Spring Migration of Eurasian Cranes *Grus grus* from Gujarat, India to Their Northern Breeding Grounds

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Abstract

Three Eurasian Cranes *Grus grus* were successfully satellite tracked during their spring migration north from Gujarat, western India. They used the same migratory flyway across Pakistan and Afghanistan, skirting the Hindukush mountains, during their spring migration north, but their stopover sites differed from each other. The cranes summered at three different locations, which were not too far from the headwaters of Ob River, in western Russia. They covered total migration distances ranging from 3,950 km to 4,786 km. The total number of stopovers ranged from three to eight. This migratory behavior suggests that there are several wetlands along the flyway that are important for these long distant migrants, and conservation of many of these wetlands warrants serious consideration, especially if any of them are under imminent danger of being altered by humans. The wetlands in the breeding areas support thousands of cranes, and it is also in this same region that the last of the breeding grounds of the critically endangered western flock of Siberian Cranes are to be found. This region will be important for the conservation of cranes.

Key words: Eurasian Crane, *Grus grus*, migration, satellite tracking, wetland

1. Introduction

Satellite telemetry has been used since the late 1980s to track numerous avian species. The migration routes, stopover sites, staging areas, summer locations, and wintering areas of populations of Japanese Red-crowned Cranes *Grus japonensis*, White-naped Cranes *Grus vipio*, Hooded Cranes *Grus monacha*, Demoiselle Cranes *Anthropoides virgo*, Siberian Cranes *Grus leucogeranus*, Eurasian Cranes *Grus grus*, Oriental White Storks, *Ciconia boyciana*, Bar-headed Geese, *Anser indicus*, and numerous other avian species have been successfully tracked (Strikwerda *et al.,* 1986; Jouventin & Weimerskirch, 1990; Higuchi *et al.,* 1992, 1994a, 1994b, 1996, 2000, 2004; Launay *et al.,* 1999; Javed *et al.,* 2000; Meyburg *et al.,* 2000; Kanai *et al.,* 2000, 2002a, 2002b; Shimazaki *et al*., 2004; Higuchi & Pierre, 2005). Cranes migrate enormous distances, and those that breed in the northern latitudes of Asia, such as Siberian, Eurasian, Demoiselle, Japanese Red-crowned, White-naped and Hooded Cranes, migrate across numerous countries, some over the tallest mountains in the world, the Himalayas (Kanai *et al.,* 2000). India is an important winter terminus for Siberian, Eurasian and Demoiselle Cranes.

Cranes encounter enormous challenges during migration, including inclement weather, inhospitable habitats, hunting, disappearance of wetland habitat and toxins such as pesticides, all of which impact their continued survival. There are 15 species of cranes in the world, ten of which occur in Asia, six of these being threatened (Collar *et al.,* 1994, Meine & Archibald, 1996; BirdLife International, 2000, 2003).

Cranes are wetland obligate species, and wetland habitats around the world are threatened, especially in areas where there is human habitation (Scott, 1989). Furthermore, cranes use the same migratory routes and wetlands year after year, return to the same breeding territory and generally use the same wintering area annually (Johnsgard, 1983; Sauey, 1985; Higuchi *et al.,* 1994a; Urbanek & Bookhout, 1994; Meine & Archibald, 1996). Identifying the migration routes, stopover sites, staging areas, wintering grounds, breeding territories, summer sites and causes of mortality, have all become essential components of the conservation effort to protect cranes.

Two Eurasian Cranes were first satellite tracked from Keoladeo National Park (KNP) in Bharathpur, Rajasthan, India, in 1993. These two birds left India on 2 April 1993, took a westerly route skirting the Hindukush, and arrived at their summer site near Omsk, Russia, on 2 May 1993, flying a total distance of 4,000 km, in 30 days of which 20 days were spent at rest sites (Higuchi *et al.,* 1994a). Kanai *et al*. (2000) described the fall migration south of Demoiselle Cranes from Mongolia and Kazakhstan to Gujarat, India. Also in that study (Kanai *et al*., 2000) the cranes from Mongolia flew directly over the Himalayas, and the crane from Kazakhstan skirted west of the Hindukush, finally wintering in Gujarat.

The objectives of the present study were to determine the migration routes, stopover sites and migration pattern of a few Eurasian Cranes satellite-tracked from a different wintering area than KNP, *i.e*., Gujarat in northwestern India. This study was part of a larger project that also involved satellite tracking cranes and storks from the Russian Far-East (Higuchi *et al.,* 2000; Tamura *et al.,* 2000). We also discuss conservation issues in relation to the migration of Eurasian Cranes.

2. Study Area and Methods

The state of Gujarat, India, is an important wintering area for thousands of migratory birds, especially cranes and other water birds (Ali & Ripley, 1987; Grimmett *et al.,* 1999; Tiwari & Rahmani, 2002). Wetlands and grasslands in the area are important habitats which are now much reduced and fragmented (BirdLife International, 2003). Our field efforts were carried out in wetlands, agricultural lands and natural grasslands not far from the city of Bhuj. The area encompassing the Rann of Kutch and its surrounding wetlands and grasslands provide habitat for numerous species of birds and mammals.

Eurasian Cranes were captured using traditional, indigenous capture techniques to capture waterbirds (Higuchi *et al.,* 1994a). Experienced bird trappers who had worked on various projects with the Bombay Natural History Society and Department of Wildlife Sciences, Aligarh Muslim University, captured the birds. A series of noose lines (leg nooses) were laid out in potential feeding and drinking areas of the cranes, around peanut *Arachis hypogea* and sorghum *Sorghum vulgare* fields. Peanuts and sorghum are grown in Gujarat and are harvested during winter. Waste peanut and sorghum seeds after harvesting constitute the preferred food items for thousands of cranes in the region. Cranes typically visit these feeding sites at dawn. Our strategy of hiding noose lines in such areas was successful in capturing the cranes.

Two Eurasian Cranes were captured just 1 km from Lyja Village on Mandvi-Naliya Road (22.91ºN, 69.20ºE) and fitted with PTT IDs 22156 (on 2.01.1999) and 19003 (on 15.12.2000). A single Eurasian Crane was captured and fitted with PTT ID 22158 at Nakhatrana Village (23.240ºN, 69.151ºE) on 4.01.2000. All the cranes were captured and marked in the Bhuj district (27.217ºN, 77.533ºE), in Kutch (Table 1). Five other cranes were also captured and fitted with PTTs, but they could not be successfully tracked as location signals ceased to be received shortly after deployment of the PTTs, because of either malfunctioning PTTs or bird mortality.

The PTTs used were model T-2050, (manufactured by Nippon Telegraph and Telephone Corporation, NTT), 70×34×23 mm in size, weighed 45 g, and included an 18 cm antenna. These PTTs were harnessed as backpacks on captured cranes, with Teflon-treated ribbons as described in Nagendran *et al.* (1994). Each transmitter was programmed to send a signal every 60 seconds on a 6 hr active 12 hr inactive duty cycle to extend the battery life over 119-170 days. Location data were received through the Argos satellite system. Satellite location data ranged in accuracy from location class (LC) 0 (least accurate; >1,000 m) to LC3 (most accurate; <150 m). We assumed LC1(350 m ≤ accuracy <1,000 m) and LC2 (150 m ≤ accuracy < 350 m) were accurate within 1 km, in line with maximum margins of error given by Keating *et al.* (1991) and Service Argos (1996). We included LC0 data when determining migration routes as long as locations obtained were reasonable with respect to tracking times and the location appeared to be logical and along the migration route where the preceding and following locations were LC1-3. We received some aberrant locations that were not in line with tracking times and excluded these from analyses. The time spent at any site was estimated as the difference between the first day of arrival and the day of departure from that site.

3. Results

Three of the eight Eurasian Cranes captured and fitted with PTTs provided valuable migration data (Table 1, Fig. 1). For these three birds, twenty sites were identi-

Table 1 Capture, marking and tracking of the three Eurasian Cranes that were successfully tracked.

PTT ID	Date of Marking	Locality	Area	Age	Duration of migration	Distance traveled from wintering area to summer location in km	Summer Location/ Country
22156	2.1.1999	Lyja, Crop field	Mandvi	Adult	98 days	3,950	Kokalaat, Kazakhstan
22158	4.3.2000	Chari Dhand	Nakhatrana	Subadult	27 days	4,363	Isim, Russia
19003	15.12.2000	Lyja, Crop field	Mandvi	Adult	28 days	4,786	Chelyabinsk, Russia

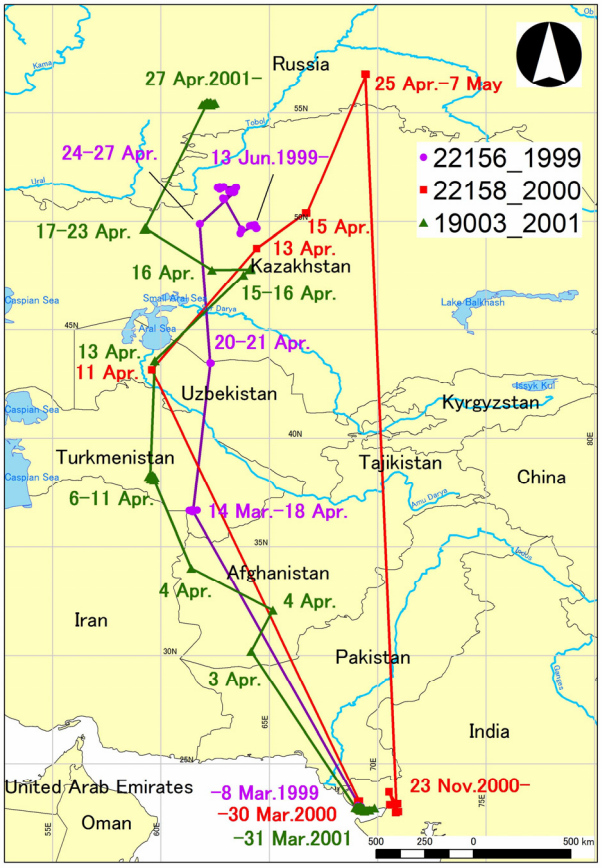

Fig. 1 Spring migration routes of three Eurasian Cranes satellite tracked from Gujarat, India, during 1999-2001.

fied as stopover areas during the course of migration, excluding the wintering areas and summer sites (Table 2).

The Eurasian Crane fitted with PTT ID 22156 started spring migration on 8 March 1999. The last location signals were received from this bird on 29 July 1999. This crane had a total of eight stopover sites, one in Turkmenistan and the rest in Kazakhstan. The time spent at each stopover site was highly variable, ranging from 2-36 days (Table 2). The crane signaled from the first stopover site in Turkmenistan, in marshes around the Tedzen River east of the Iran-Turkmenistan border on 14 March and rested at this location for 36 days. The summer area for this crane was at Kokalaat (49.682ºN, 64.318ºE) in marshes along drainages of the Turgaj and Uly Ziansik Rivers in Kazakhstan. The crane covered a total of 3,950 km over a period of 98 days.

The Eurasian Crane fitted with PTT ID 22158 left India on 30 March 2000. Locations were not available for this crane until 11 April, and on this date locations were received from the marshes on the southern shores of the Aral Sea, south of Mujnak, at the mouth/delta of the Amu Darya, in Kazakhstan. Between 30 March and 11 April the crane had covered approximately 2,500 km. The bird left this site on 11 April. This crane had a total of two more stopover sites in Kazakhstan, before arriving at its summer site in Isim (56.805ºN, 69.409ºE), Russia, on 25 April, 2000, covering a total of 4,363 km over 27 days (Table 2, Fig. 1). PTT ID 22158 continued

Table 2 A list of areas visited by the three Eurasian Cranes satellite tracked from Gujarat, India, during 1999-2001.

PTT ID	Location	Country	Latitude	Longitude	Duration of stay, dates (days)	Habitat	Comments
22156	Mandvi	India	22.900-23.060N	69.021-69.245E	Jan. 2-Mar. 8, 1999, (66+)	Wetland	Capture site
22156	East of Turkmenistan border	Turkmenistan	36.612-36.701N	61.296-61.671E	Mar. 14-Apr. 18, 1999, (36)	River drainage	Rest area
22156			43.427-43.485N	62.010-62.322E	Apr. 20-21, 1999, (2)	River drainage	Rest area
22156	Zhuban	Kazakhstan	49.889-49.909N	61.775-61.816E	Apr. 24-27, 1999, (4)	River drainage	Rest area
22156			51.337-51.441N	63.131-63.403E	May 1-8, 1999, (8)	Wetland	Rest area
22156	Ul'Kensor	Kazakhstan	51.505-51.621N	62.605-62.897E	May 9-27, 1999, (19)	Wetland	Rest area
22156	Kosagal	Kazakhstan	51.565-51.588N	63.417-63.485E	May 28-31, 1999, (4)	Wetland	Rest area
22156	Aralkol	Kazakhstan	51.033-51.081N	62.847-62.942E	Jun. 2-8, 1999, (7)	Wetland	Rest area
22156	Torghay	Kazakhstan	49.460-49.651N	63.652-63.741E	Jun. 9-12, 1999, (4)	River drainage	Rest area
22156	Kokalaat	Kazakhstan	49.682-49.852N	64.094-64.443E	Jun. 13-Jul. 29, 1999, (47+)	River drainage	Summering area
22158	Nakhatrana	India	23.224-23.257N	69.075-69.163E	Mar. 4-30, 2000, (27+)	Wetland	Capture site
22158		Kazakhstan	43.157N	59.577E	Apr. 11, 2000, (1)		Rest area
22158		Kazakhstan	48.764N	64.412E	Apr. 13, 2000, (1)	Amu Darya delta	Rest area
22158		Kazakhstan	50.397N	66.675E	Apr. 15, 2000, (1)	River drainage	Rest area
22158	Ishim	Russia	56.792-56.808N	69.409-69.469E	Apr. 25-May 7, 2000, (13+)	River drainage	Summering area
22158	Morvi	India	22.727-23.697N	70.520-70.967E	Nov. 23, 2000-Feb. 13, 2001, (83+)	Wetland	2000 capture site, 2001 winter site
19003	Mandvi	India	22.796-23.002N	68.962-69.849E	Dec. 15, 2000-Mar. 31, 2001, (107+)	Wetland	Capture site
19003		Afghanistan	30.197N	64.153E	Apr. 3, 2001, (1)	River drainage	Rest area
19003		Afghanistan	32.059N	65.151E	Apr.4, 2001, (1)	Wetland	Rest area
19003		Afghanistan	34.007N	61.396E	Apr.4, 2001, (1)	River drainage	Rest area
19003	East of Ashikabad	Turkmenistan	38.080-38.312N	59.428-59.710E	Apr.6-11, 2001, (6)	River drainage	Rest area
19003		Kazakhstan	43.578N	59.709E	Apr.13, 2001, (1)	Near Aral Sea	Rest area
19003		Kazakhstan	47.538-47.858N	63.799-64.141E	Apr.15-16, 2001, (2)	River drainage	Rest area
19003		Kazakhstan	47.774N	62.345E	Apr.16, 2001, (1)	River drainage	Rest area
19003	Emba	Kazakhstan	49.643-49.727N	59.224-59.332E	Apr.17-23, 2001, (7)	River drainage	Rest area
19003	Chelyabinsk	Russia	55.361-55.478N	61.900-62.483E	Apr.27-Jul.28, 2001, (93+)	Wetland	Summering area

to signal intermittently throughout the summer, and even provided some locations during its fall migration south. Final signals were received from this PTT during 5-13 February, 2001, from Morvi in Gujarat, India, which was about 200 km from its capture site/wintering area in 2000.

The Eurasian Crane fitted with PTT ID 19003 left on migration on 31 March, 2001. The crane had three stopover sites in southern and southeastern Afghanistan along the tributaries and floodplains of the Helmand River, each for one day, on 3 and 4 April, then it rested in Turkmenistan from 6-11 April east of Ashbad, followed by three stopover locations in Kazakhstan, each for one day, on 13, 15, and 16 April. On 13 April this crane rested by the Aral Sea, followed by stops along the Turgaj River drainage from 15-23 April. This crane's summer site was near Chelyabinsk (55.395ºN, 62.117ºE), Russia, where it arrived on 27 April (Table 2, Fig. 1). Signals were received from this PTT through 28 July, 2001. This crane covered a total of 4,786 km over a period of 28 days.

4. Discussion

The three cranes used the same migratory flyway across Pakistan and Afghanistan, skirting the Hindukush mountains, during their spring migration north, but their stopover sites differed from each other. Both the cranes tracked in 1993 took 30 days to complete their migration covering little over 4,000 km of total distance. The cranes tracked in our study covered total migration distance from 3,950 km (ID 22156) to 4,786 km (ID 19003). The total number of stopovers ranged from three to eight, which is comparable to five main stopovers used by the two cranes in 1993.

This migratory behavior suggests that there are several wetlands along the flyway that are important to these long distant migrants (Shimazaki *et al*., 2004; Higuchi & Pierre, 2005), and conservation of many of these wetlands warrants serious consideration, especially if any of them are under imminent danger of being altered by humans. Their staging and stopover sites also differed from those used by the Eurasian Cranes tracked from India in 1993 (Higuchi *et al.*, 1994a). The summer sites of cranes satellite tracked from India to Russia in 1993 were east of the Ural Mountains, not far from the summer sites of the Siberian Cranes satellite tracked from Iran (Kanai *et al.*, 2002a). However, it appears that all three successfully satellite tracked cranes from this three-year study summered within fairly close proximity of each other. The wetlands in this region support thousands of cranes, and it is also in this same region that the last breeding grounds of the critically endangered western flock of Siberian Cranes are to be found (Kanai *et al.*, 2002a). This region is important for the conservation of cranes.

More long term satellite tracking studies of Eurasian and Demoiselle cranes from their wintering grounds across India would provide much needed migratory data, such as different migratory routes, innumerable stopover and staging areas, different breeding/summer sites, and the potential threats that these migrants face. Basic biological and ecological information is necessary to the continuation of conservation efforts for many species, and cranes rank high on the list, since they continue to decline in numbers. This three-year study is a pilot effort, and the results suggest a continuation of such satellite tracking efforts to help expand our basic knowledge and understanding of these long-distant migrants.

Acknowledgements

We thank the University of Tokyo for providing grants to undertake this work. Special thanks are extended to D. Ferguson (USFWS) for his support and encouragement. We thank the Gujarat Forest Department for its unprecedented support to undertake crane telemetry work. Special thanks are extended to C.S. Upadhyay (Undersecretary Gujarat Government), G. A. Patel (Chief Wildlife Warden, Gujarat) and Bharat Pathak (Conservator of Forest, Gujarat) for their unconditional support and quick processing of our permission. We also thank the Conservator of Forests, Kutch, Surendra Kumar (Wildlife Preservation Officer, Govt. of India) for their support. We sincerely acknowledge the support and cooperation of the officials of Ministry of the Environment, Government of India, Department of Wildlife Sciences, AMU, and the Bombay Natural History Society (for leasing the bird trappers during our fieldwork). We also thank Emiko Morishita, Emiko Hiraoka, Naoya Hijikata, Shahid Bashir Khan and Tahmina Shafiq for their help in preparing this manuscript. Finally we thank Himmatsinhji, M. Qasim, M. Akhtar, Ali Hussain, Mohammad, Jaseem Baksh and Tanveer for their invaluable expertise and assistance with field work. This research was funded by Ministry of the Environment of Japan.

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(Received 27 December 2007, Accepted 11 January 2008)