A Review of the Three Subspecies of Sarus Cranes *Grus antigone*

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The tallest bird that flies is an evolutionary achievement awarded exclusively to the Sarus Crane *Grus antigone*. Standing at 1.5 - 2 meter, with a wing span to match, this enormous grey crane with bare red skin on the sides of its head that runs into the upper portion of the neck, is a bird of the subtropical regions of northern regions of the Indian subcontinent and tropical portions of southeast Asia and northeastern Australia (Meine and Archibald 1996, BirdLife International 2001). Today Sarus are confidently found in India, Nepal, Myanmar, Cambodia, Lao PDR, Vietnam and Australia. In recent times they were also found in Pakistan, Bangladesh, China, Thailand and the Philippines. The forces that led to their extirpation in these nations are now pressuring the surviving Sarus populations in all areas except Australia where there are fewer humans.

The Sarus Crane is one of 15 species within the crane family, Gruidae. It shares its genus with 9 other species among which its closest relatives are the look-alike Brolga *G. rubicunda* from Australia and New Guinea, and the White-naped Crane *G. vipio* from northeast Asia (Krajewski 1989, Krajewski and Fetzner 1994).

The historic range of the Sarus stretched from the lowlands of the Indus River in Pakistan, east across the upper portions of the lowlands of India, southeast though Myanmar, Cambodia and Vietnam and touching into China and Lao PDR. Until recently, Sarus were found on the northern lowlands of Luzon, the most northern island of the Philippine (McGregor 1909, Madsen 1981). Since the late 1960s they have been reported in northern Australia. Aboriginal folklore and genetic studies on fossil remains show that they have been in Australia well before the arrival of Europeans (Lavery and Blackman 1969, Schodde et al. 1988, Wood and Krajewski 1996). There are three recognized extant subspecies namely the Indian Sarus *G. a. antigone*, the Eastern Sarus *G. a. sharpii* and the Australian Sarus *G. a. gilli*. Population estimates for the three subspecies are 10,000, 1000, and 5,000 respectively for a world population of 15,000 - 20,000 birds.

Meine and Archibald (1996) provided the first comparative review of the three subspecies. Since, however, many ecological studies have been conducted on the Indian subspecies, and surveys and satellite telemetry on the Eastern subspecies have helped resolve information to a much finer scale than before. The Australian subspecies remains the least known. In this paper, we provide an updated review of the biology, distribution and status of the three subspecies. In this review we use a combination of published information, unpublished personal observations and understanding of the subspecies based on many years of fieldwork.

1. The Indian Sarus Crane *Grus antigone antigone*

Description

The Indian Sarus is the tallest and the heaviest of the three subspecies. The Indian Sarus has a white neck collar just beneath the red upper neck area, and white inner tertiary feathers that are elevated during display. The white tertiary feathers give the appear-

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ance of a bird with a white rump when the wings are closed. The white band on the neck can vary from a very small, narrow strip, to a large irregular shape that can be unequally large in the front or back of the neck (Plate 1). Its larger size and these white portions make the Indian Sarus a much more conspicuous bird than the Eastern and Australian Sarus that are a more uniform steel grey.

**Distribution and movements**

The Indian Sarus has a continuous distribution that does not vary seasonally (Sundar et al. 2000, Sundar and Choudhury 2003). The only discontinuity in the distribution range occurs in West Bengal and Assam where the Sarus are believed to migrate in winter, but the source of this population remains unknown (Choudhury 1998, Sundar et al. 2000). In other areas, seasonal movements are restricted and driven by availability of water. Large flocks of Sarus gather to roost along remaining wetlands and along the shores of lakes and rivers during the summer between April and July (Mukherjee et al. 1999). Over extended periods of time, flocks slowly build at dry season roosting and feeding areas, with birds rapidly dispersing in pairs and small flocks to their breeding territories with the arrival of the seasonal rains (monsoon) between July and October. In areas with year-round water supply, pairs can be perennially territorial (K.S.G. Sundar, personal observation). There are no records of regular, seasonal migrations in this subspecies.

**General habits**

The Indian Sarus Cranes are rarely found in forested areas and prefer widely open landscapes with a mosaic of wetlands and fields with wet crops (Sundar et al. 2000). Though habitat preference studies have not been conducted on the subspecies to date, information from surveys indicate that the Indian Sarus are increasingly being seen in crop fields, primarily rice paddies, in areas with extensive cultivation (Sundar and Choudhury 2003). In other areas that are dominated by wetlands, most of the Sarus seem to be using wetlands (see Sundar and Choudhury 2003 for details and references).

The Indian Sarus is an omnivore and a remarkably versatile bird in its foraging behavior. There have not been any feeding ecology studies, but anecdotal information based on casual observations indicates that the diet and feeding strategies are very diverse. They have the ability to hunt for small animal food (insects, fish, amphibians, reptiles, bird eggs and rodents), dig for the roots, tubers and bulbs of plants in both aquatic and upland habitats, strip seeds from grasses, and graze on fresh green vegetation (BirdLife International 2001). This enables the subspecies to survive in both wetland and upland areas throughout the year. Of major benefit to the Sarus until the advent of pesticides, was its ability to forage on a variety of food items in agricultural fields and in particular to eat waste grains in harvested fields during dry periods (Muralidharan 1983, Rana and Prakash in press). At Keoladeo National Park where Sarus and Siberian cranes were sympatric in winter, the Sarus fed in both uplands and wetlands while the Siberian Cranes were restricted to the wetlands.

Although human populations are high in many areas of the former range of the Sarus, the cranes and other wildlife that could adapt to a human-altered environment, flourished. In a few areas of India where traditional agricultural practices are maintained, Sarus cranes are abundant (Gole 1989, Sundar et al. 2000). One such area is the wetlands and agricultural lands in the districts of Etawah and Mainpuri in Uttar Pradesh, a region that is <5% of the range of the Indian Sarus but includes almost 3000 birds or 30% of the nation’s crane population (Sundar 2003). This has remained unchanged at least for a decade (Gole 1989, Sundar 2003). In glaring contrast, in areas of India where modern agricultural practices have destroyed the wetlands and transformed the landscapes into monocultures dependent on advanced mechanization, the cranes have disappeared (Gole 1989, Sundar et al. 2000). Crops that have been particularly harmful to the habitats and breeding habits of the Sarus are soybean and sugarcane. In other areas where cranes are revered, toxic chemical applied to seed grains to kill termites (Muralidharan 1983), and power lines with which cranes collide (Gole 1991, Sundar and Choudhury 2001), result in the deaths of many birds due to collision and/or electrocution.

**Breeding biology**

The Indian Sarus typically nests during the monsoon season, although some nesting of pairs can occur in late winter (Suwal 1999, Vyas 1999, Mukherjee et al. 2002, Sundar and Choudhury 2003). The second nesting is thought to be of pairs that were unsuccessful in raising young during the monsoons. Indian Sarus use both flooded rice fields and natural wetlands to nest in. In areas with large marshlands, nests are characteristically spread out over the entire marsh (e.g. in the 29 k m² Keoladeo National Park in Rajasthan; Ramachandran and Vijayan 1994). In areas with intensive cultivation, pairs prefer to nest in natural wetlands.
When wetlands are scarce and density of breeding pairs is high (e.g. as in Etawah and Mainpuri, Uttar Pradesh; Sundar and Choudhury, in preparation), simultaneously active nests can be as close as 25 m (Plate 2a). In areas where birds are not actively persecuted, pairs construct nests in wetlands as small as one ha. Nests can be as close as 37 m to human habitation, and as close as 4 m to metalled roads (Sundar and Choudhury in preparation). When extent of wetlands is very low in the landscape, pairs often nest in flooded paddy fields (Suwal 1999, Mukherjee et al. 2002, Sundar and Choudhury in preparation; Plate 2b).

Present status

At first appearance, the subspecies seems to be adept at adapting to changes in its habitat, food and nesting areas, but there is certainly a limit to its versatility. Except in the districts of Etawah and Mainpuri in Uttar Pradesh, the Indian Sarus appears to be declining everywhere else in their distribution range. There are some other districts in Uttar Pradesh that have wetland areas comparable to that found in Etawah and Mainpuri districts. However, until these areas are surveyed in detail to establish numbers of cranes and the existence of good habitat conditions for the cranes, the overall population of the subspecies can be described to be declining. The Indian Sarus is not hunted due to religious beliefs attributed to them. Changes in cropping from flooded rice paddies to dry sugarcane or soya bean, in association with deterioration of the wetland habitat appears to be the most important reason for decline since these remove both nesting habitat and food. An additional limiting factor appears to be reduced tolerance levels in farmers that have led to an increased mortality of eggs and chicks (Mukherjee et al. 2001).

2. The Eastern Sarus Crane *Grus antigone sharpii*

Description

Although large male Eastern Sarus stand almost as tall as the Indian Sarus, they are a much darker grey with only a slight tinge of lighter grey in a color where the bare red skin of the upper neck meets feathers (Plate 3). The Eastern Sarus Cranes are found in forested areas and nest in savannah-like habitats much more than any other species of crane, and its uniform grey colouring perhaps assists in making it less conspicuous to terrestrial predators.

Distribution and movements

There are two distinct populations of the Eastern Sarus Crane. The northern population is found in Myanmar and China. In Myanmar, the Sarus is concentrated in the Ayeyarwady and Bago divisions and the states of Kachin, Shan, Rakhine and Yangon (Latt 1998, 2002, 2003, Meine 1999). In China, the Sarus are known to be very rare and the most recent report is from 1986 when a young Sarus Crane was captured from the Napahai Nature Reserve in western Yunnan province (Barzen and Seal 2000). Unconfirmed reports also exist from Yunxiang county in 1991 (Barzen and Seal 2000). In Southeast Asia, Sarus are found in Cambodia and Vietnam.

The movements of the cranes of the Myanmar population vary from being sedentary (as in the Ayeyarwady and the Rakhine), to birds that appear to have altitudinal migrations (as in Inlay and Daji, and rarely in the Rakhine; J. Barzen, unpublished information). These cranes behave like the Indian Sarus, nesting on natural wetlands and in wet agricultural fields during the monsoon season, and gathering at regions of available water during the dry season (Latt 1998, 2002, 2003, Meine 1999). However, the cranes that nest in north-western Cambodia have distinct migrations to wintering areas with distances ranging from 200-300 km (Barzen and Seal 2000, Barzen 2001a). Even here, it is possible that some birds are either entirely resident, or have seasonal movements over very small distances. Sarus Cranes that nest in the Ang Trapping Thmor (ATT; a large reservoir on a wide lowland basin west of the large lake, Tonle Sap in Cambodia that was improved and enlarged by the Khmer Rouge) for example, likely travel a maximum of 50-100 km during the winter, and only in response to drying up of the water in the reservoir (Barzen and Seal 2000, J. Barzen, unpublished information). This area is a mosaic of smaller wetlands and is good habitat for the Sarus Cranes when flooded.

Historically, records of the Sarus Crane can be found in the Plain of Reeds, a 62,500 km² depression in the Mekong River delta extending from Phnom Penh in Cambodia to near My Tho in Vietnam. This lies between the two populations that are presently clearly separated. Birds in the Plain of Reeds may have been largely sedentary, and the distribution range of the migratory population may well have overlapped with this population. This is similar to conditions that exist for the Whooping Crane *G. americana* and Sandhill Cranes *G. canadensis*.
Cambodia and Vietnam, all of which provide dry season habitat for Eastern Sarus from November through April.

On the delta of the Ayeyarwady River in Myanmar, the Eastern Sarus Cranes usually nest in flooded rice fields where the construction of the nest uproots and destroys newly planted rice seedlings. In Myanmar, efforts by Buddhist monks have served to increase local respect for the cranes and many nests are protected. In other nearby areas like the Rakhine, Inlay and Daji, however, people destroy nests in crop fields. These people are angered more with the damage caused by trampling of the paddy by adult cranes rather than the loss incurred due to the construction of a nest using the paddy stalks (J. Barzen, personal observation).

The Eastern Sarus Crane is much less able to adapt to changing conditions compared to the Indian subspecies. Although numbers of the Eastern Sarus appear to be increasing, there are fears that a combination of wetland reclamation and permanent flooding may be diminishing the size of the communities of sedges upon which the cranes depend. Population viability analysis of the Eastern Sarus Crane in Tram Chin shows that this is a highly unstable population prone to extinction if current rates of environmental degradation and low breeding success of the cranes are not dealt with (Barzen and Seal 2000).

3. The Australian Sarus Crane *Grus antigone gilli*

**Description**

The Australian Sarus resembles but is slightly smaller and a bit lighter than the Eastern Sarus. The voice of the female during the unison call is quite aberrant from that of Indian and Eastern Sarus, an adaptation that might help reduce interbreeding with the closely-related and sympatric Brolga (Archibald 1976). The red on the neck does not extend as far down the neck as in the other subspecies (Plate 5).

**Distribution and movements**

Sarus were first reported in Australia by ornithologists in 1966 with the first breeding record about an year later (Gill 1969, Archibald and Swengel 1985, Bransbury 1991), when a few pairs appeared during the dry season (March through October) on agricultural fields near Normanton on the Gulf of Carpentaria in northern Australia. Their numbers increased annually and today there are several thousand. They were initially considered to be Eastern Sarus that has recently arrived from Indo China (Gill 1969, Lavery and...
Blackman 1969). However, a comparison of their anatomy revealed them to be distinct (Shodde 1988). They were named *G. a. gilli*, after Mrs. H.B. Gill who first described Sarus in Australia (Gill 1969). The aboriginal people have a separate word for Sarus and Brolga. The Sarus are called the “brolga that dips its head in blood” referring to the greater area of bare red skin on the upper neck in the Sarus, or “the Brolga with red legs”; the true Brolgas have black legs (Lavery and Blackman 1969). Undoubtedly the Sarus has been in Australia for hundreds if not thousands of years, yet had remained unnoticed among the more abundant Brolgas. DNA analyses indicate that the Sarus in Australia have been isolated for fewer than 37,500 years (Wood and Krajewski 1996). This time frame is consistent with Mayr’s (1944) scenario for the origin of Australian-endemic avian fauna. Lowered sea levels supposedly created grasslands and marshy areas between islands of the Malay archipelago and provided a dispersal route for Southeast Asian birds into Australia via Timor (Mayr 1944, Wood and Krajewski 1996). Furthermore, geological evidence indicates that the last land bridges between the Malay islands and Borneo disappeared only 18,000 years ago (Morley and Flenley 1987) implying that the Sarus have had ample time to colonize Australia.

Within Australia, the Sarus are partly migratory (Marchant and Higgins 1993). In November with the onset of the rainy season, the Australian Sarus migrate from the Cape York peninsula northwest to the lowlands of the Gulf of Carpentaria where they breed during the wet season between December and February, a distance of c. 400 km (Meine and Archibald 1996).

**General habits**

No ecological studies have been conducted to understand the habits of the Australian Sarus Crane and available information is entirely anecdotal. They forage on insects, rodents, snakes and waste corn in the harvested fields and roost at night beside a reservoir and in natural wetlands. Like the Eastern Sarus in Cambodia and Vietnam, during the dry season the Brolgas gather in large flocks and congregate on dry coastal wetlands where they forage on the tubers of the “bulkuru” sedge or *E. dulcis*. The sympatric Brolgas are also known to have a very diverse diet, but have developed a seasonal preference for the sedges at least in Northern Australia (Marchant and Higgins 1993). In general, the Australian Sarus Cranes seem to have no known preference to foods in any season while Brolgas exhibit specialized feeding habits on an area with localized foods but can exist opportunistically on other food sources when conditions vary (see Harding 2001).

**Breeding biology**

The Australian Sarus Cranes are able to nest in wooded areas, and in areas with dense undergrowth (Figure 6). This is very different from the Brolga that are known to prefer only open and shallow wetland areas to nest in (Harding 2001). There have been no studies conducted, however, to identify limiting factors for breeding in Australian Sarus Cranes.

**Present status**

One theory suggests that before Europeans came to northern Australia there were more forests and brushy areas where cranes could not live. The introduction of tens of cattle and agricultural grain crops dramatically changed the landscapes of many regions of Queensland. In presettlement times, the Atherton Tableland was a tropical forest that was transformed to pastures and cornfields. Grazing on the savannas around the Gulf of Carpentaria undoubtedly made more habitat available for cranes. These anthropogenic changes in the landscape, perhaps resulted in an increase of the Sarus.

In 1984 and 1995, surveys of the nesting populations of Sarus in Australia and Brolgas were conducted on the Delta Downs cattle station on the lowlands of the Gulf of Carpentaria in 1984. Of 72 nests located, 48 were Sarus and 24 were Brolga (G.W. Archibald, unpublished information). It appeared that Sarus preferred more savanna-like wetlands and often nested in wooded areas (Plate 6), whereas Brolgas more frequently nested in wide-open wetlands. Both species answered the unison calls (a territorial threat display) of neighboring pairs irrespective of species and both species drove members of their own species and the other species from their nesting territories. Although through time restrictions in 1995, the territories of fewer breeding pairs were determined, the ratio of 2:1 Sarus: Brolga was maintained suggesting that an equilibrium had been reached between the two species in that area. It appears that the non-specialized habits of the Sarus in Australia are leading to the displacement of the Brolga, but there is no empirical evidence of this happening (G.W. Archibald, personal observations).

**Other Sarus Cranes**

The Sarus that inhabited Pakistan and Bangladesh, undoubtedly were the Indian Sarus. Those that once ranged into the tropical regions of southern Yunnan
Province, China, were undoubtedly the Eastern Sarus. But there is an unusual population of Sarus in north-west Burma near the border with India in the Rakhine state, that appears to be intermediate between the Indian and the Eastern Sarus as indicated by the size of the white collar and distinct white tertiary feathers. Perhaps it is a distinct subspecies, or perhaps there is a clinal change in the transition between the two subspecies. The first mention of this is in Blyth (1881), where Tegetmeier includes a letter by Col. Tickell. Col. Tickell, discussing the possibility of two separate forms of the Sarus in India, writes of T.C. Jerdon's descriptions of Sarus which is self explanatory: "... whitish-grey neck below the white auriculors, and no mention of the smooth nude pale orange collar intervening between the crimson papillous skin of the face and throat, and the feathered part of the neck. So if Jerdon mentions it correctly, he refers to a subspecies different to any I have seen. Have we then three species in India?" Latt (2003) reports sighting of cranes in the Rakhine state, and photographs provided show Sarus Cranes with distinctly white tertiary feathers and white band on neck. These birds were seen foraging in a saline area close to mangroves (Latt 2003). Are these birds from an isolated population in north-east India that has seasonal movements into neighbouring Myanmar?

In the early half of the twentieth century, Sarus were native to the lowlands of northern Luzon of the Philippines. It was much smaller than the Eastern Sarus of the mainland and was suggested to be a distinct subspecies, *G. a. luzonica*. Several museum specimens confirm its small size. Cranes have not been reported in the wild since the early 1970s. Their former wetlands habitats have been converted to agricultural fields and towns. Unlike in India and parts of Myanmar where birds were protected due to religious beliefs, the Philippine subspecies was probably hunted to extinction.

**Other historical information on distribution**

The first two monographs on cranes provide information on distribution that is hard to confirm and understand, but is necessary to point out in this comparison of all the three subspecies of the Sarus Crane. The information in this section is compiled from Blyth (1881) and Blaauw (1897). Previously, only two forms of the Sarus were recognized; the Indian Sarus Crane (the present *G. a. antigone*, previously called "*G. torquata" or "G. collaris"), and the Eastern Sarus Crane (described as *Ardea antigone* by Linnaeus. The Indian subspecies was differentiated from the Eastern Sarus as “larger and higher than the other, distinguished by its broad and pure white nuchal ring, and by its albescent almost pure white, tertiaries”. Not many specimens were collected possibly due to the general opinion and respect accorded to their long-term pair bond. The differentiation was apparently first made by Blyth in a paper that could be accessed, but the results of which were present in his monograph (Blyth 1881) published posthumously by W.B.T. Tegetmeier.

Col. Tickell wrote several notes in response to the initial paper by Blyth differentiating two species of Sarus Cranes. These were included in the monograph. One line is of particular interest to the discussion that follows: "I have closely examined Sarus dead and alive, in various parts of India – on the Nepal frontier, in Tirhoot, near Patna, Bhagulpore, Rajmahal, near Sumbhulpore (in modern day Bihar in India), also in Arakan and Tenasserim – and never met with an individual with a white collar". Tegetmeir also quotes a para from a book by T.C. Jerdon on the *G. collaris*, which is in stark contrast to Col. Tickell’s information. Jerdon writes "the Særæs is found throughout the greater part of India and Burma, is rare south of the Godavery, and also apparently in the Pønjæ, …, but common in Central India, Bengal and parts of the north-west provinces and still more in the Candeishe".

If Col. Tickell’s assessment, pointing out specifically to the lack of white collar, was true, it appears that the Sarus in India was previously the Eastern subspecies. However, this may not be accurate since paintings of the Sarus from the late 16th or early 17th century shows the Sarus to have a white collar and tertiary feathers. The emphatic nature of Col. Tickell’s dismissal of the presence of white collar and tertiary feathers in Sarus Cranes in India is inexplicable, particularly given his reputation as an observant and fastidious naturalist. Jerdon’s paragraph on the Sarus was specifically for birds with the white band on the neck, and confirms information on Sarus Cranes as is presently known. Many of the areas mentioned by Col. Tickell to have Sarus Cranes no longer have Sarus populations, and are closer to the present distribution range of the Eastern subspecies. This region has cropping patterns that are conducive to the survival of the Sarus Cranes, similar to areas in Uttar Pradesh, Rajasthan and Gujarat where the Indian Sarus presently continues to survive. However, hunting pressures are very high. An interesting conundrum is whether the Sarus that was in Bihar and areas eastwards from here the Indian subspecies, and whether the cause for the disappearance was habitat modifi-
Another remark referring to the G. collaris in Blyth (1881) that is clearly in need of verification or substantiation concerns the distribution of the Sarus. In reference to the confusion in names and subspecies, Blyth writes “in the trans-Baikal countries the species (G. collaris) is G. leucauchen of Temminck ...”. We have been unable to obtain any other reference to the presence of the Sarus from the “trans-Baikal” region except for Walkinshaw’s (1973) mention of fossil records from “Europe”. The lack of specific sites and very broad nature of information on distribution makes it very difficult to ascertain locations of historical presence. If the distribution of the Sarus did extend to the area near and around Lake Baikal, they must have needed to migrate at least short distances for the winter. There should be references of these migrations in non-English languages of the area. Considering the rich folklore of the people of the region, there should be substantial mention/use of the Sarus in traditional folklore, poetry and/or art if they carried out migrations in the area, or even if they were resident.

A related casual statement that does not bear a correlation with contemporary information is the possibility that the presence of the Sarus in Australia was recognized earlier. Blyth (1881) writes “… in Australia, the G. australis is the antigone of the older catalogues”. Whether this was a faux pas by Blyth remains to be verified.

**Epilogue**

Concerted research efforts to understand the biology and requirements of the Indian and Eastern Sarus Cranes have been driven by the necessity to conserve them and their habitats. In Australia, interest on the Sarus has been little owing to the apparent increase in the population. However, the information that presently exists is sufficient to indicate that the three subspecies exhibit widely differing behaviours at least with respect to seasonal movements and breeding biology. However, all three subspecies, though capable of using upland areas for foraging require wetland areas to breed, are limited by the deterioration that these habitats face in their distribution range. As demonstrated in India, Myanmar and Australia, within certain constraints the adaptable Sarus can flourish in areas where human populations are high and/or where humans have altered the landscape to the accidental benefit of the cranes. However, the cranes have their limits of tolerance. If wetland habitats that are vital for breeding and wintering are altered, the cranes will move elsewhere. Power lines and poisons applied to newly planted grain will kill cranes just as effectively as guns and snares. Man knows what he can do and cannot do to live in harmony with these enormous and inspiring birds. Let us hope that through the enlightened actions of man, Sarus can one day return to areas of their wide range from which they have disappeared because of humans.

**Plate 1**: Variation in the amount of white on neck in the Indian subspecies of Sarus Crane G. a. antigone. (a) Adult male (left) and female (middle, feeding), and adult of indeterminate sex (right). Note variation in the amount of white on neck, and lesser amount of white on male. (b) Adult pair; female (left) with lesser amount of white, and male (right) with more white on collar. Note also for male how the white marking is more on the front of the neck than the back. (c) Adult male with white marking more on the back of the neck than the front. © K. S. Gopi Sundar. All pictures were taken in Uttar Pradesh.
Plate 2: Breeding habitat and nest structure of the Indian Sarus Crane. (a) Picture showing two simultaneously active nests of Indian Sarus Cranes in natural marshlands (low vegetation and flooded area) in the midst of rice paddies (taller vegetation). Pair on far side is seen reinforcing their nest (position indicated by arrow). Note openness of habitat. (b) A nest in the middle of a paddy field constructed entirely out of paddy stalks. © K. S. Gopi Sundar. All pictures taken in Uttar Pradesh.

Plate 3: Eastern Sarus Cranes from the two known populations. (a) Four Sarus Cranes from a non-breeding flock of the China-Myanmar population photographed in the Ayeyarwady Delta, Myanmar. Note colouring on the neck present as grayish-white markings, and almost entirely absent on tertiary feathers when wings closed giving the birds a overall appearance of uniform gray. (b) Pair of Sarus Cranes from the south-east Asia population photographed in the Preah Vihear Province, Cambodia. Note how white on both neck and on the tertiary feathers are present as an indistinct markings. © Eleanor Briggs.

Plate 4: Aerial pictures of Eastern Sarus Crane breeding habitat and nest in north-east Cambodia. (a) Typical breeding habitat showing dipterocarp forest and open wetland areas. (b) Picture of an Eastern Sarus Crane nest (white arrow) and adult bird (black arrow) taken from 100 m altitude. Note proximity to wooded area (top left corner). © J. Barzen.
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Plate 5: Pictures of Australian Sarus Crane showing much reduced white on body. (a) Pair unison calling. Note how the tertiary feathers are marked with very light white on the outer edges (in male on left) preventing the appearance of a bird with a white rump when wings are closed (female on right). (b) Adult male showing grayish markings on neck. Note how red skin on head extends to a much shorter extent in comparison with the other two subspecies. © G. W. Archibald.

Plate 6: Breeding habitat and nest structure of Australian Sarus Crane. (a) Nest in typical nesting habitat. Note proximity to trees. (b) Pair at nest with one chick hatched. Note dense undergrowth and proximity to trees (in the background).

Acknowledgements

We thank Mr. Prakash Gole for inviting the paper for the special issue of the Journal of the Ecological Society on Sarus Cranes. The paper was written using the extensive bibliography of the Ron Sauer Memorial Library, International Crane Foundation and we thank Betsy Didrickson for her ready help with literature and obtaining photographs. KSGS was supported at ICF through grants by the International Crane Foundation and the United States Fish & Wildlife Services and thanks L. Dando, D. Ferguson and J. Harris for facilitating travel and stay at the International Crane Foundation during the writing of this paper. We thank Daw Latt for allowing the use of her photograph of the cranes in the Rakhine. A previous draft of the paper benefited from the comments of B. Didrickson and we thank her for her assistance.

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