FACTORS AFFECTING DISTRIBUTION OF THE SARUS CRANE *GRUS ANTIGONE ANTIGONE* (LINN.) IN KHEDA DISTRICT, GUJARAT[1]

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(*With one text-figure*)

Key words: Distribution, paddy crop, sarus crane, *Grus antigone antigone*, visibility index, Kheda district

573 individuals of the sarus crane *Grus antigone antigone* were counted in an intensive ground survey, carried out in Kheda district, Gujarat, during August 1998. There was a distinct difference in the crane abundance amongst the tehsils (subdivisions) of Kheda district. Crane distribution in the district was determined by the physical structure of the habitat. The factors determining distribution within the district were (a) Pattern, height and water requirement of the crops, particularly the percentage of irrigated land for paddy crop (r = 0.47). (b) Standing water body with vegetation. (c) Visibility index or openness of the landscape (r = 0.46) influenced by vegetation height and density.

INTRODUCTION

The sarus crane *Grus antigone antigone* is restricted to a few northern and western states of India (Ali and Ripley 1983). Though once widespread, its population is now chiefly concentrated in Uttar Pradesh, Rajasthan, Gujarat and Madhya Pradesh (Gole 1989). Earlier, two large-scale attempts were made to estimate the sarus crane population in Gujarat State (Vaishnav 1985) and in the whole country (Gole 1989). In both cases, the population size was estimated on the basis of a few actual counts, local inquiry, and presence of wetland and cropped area available. Since no intensive survey of a single district was done, the actual head counts are not available, and factors affecting distribution are not known. The relative abundance of the sarus crane in different tehsils (subdivisions) of Kheda district was determined and the percentage of land under paddy crop was considered as a factor affecting distribution (Parasharya *et al.* 1989, 2000). To determine and assess the factors affecting distribution of the sarus crane within a district, the present study was taken up. The species is currently categorized as globally threatened, due to rapid population decline and other threats (Meine and Archibald 1996). The present study was, therefore, warranted to identify the factors determining its distribution in Kheda district, which holds the largest crane population in Gujarat State (Parasharya *et al.* 1996), and ultimately to develop a management strategy.

STUDY AREA

Kheda district is situated in central Gujarat, an area of 7,194 sq. km, which is 3.7% of the total area of Gujarat. The district lies between two major rivers, Mahisagar on the eastern and Sabarmati on the western side. To the north is the boundary with Sabarkantha district. Ahmedabad district lies to the west and Panchmahal and Baroda on the eastern side. The southern boundary is attached to the Gulf of Khambhat. It is mainly plain, except for a small hilly area in Kapadvanj and Balasinor tehsils. The region has fertile *goradu* soil with alluvial, loamy sand.

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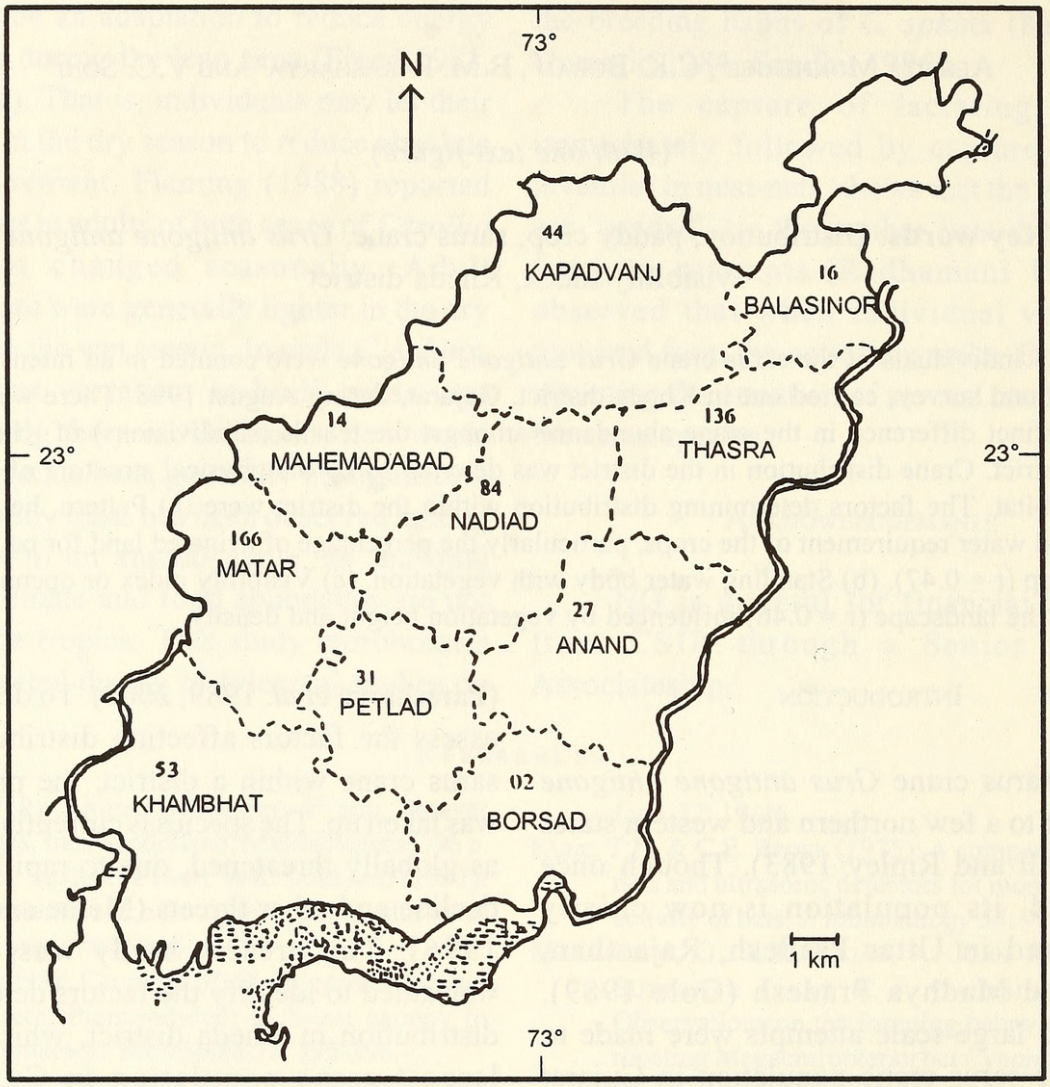

Fig. 1: Distribution of the Indian sarus crane in the tehsils of Kheda district, Gujarat

The district comprises of ten tehsils, a major area has canal irrigation, whereas in Kapadvanj and Balasinor tehsils, rain-fed farming is practiced. The total cultivated area is 6,58,495 ha (Director of Agriculture, Ahmedabad). The cropping pattern is as follows: During the monsoon, paddy (1,41,672 ha), pearl millet (1,45,916 ha) and tobacco (92,972 ha) are the major crops. Area under paddy in different tehsils is given in Table 1. In winter, wheat (60,335 ha) is the major crop. In summer, paddy and pearl millet were grown in irrigated areas.

The district is semiarid, with a tropical monsoon climate. The southwest monsoon arrives in the third week of June to September. The average maximum temperature recorded during May was 41.6 °C and during December 28.9 °C. The average minimum temperature recorded during January was 10.3 °C and during June 27.6 °C. Annual rainfall of the district was 557 mm in 1998.

Material and Methods

Sarus crane count was made from August 3 to 29, 1998 in different tehsils of Kheda district. The census route was decided on the basis of the tehsil road maps, ensuring that at least 75% of each tehsil was covered while traveling 250 km.

TABLE 1
SARUS CRANE SIGHTINGS IN KHEDA DISTRICT DURING AUGUST 1998 AND FACTORS AFFECTING ITS DISTRIBUTION

Tehsil	Survey dates	Number of cranes		% land under paddy	% land under irrigation	Visibility Index
	August 1998	Actually Seen	Claimed by Local people			
Anand	11-14	27	51	2.81	42.71	2
Balasinor	18-22	16	6	11.98	0.03	4
Borsad	15-16	2	2	32.91	20.23	1
Kapadvanj	8-15	44	42	7.63	0	3
Khambhat	7	53	49	31.65	48.79	5
Mahemadabad	25	14	44	0.01	2.33	2
Matar	4-7	166	246	42.73	36.84	4
Nadiad	26-29	84	47	32.58	12.82	3
Petlad	17-18	31	25	38.41	33.1	2
Thasra	20-24	136	97	22.04	18.85	3
Total		573	627			

This study was carried out in monsoon, particularly in August. The census time was decided on the basis of the following reasons. During the southwest monsoon, entire fields are inundated. Monsoon is also the breeding season of the crane, so they are distributed in suitable breeding habitats. Secondly, the crop height is low, and hence it is easy to locate the cranes from a long distance. Census was avoided on rainy days (Table 1).

We drove at slow speed, recording the cranes sighted. Their numbers were confirmed using 10 x 50 binoculars. Periodically, the vehicle was stopped to scan the area for cranes. The locals were questioned for their estimates of population size, and their perception about the presence of the crane.

Since the vegetation varied in each tehsil, the visibility ranged from 50-800 m from either side of the road. The distance at which the cranes were sighted varied in different tehsils, depending on the vegetation profile and the crop pattern. Based on this, a visibility index (range 1-5) was developed. The visibility index (V.I.) based on detectability range from the road was as follows: distance of visibility in metres; 0-50 = 1; 50-200 = 2; 200-500 = 3; 500-700 = 4; > 700 = 5. Data on the cropping pattern and land under irrigation was collected from the District Statistical Officer, Kheda district. Correlation analysis (Steel and Torrie 1980) was performed to test the impact of factors affecting crane distribution.

RESULTS

The cranes were recorded in all the 10 tehsils of Kheda district. However, their number varied. A total of 573 cranes were actually sighted. However, the locals claimed a total of 627 cranes to be existent in this area. Census across Kheda district (Table 1, Fig. 1) shows that the maximum number of cranes were sighted in Matar (166), Thasra (136) and Nadiad (84) tehsils. Some cranes were sighted in Borsad (2), Mahemadabad (14) and Balasinor (16) tehsils also. No trend could be established between the actual number of cranes sighted and the number claimed by the local people. However, the total number claimed was slightly higher than the actual sightings. The difference is too small to investigate further.

When the number of cranes sighted was correlated with the percent land under irrigated paddy and canal irrigation, and visibility index, a positive correlation ($r = 0.47$ *d.f.* 8, $P > 0.05$) was established between the crane number and the percent land under irrigated paddy. The paddy fields act as temporary wetlands and thus resemble the true wetland habitat of the cranes. Very weak positive correlation ($r = 0.25$ *d.f.* 8, $P > 0.05$) was observed between the crane number and the percent land under canal irrigation. This association was relatively weak compared to the former one, as several crops other than paddy which are not preferred by the sarus crane were included in this category. Some of the tehsils did not show a positive correlation at all, which compelled us to test an additional factor.

Visibility index and the distribution of crane in each tehsil showed a better correlation ($r = 0.46$ *d.f.* 8, $P > 0.05$). This suggested that an open habitat was required for the existence of crane. While conducting the census, we realised that the presence of inundated paddy and the land being under irrigation were not the only factors affecting the distribution of sarus crane. The height and density of the hedges of the crop field, and the type of crop grown, negatively affected the ability to detect the cranes. Hence, such areas were scanned more carefully. Tehsils with such a habitat had relatively few cranes. This confirmed non-preference of sarus cranes for habitat with high vegetation density and low visibility index (V.I. 1 and 2, i.e. detectability range up to 200 m). Therefore, a positive correlation between the visibility index and crane number can be deduced from our observations.

Discussion

Sarus crane distribution in the tehsils of Kheda district was patchy, depending upon the suitability of habitat. Even within a tehsil, the distribution was not uniform. A total of 573 cranes were sighted in the district. Eight tehsils were intensively surveyed, though relatively less effort was made in Mahemadabad and Khambhat tehsils. With an equal effort in these two tehsils, actual sightings would have certainly been higher.

This study was carried out in August, which is also the beginning of the crane's breeding season (Ali and Ripley 1983, Gole 1987, 1989 Parasharya *et al.* 1989), for which the cranes disperse over the agricultural landscape, particularly in the paddy growing areas. Due to the wide dispersal of the cranes and the crop growth, fewer cranes could be detected from the moving vehicle. Even in open habitats, cranes could be detected only up to 800 m on either side of the road. Hence, in tehsils like Matar, Thasra and Khambhat, several cranes may have been missed. It can be presumed that the actual number of cranes in Kheda district is much higher than the number reported here. Recently, Mukherjee *et al.* (1999) have established that for sarus crane census, summer is the most suitable period. Using two different census techniques, day and night roost count, the sarus crane population was estimated to be 457 to 548 in a 527 sq. km area around Matar tehsil alone (Mukherjee *et al.* 2001). In view of these results, if census in all the 10 tehsils of Kheda district is made during summer, a true picture of population size can be obtained. Summer census would also indicate relative improvement in the population estimation over monsoon, the cranes' breeding season.

Parasharya *et al.* (1989, 2000) estimated 1,508 sarus cranes in Kheda district, based on information collected through the Village Level Workers (VLW) of the state agricultural department. The crane numbers claimed by the local people during the current census are comparable with the numbers claimed by the VLW in 1989. The state forest department had

estimated 2,741 sarus cranes in Kheda district during 1984 (Vaishnav 1985). However, the season of census and technique was different. Compared to the population size projected earlier, the current figure of the crane sightings was certainly lower. An alarming decline in the distribution range and population size of the sarus crane was also reported earlier (Gole 1989). Density estimate of the sarus crane in Matar tehsil of Kheda district in August 1989 and 1995 on a fixed route had shown a decline of 15% of the population. Due to the restricted distribution, and reported rapid decline in the population, the sarus crane is categorized as a globally threatened bird species (Meine and Archibald 1996). A systematic census effort is urgently required.

That the sarus crane is a true wetland bird, is supported by the distribution pattern observed in different tehsils. Large manmade reservoirs linked with canals are abundant in Matar and Thasra tehsils, in which the highest number of cranes was estimated. The paddy fields are considered as temporary wetlands (Scott 1989, Gopal 1995). In the absence of natural wetlands, the sarus crane preferred and survived well in the paddy fields of Kheda district (Parasharya *et al.* 1989, 2000). Considering the per-centage of land under paddy crop as an index, we found a moderate positive correlation with the crane number in different tehsils. The sarus preferred paddy to other irrigated crops, so a weaker correlation was found with percent land under canal irrigation compared to the percent land under paddy crop. Inundated paddy fields are temporary wetlands, which provide feeding and breeding requirements of the cranes. The paddy crop usually does not grow above the height of the cranes; hence, it does not impede visibility and permits vigilance against predators. Such a situation is not found in other cereal crops like pearl millet and maize. The sandhill crane *Grus canadensis* also prefer cereal crops shorter than their own height (Sugden *et al.* 1988). Moreover, in paddy crop there is minimum human disturbance compared to other crops; this could be one of the reasons that paddy is preferred over other crops.

Visibility index of the tehsil (in effect, openness of the habitat) was another important factor determining the distribution of cranes. As in Borsad and Petlad tehsils, very high vegetation density (revealed from the V.I.) was the major limiting factor for crane distribution. A combination of high V.I. with greater percent land under irrigated paddy resulted in a greater number of crane sightings, showing that both the parameters determine habitat preference of the sarus crane.

In open habitat, it is convenient for the cranes to take off or to land. Greater height of the field hedge hampers their movement. Moreover, within dense vegetation, vigilance against predators is very poor. The whooping crane *Grus americana* also avoids areas with obstructions to visibility (Armbruster 1990). It can be concluded that the sarus crane is dependent upon the agricultural landscape, and its relative distribution was governed by the percentage of land under inundated paddy and the openness of the habitat.

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REFERENCES

ALI, S. & S.D. RIPLEY (1983): Handbook of the Birds of India and Pakistan (Compact Edn.). Oxford University Press, Bombay.

ARMBRUSTER, M.J. (1990): Characterization of habitat used by Whooping Cranes during migration. *Biological Report 90(4)*: 1-16. U.S. Dept. Interior, Washington.

GOLE, P. (1987): Observing the Sarus. *In*: Proceedings of the 1983 International Crane Workshop, Bharatpur (Eds.: Archibald, G.W. and R.F. Pasquier). International Crane Foundation, Bababoo, USA. Pp. 107-114.

GOLE, P. (1989): The status and ecological requirements of Sarus Crane, Phase-I. Paper presented in the Asian Crane Congress at Rajkot, Gujarat, India.

GOPAL, B. (1995): Handbook of Wetland Management. WWF-India, New Delhi.

MEINE, C.D. & G.W. ARCHIBALD (EDS.) (1996): The Cranes: Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland and Cambridge, U.K.

MUKHJERJEE, A., V.C. SONI & B.M. PARASHARYA (1999): Diurnal use of reservoirs by the Indian Sarus crane (*Grus antigone*) during summer months. *Zoos' Print J. 14(7)*: 72-74.

MUKHERJEE, A., C.K. BORAD, S.B. PATEL & B.M. PARASHARYA (2001): Selection of suitable census method for the Indian sarus crane *Grus antigone antigone*. *J. Bombay nat. Hist. Soc. 98(2)*: 237-241.

PARASHARYA, B.M., K.L. MATHEW & D.N. YADAV (1989): Status and habitat preference of Indian sarus crane in Gujarat, India. Paper presented in the Asia Crane Congress at Rajkot, Gujarat, India.

PARASHARYA, B.M., K.L. MATHEW & D.N. YADAV (2000): Population estimation and general ecology of the Indian Sarus Crane *Grus antigone antigone* in Kheda district, Gujarat. *Pavo 38*: 25-34.

SCOTT, D.A. (ED.) (1989): A Directory of Asian Wetlands. IUCN, Gland, Switzerland and Cambridge, U.K.

STEEL, R.G.D. & J.H. TORRIE (1980): Principles and Procedures of Statistics: A biometrical approach, 2nd edition. Mc-Graw-Hill Kogakush Ltd., London.

SUGDEN, L.G., R.G. CLARK, E.J. WOODSWORTH & H. GREENWOOD (1988): Use of cereal fields by foraging Sandhill Cranes in Saskatchewan. *J. Appl. Ecol. 25*: 111-124.

VAISHNAV, H.A. (1985): Crane survey in Gujarat. *Hornbill 1985(4)*: 38-40.

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