\_\_\_\_%

6) Vulnerable crops (in descending order):

\_\_\_\_\_

7) Crop stage vulnerable to depredation: \_\_\_\_\_

8) Seasonality of crop damage by wild ass a) winter \_\_\_\_\_% b) summer \_\_\_\_\_%  
c) Monsoon \_\_\_\_\_%

9) Crop stage vulnerable to damage \_\_\_\_\_

10) Financial loss per year per acre: Rs. \_\_\_\_\_

11) In last three crop damage incidences,

Crop Type 1) \_\_\_\_ 2) \_\_\_\_ 3) \_\_\_\_\_

Crop damage 1) \_\_\_\_% 2) \_\_\_\_% 3) \_\_\_\_% of standing crop

- **People's knowledge about wild ass and common perception about wild ass conflicts**

1) How often you see wild ass in your vicinity? \_\_\_\_\_

2) Which is the peak season of wild ass sighting in your vicinity? \_\_\_\_\_

3) What factors, you think, causes wild ass to move in human dominated landscape?

\_\_\_\_\_

4) Range of band size you have observed \_\_\_\_\_

5) In which season maximum band size is observed? \_\_\_\_\_

6) Do you know about their peak calving season? \_\_\_\_\_

7) Which wildlife species you consider problematic/pest (in descending order)

\_\_\_\_\_

8) How you are going to deal with crop raiding incidences in short and long term?  
\_\_\_\_\_

9) Is there any traditional mean or way to avoid crop raiding by large herbivores especially wild ass? \_\_\_\_\_

10) How do you see Indian wild ass?

- A species needs to be strictly conserved and causes no damage and no conflict.
- Their number has increased but causes tolerable damage and causes no conflict.
- Species causes damage but if mitigated, conflict can be avoided.
- The damage is intolerable and species needs to be removed from area immediately.

11) If conflict is increasing in the area, who is primarily responsible?

- A) Increase in wild ass population
- B) Increase water availability
- C) Increase cover by spread of *Prosopis juliflora*
- D) Decrease tolerance level of local people
- E) Change in crop pattern
- F) Change within sanctuary area

12) Suggest possible solution to the conflict issue \_\_\_\_\_

