

Threatened Birds of Asia:

The BirdLife International Red Data Book

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SARUS CRANE

Grus antigone

Critical —

Endangered —

Vulnerable A1c,d,e; A2c,d,e

This crane has suffered a rapid population decline, which is projected to continue, as a result of widespread reductions in the extent and quality of its wetland habitats, exploitation and the effects of pollutants. It therefore qualifies as Vulnerable.



DISTRIBUTION The Sarus Crane (see Remarks 1) now occupies a highly disjunct distribution: the nominate race inhabits Pakistan, northern and central India, Nepal and historically Bangladesh and Arakan in Myanmar; the race *sharpii* was previously widely distributed across South-East Asia but has all but disappeared from north-east India, mainland China, Myanmar, Thailand, Malaysia and Laos, and surviving populations are virtually confined to Cambodia and Vietnam; the third subspecies *G. a. gilliae* inhabits northern Australia. The species has suffered a considerable contraction of its range in South and South-East Asia (Roberts 1991–1992, Meine and Archibald 1996, Wells 1999, Sundar *et al.* in press). Moreover, the race *luzonica* (possibly synonymous with *gilliae* or *sharpii*) once occurred in the Philippines but is now presumed extinct (see below).

Outside the Asian region The species was first identified in Australia by ornithologists in October 1966 with the first breeding record a year later (Gill 1969, Blakers *et al.* 1984, Archibald and Swengel 1985, Marchant and Higgins 1993). There are possible records from 1953 (Archibald and Swengel 1986). Whatever the date of discovery, and contrary to the statement by Johnsgard (1983) that the population was “newly acquired”, the species must have been present in the country for a long time, as native Australians differentiate between Sarus Cranes and the similar Brolga *G. rubicunda* (Meine and Archibald 1996), and, moreover, it has apparently evolved into a separate subspecies with characteristic plumage features (Schodde 1988). It is largely confined to Queensland, breeding on both coasts of the Cape York peninsula, with small and scattered populations in north-central Australia (Marchant and Higgins 1993).

Asian region In the following distribution sections some overlap between localities has been unavoidable (particularly for India where the species is a still common roadside bird in some areas, with records concomitantly numerous); counts at sites or subsites in India are given in parentheses.

■ **CHINA** The subspecies *sharpii* has been recorded in small numbers in Xishuangbanna, Lincang and Dehong prefectures in south-west Yunnan, near to the border with Myanmar, mainly in winter; local people in its former range reported that before 1960 it used to arrive in the paddyfields in November, after the rice was harvested, but there have been no records since the early 1990s (Yang Lan *et al.* 1995; see Remarks 2). Records are from:

■ **Yunnan Nagpag Co** (Napa Hai), Zhongdian county, one captured, winter 1986 (Yang Lan *et al.* 1995); Dongxiaofang, **Gongshan county**, Gaoligong Shan mountains, at the “Eastern Guarding Post”, one corpse in a marsh, 3,250 m, August 1973 (Yang Lan *et al.* 1995); Lishu township, Lancang Jiang river, **Yunxian county**, two reported by local people, March 1991 (Yang Lan *et al.* 1995); **Nongdao**, Jiexiang district, Ruili Jiang river, Ruili county, two occasionally after the rice harvest in winter of unspecified years (Yang Lan *et al.* 1995); Man’e village, Nanding He river, **Mengjian** district, Gengma county, pair in grassland by the

river, 1986 (Yang Lan *et al.* 1995); **Meng'a**, Menghai county, two feeding on paddies, February 1960 (Yang Lan *et al.* 1995); **Mengzhe**, Menghai county, 13, January–February 1987 (Yang Lan *et al.* 1995); **Menglun**, Mengla county, one collected, March 1959 (Yang Lan *et al.* 1995); **Mengla county**, one collected, February 1960 (Yang Lan *et al.* 1995); marshlands at **Mengpeng**, Mengla county, 5–6, February 1960 (Yang Lan *et al.* 1995); Tsitkaw (untraced), two collected, March 1868 and 1875 (Anderson 1879; also Rothschild 1926).

■ **PAKISTAN** This species has apparently always been scarce in Pakistan, occurring almost exclusively in Sind in ones and twos and occasionally breeding at scattered locations (Roberts 1991–1992). It is currently a very rare visitor, perhaps breeding in tiny numbers. Records are from: ■ **Sind** unspecified localities, mostly in the south-east but at least one sighting near the Indus (Hume 1872–1873, A. O. Hume footnote to Butler 1875–1877, Barnes 1885); **Drigh Lake Wildlife Sanctuary**, Larkana district, two pairs, 1929 (at least one of which bred), with another pair breeding in 1939 at “one of the larger lakes” in the same region (Roberts 1991–1992); near **Mirpurkhas**, one, October, 1914–1920 (Ticehurst 1922–1924); **Jhimpir**, specimen in the Karachi Museum, undated (Ticehurst 1922–1924); undisclosed localities, c.1998, with a few breeding pairs recently discovered (Sundar and Choudhury 1999, C. Mirande *in litt.* 1999); ■ **Punjab** above **Marala**, on the Chenab river, a pair, 1968 (Roberts 1991–1992).

■ **INDIA** According to early reports the species was once distributed over much of the Indian subcontinent, from Sind (Pakistan) in the west to Bangladesh, Assam and Manipur in the east, throughout the Gangetic plain, and in the arid and semi-arid regions of the Deccan plateau in central India, perhaps as far south as Andhra Pradesh (Jerdon 1839–1840, Murray 1889, Ali and Ripley 1968–1998). Although its range contracted markedly during the course of the twentieth century, particularly at the eastern and southern fringes (Sundar *et al.* in press), it remains widely distributed in northern India, occurring in parts of Jammu and Kashmir, Himachal Pradesh, Maharashtra, Bihar, West Bengal, Assam, Meghalaya and Manipur, but principally in Rajasthan, Haryana, Uttar Pradesh, Gujarat and Madhya Pradesh.

■ **Jammu and Kashmir** Undated reports from unspecified localities were mentioned by Johnsgard (1983). The only specific records are as follows: **Kashmir valley**, two occasions, undated (Ward 1906–1908); **Kathua district**, at Kishanpur, a breeding pair, and at an unspecified site, 22, both in June 1999 (B. C. Choudhury *et al.* 1999), 40–50 individuals regularly congregating in the area (P. Singh *in litt.* 1999); Garuna Wetland Reserve (untraced), listed by Sahi (1993), a pair, 1998–1999 (Sundar 1999a).

■ **Himachal Pradesh** The species is scarce at lower altitudes with records from: **Dharmasala**, undated (Abdulali 1968–1996); **Kangra**, seven, May 1998–March 1999 (Sundar *et al.* in press), breeding confirmed (Sundar and Choudhury 1999); **Pong Dam lake** (Pong Lake Sanctuary), December 1985 (Gaston 1985b), listed (Pandey 1986), 1995 (Lopez and Mundkur 1997); **Mandi**, 900 m, on the plain, April 1914 (Babault 1920); Bhuntar, Beas valley, three on the airfield, March 1993 (Kovacs 1993), this possibly **Banjar**, Kulu, where two were seen c.1998 (Sundar and Choudhury 1999).

■ **Punjab** There are very few records from the state and it is unclear whether the species still occurs; there have been no records in the last 10 years despite extensive surveys (Choudhury *in litt.* 1999, Sundar *et al.* in press). Earlier records are from: Siwalik range (not mapped), listed as a rare resident (Singh 1993); **Chamkor** (Chamkaur), one pair, December 1916 (Whistler 1918).

■ **Haryana** The species currently occurs in Rohtak, Hissar, Gurgaon, Palwal and Panipat districts (Sundar and Choudhury 1999). Records are from: **Ambala**, undated (Beavan 1865–1868); between **Jagadhri** (Jagadri) and Ambala, one pair, November 1915 (Whistler 1918); Parwali lake, c.12 km from **Sirsa**, up to nine, January–March 1933 (Koelz 1940); **Bhindawas Wildlife Sanctuary**, Rohtak district, undated (Urfi 1995), three, May 1998–March 1999

(Sundar *et al.* in press), breeding in the late 1990s (Sundar and Choudhury 1999); **Sultanpur National Park** (Sultanpur jheel), previously up to 80 in the mid-twentieth century with several pairs breeding, but recent numbers very low, apparently owing to desiccation of the wetland (Sundar and Choudhury 1999, Sundar *et al.* in press), including eight, January 1983 (Bult 1983), 15, February 1987 (Turin *et al.* 1987), six, January 1988 (Berlijn *et al.* 1988), several, December 1990 (Adriaensen *et al.* 1991), three, November 1994 (Martins 1994), two, May 1998–March 1999 (Sundar *et al.* in press), three, June 1999 (B. C. Choudhury *et al.* 1999); **Palwal district**, fairly large population, with several observed from trains in 1999 (Sundar and Choudhury 1999, Sundar *et al.* in press).

■ **Delhi** Records are from: **Delhi**, 1871 (specimen in BMNH), undated (Frome 1947–1948); **Okhla**, two pairs nearby, undated (Hutson 1954), several, March 1986 (Cap *et al.* 1986), occasional in the 1990s (Urfi 1995).

■ **Rajasthan** The species is rare in the drier western portions of the state but locally common in the east. Records are from: **Alwar district**, up to six, May 1998–March 1999 (Sundar *et al.* in press); **Sariska Wildlife Sanctuary** (Tiger Reserve), listed, undated (Anon. 1993a), and at Manasarovar, one, January 1990 (Sankar *et al.* 1993); **Keoladeo National Park** (Bharatpur), maxima of 308 in February 1969, 103 in September 1969 (Walkinshaw 1973), c.100, January 1973 (R. Lévêque *in litt.* 1999), c.450, March 1978 (A. Brunnenstrasse *in litt.* 1999), 434 in December 1979 (Breedon and Breedon 1982), 258 in the area, April 1983, and 657 in the area, April 1984 (Scott 1989), c.400, February 1987 (Holman 1987), numbers dropping in 1990s and only a small breeding population remaining—26 in May 1998–March 1999 (Sundar *et al.* in press), 28 in June 1999 (B. C. Choudhury *et al.* 1999); **Aghapur**, February 1981 (Hunt 1981); **Raisar**, Jaipur district, six, 1999 (B. C. Choudhury *et al.* 1999); **Sambhar** (Sambhur lake), “very common”, January 1872 (female in BMNH, Adam 1873); **Bharatpur district**, at Ajan Dam (47), Basilpur (4), Keoladeo National Park to Sever road (2), Ban Baretta (Bund Barata, Bandh Baretha) (2), Borai Moti jheel (5), and Moti jheel (2), all June 1999 (B. C. Choudhury *et al.* 1999); **Dholpur district**, up to nine, May 1998–March 1999 (Sundar *et al.* in press), at Talab-e-shahi (2) and Ramsagar (2), both June 1999 (B. C. Choudhury *et al.* 1999); **Chaksu**, Jaipur district, a breeding pair, 1999 (B. C. Choudhury *et al.* 1999); **Sawai Madhopur district**, two, May 1998–March 1999 (Sundar *et al.* in press); **Jodhpur**, “common”, undated (Butler 1875–1877), undated (Agoramoorthy and Mohnot 1989) and Jodhpur to Jaipur, two, January 1985 (Andersen *et al.* 1986); **Ajmer district**, at Kabra Talab (2), Padabhadra Talab (2) and Khodmal Talab (2), all June 1999 (B. C. Choudhury *et al.* 1999); **Tonk district**, up to eight, May 1998–March 1999 (Sundar *et al.* in press); **Ranthambhore National Park**, listed, undated (Anon. 1993a), 1992–1994 (Drijvers 1995); near **Sonkhaliya** (Sonkalia Bustard Enclosure), three, February 1993 (P. Aström, U. Olsson and D. Zetterström *in litt.* 1999); **Sareli**, under 50, January–February 1984 (Gole 1984); **Pai Balapur**, under 50, January–February 1984 (Gole 1984); **Talwasa**, under 50, January–February 1984 (Gole 1984); **Bundi district**, up to 45, May 1998–March 1999 (Sundar *et al.* in press); **Bhilwara district**, up to 49, May 1998–March 1999 (Sundar *et al.* in press); **Meja**, under 50, January–February 1984 (Gole 1984); **Mangalwad**, under 50, January–February 1984 (Gole 1984); **Bharda**, over 50, January–February 1984 (Gole 1984); **Mandalgarh**, under 50, January–February 1984 (Gole 1984); **Mandol**, under 50, January–February 1984 (Gole 1984); **Abheda**, under 50, January–February 1984 (Gole 1984); **Ranpur**, under 50, January–February 1984 (Gole 1984); **Jawai Bandh**, Pali district, 22, June 1999 (B. C. Choudhury *et al.* 1999); **Bijapur**, Dausa district, three, June 1999 (B. C. Choudhury *et al.* 1999); **Gangrar**, 96 km from Nimach (Neemuch), breeding, February 1885 (Barnes 1885, 1887); **Alania** (Alyinia), under 50, January–February 1984 (Gole 1984); **Kota district**, up to 37, May 1998–March 1999 (Sundar *et al.* in press), specifically at Umed Ganj (Umedganj), under 50, January–February 1984 (Gole 1984), 12, June 1999 (B. C. Choudhury *et al.* 1999), and Patan Ka Talab, two, June 1999 (B. C. Choudhury *et al.* 1999), with major breeding areas around the Kota barrage (Vyas 1999b);

Atru, Baran district, two, June 1999 (B. C. Choudhury *et al.* 1999); **Bhanda**, **Udaipur district**, two, June 1999 (B. C. Choudhury *et al.* 1999); **Chhabra**, Chabra district, three, June 1999 (B. C. Choudhury *et al.* 1999); **Chittorgarh district**, up to 79, May 1998–March 1999 (Sundar *et al.* in press); **Jhalawar district**, up to 18, May 1998–March 1999 (Sundar *et al.* in press), at Jalawar tank, four, June 1999, and at Gapasgar, a non-breeding pair, June 1999 (B. C. Choudhury *et al.* 1999); **Dungarpur district**, 39 at Kala-Kho, June 1999 (B. C. Choudhury *et al.* 1999); **Banswara district**, at Aishwar Talab (2), around Banaswara (4), at Bhagora Talab (2), Bhuwasa (2), Borda (2), Choklama Taal (2), Daulat Singh Talab (4), Duglawadi (2), Ganoda (2), Jaulana Talab (2), Kimpur (2), Kuwathiya Talab (4), Lalomi Talab (2), Lasaada Talab (2), Malana Talab (2), Rawda (2), Sandani (6), Saredi Badi Talab (2), Semavasa Talab (4), Vajaagara Talab (2) and Vaka Talab (2), all June 1999 (B. C. Choudhury *et al.* 1999); Dosa district (untraced locality), at Saithal dam (5), Dangarwada (2), Jilmili dam (2) and Kalo Kho dam (44), all June 1999 (B. C. Choudhury *et al.* 1999).

■ **Gujarat** The species was once widespread in the state but is now largely confined to northern regions. Records are from: Kutch (Kachch), unspecified localities, undated (Stoliczka 1872), common, undated (Butler 1875–1877); Bheemsar, here presumed to be **Bhimasar**, Kutch district, two, June 1999 (B. C. Choudhury *et al.* 1999); **Saberkanta district**, up to four, May 1998–March 1999 (Sundar *et al.* in press); **Wild Ass Sanctuary**, Surendranagar district, unspecified numbers, 1989–1992 (Shah *et al.* 1995), 10 at Tundi Talab, May 1998–March 1999 (Sundar *et al.* in press); **Ahmedabad district**, up to 52, May 1998–March 1999 (Sundar *et al.* in press), at Bakrol Vanjhar (6), Baldana (3), Bavla (2), Bhat Visalpur (6), Bhayla (3), Changodar (2), Dadusar (3), Dholka (3), Fatewadi canal (3), Gangad (3), Ganol (4), Ingoli (4), Jhanand (3), Kasindra (3), Kerala (2), Khanpur (2), Mandal Talab (2), Matoda (2), Modasar (2), Nani Devti (2), Narimapur (8), Nesda (2), Pipal (2), Pisawadi (4), Sahij (2), Salajda (4), around Sanand (11), Sathal (5), Simej (2), Rupavati (2), Vasna (3), Vataman (2), Veerangam and Domena (2), Virdi (2), and Visalpur (4), all June 1999 (B. C. Choudhury *et al.* 1999); **Devisar**, Kutch district, two, June 1999 (B. C. Choudhury *et al.* 1999); **Kharaghoda** region (Kharagora), undated (Bulkley 1893); **Thol Lake Sanctuary** (given as Thoi Bird Sanctuary, Ahmedabad district: B. C. Choudhury *et al.* 1999), Mehasana district, 35, May 1998–March 1999 (Sundar *et al.* in press), 10, June 1999 (B. C. Choudhury *et al.* 1999); **Vijaysagar**, six, January–February 1983 (Gole 1985); **Panchmahal district**, up to six, May 1998–March 1999 (Sundar *et al.* in press); Mahi Kantha Agency, **Mahisa district**, an incubating bird, February 1903 (Mosse 1910); Tanna, at **Timbi** (Tembhi), four, March 1883 (Inverarity 1887); around **Dakor**, towards Nes, one pair, February 1996, and at Dhunadara, 8 km from Dakor, 28, June 1996 (Vashishtha 1996); **Kanewal reservoir**, 148, January 1975 (Koning and Koning-Raat 1975); **Pariej reservoir**, two pairs, February 1996 (Vashishtha 1996), and up to 12 in the area, June 1999 (B. C. Choudhury *et al.* 1999); **Kheda district**, up to 58, May 1998–March 1999 (Sundar *et al.* in press), at Bamangam (2), Bhavanpura (4), Budhej (3), Bunaj (2), Chikhhaliga (2), Daheda (2), Daloli (3), Gobrapura (2), Gorad (5), Gudel (3), Hadeva (2), Heranj (4), Jichka (1), Jinaj (2), Jinjiwada (2), Kanawada (5), Kanewar (26), Kasbara (2), Khakhsar (3), Kheda (1), Kheda bridge (6), Limbasi (3), Machhiyel (10), Mahelaj (3), Matar (2), Moraj (2), Mota Kododara (3), Nandoli (2), Narda (7), Nayaa (4), Padra (5), Palla (2), Pandad (2), Puriuj Lake (3), Radhu (2), Rasikpura (4), Rohini (2), Sayla (2), Seela pond (3), Tannsa (2), Traj village (3), Traj pond (109), 5 km beyond Traj (3), 11 km beyond Traj (2), Tranja (2), Vainj (2), Valotini (4), Varasda (4), Vastana (12), Viroja (2) and Untwada (3), all June 1999 (B. C. Choudhury *et al.* 1999); **Nalsarovar** (Nalsarovar Sanctuary), Ahmedabad district, 17, May 1998–March 1999 (Sundar *et al.* in press); **Jodiya**, two, January–February 1983 (Gole 1985); **Surendranagar district**, six, January 1987 (Scott 1989), at Pond Vitalia (2), near Patdi (2), between Taluka and Patdi (6), at Dharangadhra Halvad (4), Dholidhaja Dam (2) and Hanuman mandir (2), all June 1999 (B. C. Choudhury *et al.* 1999); **Anand district**, on the Jinuj (probably same as Jinaj above) to Kasnewal road (2), at Khodar temple (2) and

Ras (4), all June 1999 (B. C. Choudhury *et al.* 1999); **Vadodara district** (Baroda district), undated (Walkinshaw 1973), at Muval (two displaying), Timbi (2) and Wadhvana (5), all June 1999 (B. C. Choudhury *et al.* 1999); **Sayala**, four, January–February 1983 (Gole 1985); **Ajwa** and Wadhvana (presumably also Wadhvana) lakes, 22, February 1975 (Koning and Koning-Raat 1975); **Rajkot**, common, undated (Butler 1875–1877); near **Khambhat** (Cambay), towards Vadgam, one pair, February 1996, and towards Petlad, one pair, February 1996 (Vashishtha 1996); near **Bhatia**, three, January 1971 (Yealland 1971); **Velavadar National Park**, Bhavnagar district, five, May 1998–March 1999 (Sundar *et al.* in press), three, June 1999 (B. C. Choudhury *et al.* 1999); **Veri**, Gondal, two, January–February 1983 (Gole 1985); **Bhavnagar**, undated (Abdulali 1968–1996), up to eight, May 1998–March 1999 (Sundar *et al.* in press); **Porbandar district**, at Amirpur dam (14), Baradasagar dam (six) and Nalhari Pond (two), all June 1999 (B. C. Choudhury *et al.* 1999); adjacent to Daman (not mapped), two, January 1883 (Inverarity 1887); Sial Guzerat (untraced locality, probably in Gujarat), December 1892 (one egg in NMS).

■ **Uttar Pradesh** The species occurs in the districts of Aligarh, Allahabad, Azamgarh, Badaun, Bahraich, Banda, Ballia, Bara Banki, Bareilly, Basti, Bijnor, Bulandshahr, Deoria, Etah, Etawah, Faizabad, Farrukhabad, Fatehpur, Firozabad, Ghaziabad, Gonda, Gorakhpur, Hardoi, Jalaun, Kanpur, Lakhimpur-Kheri, Lucknow, Maharajganj, Mainpuri, Mathura, Mau, Meerut, Pilibhit, Rae Bareli, Shahjahanpur, Siddharthnagar, Sitapur and Sultanpur (Sundar and Choudhury 1999). Specific sites, or counts within these districts, are as follows: **Hastinapur Wildlife Sanctuary**, Meerut district, locally reported, May 1998–March 1999 (Sundar *et al.* in press); between **Dhampur** and Najabad, two, March 1993 (Kovacs 1993); **Udham Singh Nagar district**, at Kokhratal (2) and Hempur (3), both June 1999 (B. C. Choudhury *et al.* 1999); Suket, near **Bilaspur**, 900 m, April 1914 (Babault 1920); near **Moradabad**, one pair, February 1983 (Suter 1983); **Pilibhit district**, up to 19, May 1998–March 1999 (Sundar *et al.* in press); **Dudwa National Park**, Lakhimpur-Kheri district, principally at Bankey taal, listed (Chandola 1978, Singh and Singh 1985, Scott 1989), two, June 1999 (B. C. Choudhury *et al.* 1999); **Bareilly district**, November 1928 (Law 1930), 15, May 1998–March 1999 (Sundar *et al.* in press), and specifically at Chanheti, nesting, around 1934 (Bates 1935), and Sayyadpur, 14, June 1999 (B. C. Choudhury *et al.* 1999); **Bulandshahr district**, breeding, July, unspecified year (Hume and Oates 1889–1890), and specifically “near Narara”, six, June 1999 (B. C. Choudhury *et al.* 1999); **Kheri district** (Lakhimpur-Kheri), undated (Abdulali 1968–1996), two, May 1998–March 1999 (Sundar *et al.* in press), and specifically at Oel, seven, June 1999 (B. C. Choudhury *et al.* 1999); **Shahjahanpur district**, September 1908 (two clutches in NMS), and specifically at Tilhar, two, June 1999 (B. C. Choudhury *et al.* 1999); **Aligarh district**, specifically around Aligarh town, breeding in September, year unspecified (Hume and Oates 1889–1890), at least 42, May 1998–March 1999 (Sundar *et al.* in press), one pair, February 1983 (Suter 1983), one pair, 1994 (Xavier 1995), and at Kulwa (4), Ashpan (5) and Sheikha and surroundings (40), June 1999 (B. C. Choudhury *et al.* 1999); **Bahraich district**, at Nibia, six in March 1998 (Javed 2000), at Pittora, Rissia, Binhga (total of 20), and Bijnor (3), all June 1999 (B. C. Choudhury *et al.* 1999); **Chhata lakes**, on the border with Rajasthan, 42, January 1987 (van der Ven 1987), and Chaata (presumably same) (2), June 1999 (B. C. Choudhury *et al.* 1999); **Mathura district** (Muttra district), breeding in August, year unspecified (C. H. T. Marshall in Hume and Oates 1889–1890), near Mathura, four, February–March 1988 (Kovacs 1988), 22, May 1998–March 1999 (Sundar *et al.* in press), and specifically at Mathura (148), on the Mathura to Aligarh road (5) and at Farah (6), all June 1999 (B. C. Choudhury *et al.* 1999); **Sitapur district**, 18, May 1998–March 1999 (Sundar *et al.* in press); **Farrukhabad district**, seven, May 1998–March 1999 (Sundar *et al.* in press); **Etah district**, 58 (including 20 in Patna Sanctuary), May 1998–March 1999 (Sundar *et al.* in press), at Patna Sanctuary (21), “G. T. Road” (5), the Patna to Jalesar road (24) and the Jalesar to Agra road (17), all June 1999 (B. C. Choudhury *et al.*

1999), another count of 120, also in June 1999 at Patna Sanctuary (Sundar 1999); **Hardoi**, two nests, August, undated (Jesse 1896–1899), breeding pair, December 1901 (Pershouse 1911), 213, May 1993 (Prasad *et al.* 1993); **Fatehgarh**, February 1870 (Anderson 1871a), and on the Ganges nearby, c.40, April 1898 (Jesse 1896–1899, 1902–1903); **Sohagibarwa Wildlife Sanctuary**, at Singhrana taal, 50, June 1987 (Rahmani and Qurieshi 1991); **Gonda district**, seven, May 1998–March 1999 (Sundar *et al.* in press), specifically at Parrate-Arga Sanctuary, 112, June 1999 (B. C. Choudhury *et al.* 1999); Yamuna (Jumna) river, in the **Agra** area, 54, mid-April, c.1941 (Lowther 1941), towards Fatehpur Sikri, two, February–March 1987 (Jepson and Holman 1987), towards Moradabad, four, February 1993 (Holman 1993), and in Agra district between Tasod and Udaipur (58), at Dayalbagh (5), “SSBS” (6) and Yamuna catchment area, Dayalbagh (2), all June 1999 (B. C. Choudhury *et al.* 1999); **Mainpuri district**, up to 158 (including 16 in Saman Sanctuary), May 1998–March 1999 (Sundar *et al.* in press), in “agricultural fields”, 62, June 1999 (B. C. Choudhury *et al.* 1999), 166 at Saman Sanctuary, June 1999 (Sundar 1999b); **Pharenda**, 150–200, April 1991 (Rahmani and Qurieshi 1991) and between Siddharthnagar and Pharenda (10 km from latter), nine, March 1998 (Javed 2000); **Gorakhpur district**, at Gandak river, two flocks of 20 and 24, January 1911 (Osmaston 1913), and elsewhere, two, May 1998–March 1999 (Sundar *et al.* in press); unspecified localities in Avadh (“Oudh”), undated (Irby 1861), January 1874 (specimen in BMNH), the provincial capital of the time being **Lucknow**, where the species was recorded pre-1881 (Reid 1887), and at Aturia, between Lucknow and Sitapur, October, year unspecified (Jesse 1896–1899); **Nawabganj Priyadarshani Sanctuary**, Unnao district, two, April 1998 (Javed 2000), five, June 1999 (B. C. Choudhury *et al.* 1999); **Etawah**, undated (female in BMNH), 61, May 1998–March 1999 (Sundar *et al.* in press), including Barthara, three juveniles accompanying a pair, September 1999 (K. S. G. Sundar *in litt.* 1999) and Etawah district, “in agricultural fields” (114) and at Sarsai Nawar jheel (228), both June 1999 (B. C. Choudhury *et al.* 1999) and between Murong and Pachnada and at the Chambal river, Etawah and Auriya districts, 50, June 1999 (B. C. Choudhury *et al.* 1999); **Faizabad district**, up to seven, May 1998–March 1999 (Sundar *et al.* in press); **Bara Banki district** (Bara Banki), at Ukhra pond, two, June 1999 (B. C. Choudhury *et al.* 1999); **Kanpur Dehat district**, two, May 1998–March 1999 (Sundar *et al.* in press), at Sikandra (14), Sandalpur (2), Auraiya (3) and Kanchausi village (3), all June 1999 (B. C. Choudhury *et al.* 1999); **Maharajganj district**, four, May 1998–March 1999 (Sundar *et al.* in press); **Majhauli**, 17 in March 1998 (Javed 2000), and at unspecified localities in Siddharthnagar district, two, May 1998–March 1999 (Sundar *et al.* in press); **Rae Bareli district**, at Samaspur Sanctuary, 15–20, May 1998–March 1999 (Sundar *et al.* in press), at Unchahar-Rae Barely, 12, June 1999 (B. C. Choudhury *et al.* 1999), and at Sayyadpur, 14, June 1999 (B. C. Choudhury *et al.* 1999); **Mau district**, two, May 1998–March 1999 (Sundar *et al.* in press); **Hamirpur district**, two, May 1998–March 1999 (Sundar *et al.* in press); **Fatehpur district**, five, May 1998–March 1999 (Sundar *et al.* in press); **Banda**, up to 14, May 1998–March 1999 (Sundar *et al.* in press); **Allahabad**, two, 1999 (Sundar *et al.* in press).

■ **Madhya Pradesh** Records are from: along c.18 km stretch of the Chambal river, 11, January 1987 (Scott 1989), and specifically within the **National Chambal Sanctuary**, Rampura to Kharoti, five, January 1994 (Sharma *et al.* 1995), 39, June 1999 (B. C. Choudhury *et al.* 1999), and near Ghandi Sagar reservoir, nine, February 1998 (*Oriental Bird Club Bull.* 27 [1998]: 61–66); **Gwalior district**, several along road to Shivpuri, February 1983, (R. Lévêque *in litt.* 1999), two, May 1998–March 1999 (Sundar *et al.* in press); **Morena district**, undated (Saxena 1998), specifically on the Sank river, six, June 1999 (B. C. Choudhury *et al.* 1999); **Karera Bustard Sanctuary**, at Dihaila jheel, two or three pairs breeding annually, 1980s (Rahmani 1986, 1987c, Rahmani and Manakadan 1987), five, June 1999 (B. C. Choudhury *et al.* 1999), and at Berkhera jheel, one pair annually, 1980s (Rahmani 1987c); Harsi lake, **Narwar district**, March 1938 (Ali and Whistler 1939–1940); **Shivpuri district**, one, May 1998–

March 1999 (Sundar *et al.* in press); **Madhav** (Shivpuri) **National Park**, at Chandpata jheel (Sakhya Sagar), four, February 1983 (R. Lévêque *in litt.* 1999), 250, January 1987 (Scott 1989, Johnson *et al.* 1993), and two, June 1999 (B. C. Choudhury *et al.* 1999); **Surwaya**, Chanderi, April 1938 (Ali and Whistler 1939–1940); **Guna district**, two, May 1998–March 1999 (Sundar *et al.* in press); **Nimach** (Neemuch), breeding, undated (Barnes 1886), and at Jeerun, c.19 km from Nimach, breeding, March 1885 (Barnes 1885, 1887); **Mandsaur district**, at Buy pond (14), Premtura (8) and Sanwat pond (2), all June 1999 (B. C. Choudhury *et al.* 1999); Sahaspura to **Barhi**, four, February 1994 (Sharma *et al.* 1995); Sagar lake (Saugor), breeding, undated (Moss King 1911) and at an unspecified locality in **Sagar district**, two, May 1998–March 1999 (Sundar *et al.* in press); **Damoh district**, two, May 1998–March 1999 (Sundar *et al.* in press); **Talod**, Mahikantha, one nesting pair, February 1909 (O’Brien 1909); **Bandhavgarh National Park**, November 1987 (Winkel 1988), two, June 1999 (B. C. Choudhury *et al.* 1999); **Umaria district**, at Jovivah (2), Panpatha (4) and Pariksheya (2), all June 1999 (B. C. Choudhury *et al.* 1999); **Bhopal district**, six, May 1998–March 1999 (Sundar *et al.* in press), specifically at Bhopal lake, January 1938 (Ali and Whistler 1939–1940); Gulgaon tank, **Sanchi**, January 1938 (Ali and Whistler 1939–1940); **Shajapur district**, two, May 1998–March 1999 (Sundar *et al.* in press); **Jabalpur district**, fairly common, undated (Hewetson 1956), specifically at Kundan tank, 42, June 1999 (B. C. Choudhury *et al.* 1999); **Sehore district**, 1908–1910 (Whitehead 1911), six, May 1998–March 1999 (Sundar *et al.* in press); **Raisen district**, two, May 1998–March 1999 (Sundar *et al.* in press); **Surguja**, undated (Beavan 1865–1868, Ball 1874, 1878); **Hoshangabad**, along the Narmada, undated (Hewetson 1956); **Indore district**, up to 64, May 1998–March 1999, including a “large flock” at Yashwanth Sagar reservoir, May 1998–March 1999 (Sundar *et al.* in press); **Mhow**, November 1894 (specimen in BMNH), 1927–1929 (Briggs 1931); Balwada tank, **Choral**, August–September 1938 (Ali and Whistler 1939–1940); **Mandu**, September 1938 (Ali and Whistler 1939–1940); **Kanha National Park**, at Khapa, a pair, April 1982 and nearby at Julluk, undated (Newton *et al.* 1987), a pair in the buffer zone until 1996, but then at least one shot (Sundar *et al.* in press); **Choli** tank, Mandleshwar, August–September 1938 (Ali and Whistler 1939–1940); **Seoni**, 1874 (male in BMNH); **Balaghat district**, fairly common, undated (Hewetson 1956), specifically at Bhondua, Parsatola and Paraswara, January 1912 (D’Abreu 1912); **Raipur**, fairly common, undated (Hewetson 1956), two, May 1998–March 1999 (Sundar *et al.* in press); **Raj Nandgaon district**, at Latmara (4) and Laxmi Levi Dam (1), both June 1999 (B. C. Choudhury *et al.* 1999); **Bastar**, undated (Ball 1878).

■ **Maharashtra** Records are from: **Bhandara**, fairly common, undated (Hewetson 1956), four, May 1998–March 1999 (Sundar *et al.* in press); Nizampur, **Dhule** (“Western Khandesh”), reported to be breeding, c.1880 (Davidson 1882) and Tapti, Dhule, one, April 1881 (Davidson 1882); **Chandrapur** (Chanda), in the Wardha valley, undated (Blanford 1871), and in Chandrapur district, at Erai dam (2) and Junonia lake (4), both June 1999 (B. C. Choudhury *et al.* 1999); **Santa Cruz**, Salsette, one, December 1908 (Symons 1909a); **Panvel** (Panwell), Salsette, one, 1897 (Symons 1909a); **Bombay** (Mumbai), several, 1900 (Ali and Abdulali 1936–1939).

■ **Andhra Pradesh** The species was listed for the state by Taher and Pittie (1989). Although it has been suggested that it never occurred so far south (Whistler and Kinnear 1931–1937), the following early records are accepted here but not mapped: Godaveri river and the Kistna (=Krishna) river, once or twice at unspecified locations, undated (Jerdon 1839–1840; also Hume and Marshall 1879–1881). There have been no recent records (A. Pittie verbally 1999).

■ **Bihar** Records are from: **Valmikinagar Sanctuary** (Valmiki Tiger Reserve), listed, undated (Anon. 1993a), with a pair reported nearby, May 1998–March 1999 (Sundar *et al.* in press); near Allumpur, here taken to be **Halimpur**, one adult and later two juveniles, 1900–1902 (Inglis 1901–1904); **Darbhanga district**, undated (Dalgleish 1902); **Saharsa district**, in Mahestri block, 25, June 1999 (B. C. Choudhury *et al.* 1999); **Vaishali district**, at Baraila chaur and Dulour Duha, nine, June 1999 (B. C. Choudhury *et al.* 1999); **Patna**, late 1990s (Sundar and Choudhury

1999); **Bhagalpur district**, Simal lake, 15, June 1999 (B. C. Choudhury *et al.* 1999); **Lohardaga**, undated (Ball 1878); **Singhbhum** (=Dhalbum) district, undated (Tickell 1848).

■ **Orissa** The only record is from: **Sambalpur**, north of Mahanadi, undated (Ball 1878).

■ **West Bengal** Records are from: **Jalpaiguri** and **Koch Bihar**, undated (Beavan 1865–1868), locally reported to persist, 1998–1999 (Sundar *et al.* in press); **Puruliya** (“Manbhum”), undated (Tickell 1848), undated (Beavan 1865–1868, Ball 1874, 1878); **Barrackpur**, undated (Beavan 1865–1868); Rasik beel (untraced), Atimochar district, “a few pairs” recorded as migrants in the late monsoon period, 1990s (B. C. Choudhury *in litt.* 1999).

■ **Assam** One report suggested that *G. a. antigone* occurred eastwards as far as Lakhimpur in Assam (Blanford 1895–1898), another that *G. a. sharpii* replaced it east of Kamrup (Baker 1922–1930). Both races are now rarely seen in Assam: there have been no records of *G. a. sharpii* for “several decades” while there are recent records of small numbers of *G. a. antigone* as far east as Tinsukia district (Choudhury 2000c). Records are from: **Dibru-Saikhowa National Park**, Dhadum pathar, two (*G. a. antigone*) in March 1994 (Choudhury 1995), unspecified numbers subsequently almost annual, maximum group-size of 16 in December 1998 (A. Choudhury 1998a, 2000c); **Dibrugarh**, undated (Hume 1888); **Digboi district**, 16, June 1999 (B. C. Choudhury *et al.* 1999); **Margherita**, nesting, undated (Baker 1922–1930); between Ting Kong and **Jaipur**, Dibrugarh district, 20, June 1883 (Hume 1888); **North Lakhimpur district**, pre-1881 (Hume 1888), occasional records, undated (Baker 1922–1930), but repeated trips along the Subansiri between Dhunsirimukh and Boduti, 1901–1911, failed to produce any records (Stevens 1914–1915); **Dehing river**, *G. a. sharpii* breeding, 1902–1903 (Baker 1922–1930); **Darrang district**, pre-1881 (Hume 1888); **Rangia**, Kamrup district, two, June 1999 (B. C. Choudhury *et al.* 1999); **Gauhati**, undated (Baker 1922–1930); **Jheel Par, Karbianglong district**, eight, June 1999 (B. C. Choudhury *et al.* 1999); **Hailakandi**, North Cachar, two, winter, 1894 (Baker 1894–1901).

■ **Meghalaya** The only records are from: **Shillong**, East Khasi Hills district, 12, June 1999 (B. C. Choudhury *et al.* 1999), and elsewhere in the district at Lady Hydari Park, nine, June 1999 (B. C. Choudhury *et al.* 1999).

■ **Manipur** Apart from the report that it was not uncommon at unspecified localities in the south of the Manipur valley until 1933 (Higgins 1933–1934), the only records are from: **Logtak (Loktak) lake**, pre-1881 (Hume 1888) and a “good number” recorded at the south end of “Kopum Thall” (apparently in Manipur, but not in “the basin”), pre-1881 (Hume 1888).

■ **NEPAL** The species occurs in the south-central and south-western lowlands (Inskipp and Inskipp 1991, Suwal and Shrestha 1988a, 1992b). Records are as follows: **Kanchanpur**, by local report, 1988 (Suwal and Shrestha 1988a), 1990–1992 (Suwal and Shrestha 1992b); **Royal Sukla Phanta Wildlife Reserve**, a pair nearby, 1997 (H. S. Baral *in litt.* 2000); **Kailali district**, at Bangara-ke-tan on the Mohana river, one, June 1988 (Suwal and Shrestha 1988a), 1990–1992 (Suwal and Shrestha 1992b); **Dhangarhi**, 300 m, one female, December, c.1950 (Rand and Fleming 1957); **Royal Bardia National Park**, very few records (Inskipp 1989), including one at Lamkauli phanta, June 1988 (Suwal and Shrestha 1988a), **Banke district**, around Dundwa creek, Rapti river and Nepalgunj, nine, June 1988 (Suwal and Shrestha 1988a), 1990–1992 (Suwal and Shrestha 1992b); **Dang district**, by local report, June 1988 (Suwal and Shrestha 1988a); near **Butwal**, a pair, March 1959 (Fleming 1959); **Kapilvastu district**, five, June 1988 (Suwal and Shrestha 1988a), confirmed breeding in 1988 (Suwal and Shrestha 1988a), 1990–1991 (Suwal and Shrestha 1992b); **Nawalparasi**, by local report, 1988 (Suwal and Shrestha 1988a), 1990–1992 (Suwal and Shrestha 1992b); **Royal Chitwan National Park**, a few reports, c.1980 (Gurung 1983, C. and T. P. Inskipp verbally 1997) and considered a vagrant in the park (Baral and Upadhyay 1998); **Lumbini Sanctuary**, and environs in Rupandehi district, 14, June 1988 and confirmed breeding in September 1988 (Suwal and Shrestha 1988a, Prentice and Shrestha 1989), 1990–1991 (Suwal and Shrestha 1992b), 70, April 1993 (*Nepal Bird Watching*

Club 2, 3 [1993]: 2, Baral 1996b), and c.50 remaining in this area, including 11 nesting pairs, until at least 1999 (Harris *et al.* 1998, Suwal 1999a,b).

■ **BANGLADESH** Rashid (1967) considered the nominate race a possible resident in western portions of the country and *G. a. sharpii* a possible resident in the north-eastern lowlands (although see Remarks 2 under Manipur Bush-quail *Perdica manipurensis*). The species was subsequently listed as a rare visitor to north Bangladesh and Chittagong (Khan 1982), although there is no direct evidence that it ever visited the latter. However, it is now extinct as a breeding species in the country and occurs only as an irregular vagrant (P. M. Thompson *in litt.* 1997). Records are from: **Thakurgaon**, a pair up to 1989 (Thompson *et al.* 1993), probably the “village in extreme NW” mentioned by Harvey (1990); **Mymensingh**, “not uncommon”, undated (Simson 1882); **Dhaka**, “not uncommon”, and an occasional visitor to a large jheel near the Bunser river north-west of the city, c.1880 (Simson 1882).

■ **MYANMAR** Early in the twentieth century the species was locally distributed throughout the country, breeding in Myitkyina district, around the Shweli river, and in the Shan hills (Smythies 1986). A young bird was seen in captivity at Loikaw, Karenni (=Kayah state), Myanmar, in 1982 (Sayer and U San Han 1983); it reportedly came from around Mong Pai lake, and a small population was thought to survive in the region. The species may now occur only as a vagrant (Khin Ma Ma Thwin *in litt.* 1998), although equally a small population may persist; surveys are needed to verify the situation. Records are from: **Pidaung Sanctuary**, a pair regular on Hopak marsh, March 1936 (Smith 1942); **Myitkyina** district, eight seen, and known to breed in the area, undated (Smythies 1986); **Hokat**, “many” in early June, 1930s (Stanford and Ticehurst 1938–1939); **Bhamo**, “recorded”, undated (Harrington 1909–1910); **Thazi**, Bhamo district, a pair “dancing” on the “Hnokkyo Et”, presumably near **Hnokkyo**, March 1927 (Smith 1942); **Singon**, pair with young, February 1927 (Smith 1942); **Kindat**, Chindwin, occasional, undated (Hopwood 1908); **Tonkwa**, Bhamo district, most marshes with “a pair or more”, February 1927 (Smith 1942); **Mabein**, Shweli river, February 1927 (Smith 1942); **Kinzan** (Kinsan), Shwebo district, two, November 1928 (Smith 1942); **Yeu canal**, Shwebo district, two, February 1931 (Roseveare 1949); **Kadu lake**, Shwebo district, one, August 1933 (Roseveare 1949); **Myingyan district**, undated (Macdonald 1906); **Heho swamp**, 25 km east of Kalaw, probably also wandering to the vicinity of Kalaw, c.1895 (Rippon 1896); **Mong Hsawk** (Fort Stedman), possibly at Inle lake, “a couple of parties”, 1899–1900 (Bingham and Thompson 1900); 1–30 km south of **Inle lake** (between this site and Mong Pai lake), small numbers, 1980s (Sayer and U San Han 1983, Scott 1989), two pairs near the lake, January 1996 (*Oriental Bird Club Bull.* 23 [1996]: 49–53); **Arakan**, *G. a. antigone* “not common”, c.1910 (Hopwood 1912b); **Toungoo** (Thoungoo), August 1875 (one egg in NMS), breeding nearby, undated (Wardlaw Ramsay 1877), around 1880 (Oates 1882), July 1911 (two eggs in NMS); **Mohingyi Wetland Sanctuary**, a “regular visitor” with one seen, February 2000 (U That Htun verbally 2000); **Thaton**, several flocks of up to c.60, August, “in mid-monsoon”, undated (Hume and Marshall 1879–1881); **Yangon** (label read as “Rangoon Turante”, probably referring to lowlands between Yangon and Twante), October 1917 (two eggs in NMS); **Pye** (Prome) (not mapped), recorded as a migrant, undated (Hume and Marshall 1879–1881; see Migration). There is an unconfirmed record from Myothit, in the Kachin hills of the far north, where unspecified numbers of “a large kind of crane” in marshes nearby were probably this species by description, c.1890 (Couchman 1893).

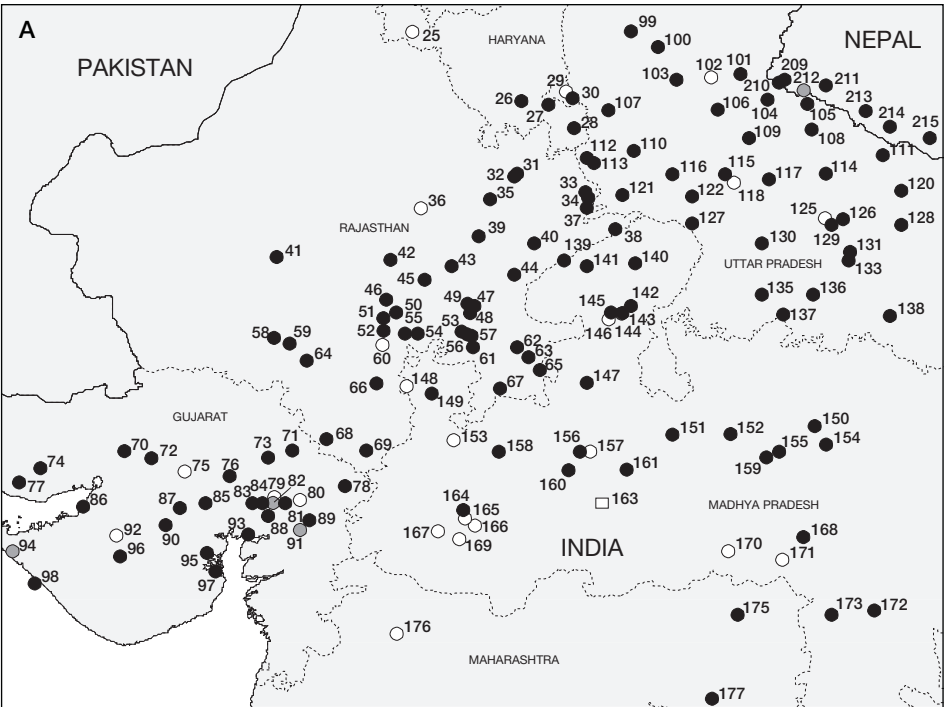
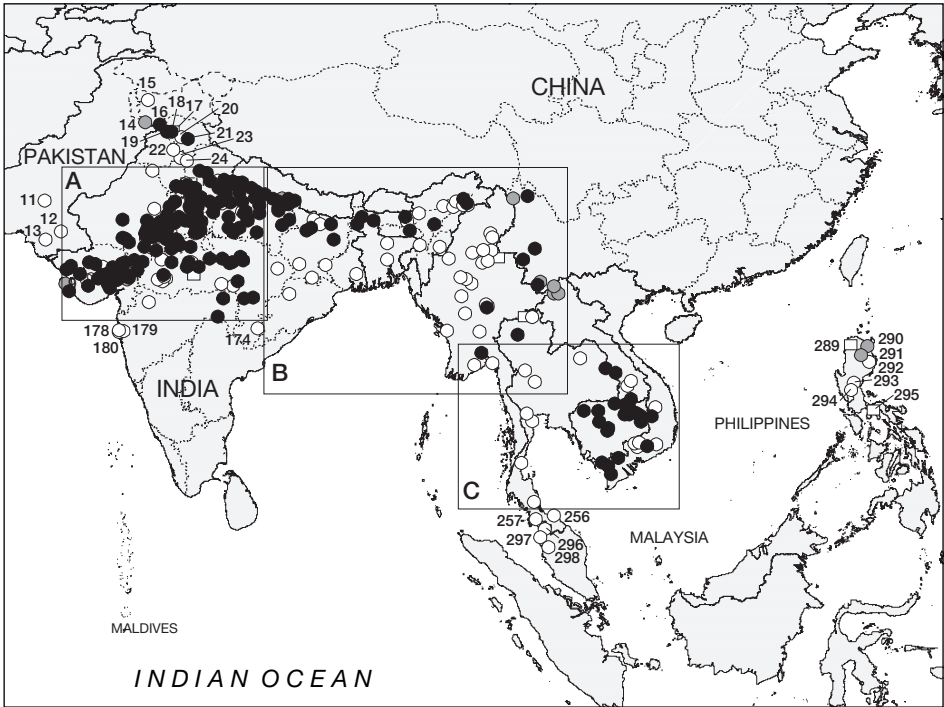
■ **THAILAND** The species was once common in the north (Deignan 1945), while in the south it was said to be “occasionally met with” in the peninsula (Robinson and Kloss 1921–1924). It is now extinct in the country (Round *et al.* 1988, Treesucon and Round 1990). Records are from: **Tha Ton**, previously recorded, but no details and no recent records (Scott 1989); **Chiang Rai**, “plentiful” in 1929 (Meyer de Schauensee 1930), “common”, 1930s

(Deignan 1945); **Chiang Mai**, in the 1930s “frequently seen during the cold weather flying north or south, high overhead” although they seemed “never to alight” (Deignan 1936a), now very rare (P. D. Round *in litt.* 1998); **Muang Fang**, nesting, July 1914 (Gyldenstolpe 1916); **Kamphaeng Phet**, Mae Ping valley, 8–10 regularly, April 1949, a nesting pair nearby in June 1949 (Madoc ms, 1950); **Nakhon Sawan** (Paknampho), km 40 on road to Khamphaeng Phet, two, April 1949 (Madoc ms); **Ratburi province**, without further details, 1910–1914 (Gairdner 1915); **Petchaburi province**, recorded without further details, 1910–1914 (Gairdner 1915); **Sawi bay**, south of Chumpon (Chumpong), April 1919 (Robinson and Kloss 1921–1924); **Songkhla lake**, early twentieth century (Medway and Wells 1976); **Pattani** (probably referring to all the territory now occupied by Pattani, Yala and Narathiwat provinces: D. R. Wells *in litt.* 2001), undated record (Robinson and Chasen 1936); **Satul**, undated (Hamilton 1923); about 10 km north of Ban Chong (untraced), undated (Meyer de Schauensee 1929); unspecified localities in the Central Plains (referring to the floodplain of the Chao Praya river), early twentieth century reports (Deignan 1963).

■ **LAOS** The species was encountered in the late 1920s and early 1930s in Salavan, Champasak and Attapu provinces (Delacour *et al.* 1928, Engelbach 1932). The remaining few individuals now occur in the extreme south and south-west of the country. Records are from: **Savannakhet**, reportedly scarce and localised, a pair in ricefields at Kong Kok (see Remarks 3), 1944 or 1945, being the only record during two years in the region (David-Beaulieu 1949–1950), and at Ban Kalon-Dong, one shot, June 1992 (Salter 1993); **Nong Louang**, Savannakhet, egg taken in 1987, bird still alive in captivity in Savannakhet town, 1992 (Salter 1993); near **Salavan**, 1925 (Delacour *et al.* 1928), groups of 4–5, undated (Engelbach 1932); **Xe Don**, undated (Delacour and Jabouille 1931), undated (Engelbach 1932); the **Xe Kong plains**, Xe Pian NBCA, two, and eggs reportedly taken, March 1989 (Salter 1993), two, April–May 1992 (Cox *et al.* 1992), two adults with a well grown juvenile, March 1993 (Thewlis *et al.* 1998); near **Ban Khiam** (Ban Khem), Dong Khanthung proposed NBCA, two at Nong Toom, August 1996, probably breeding (Barzen 1997, Evans *et al.* 2000), one observed, July 1998 (Round 1998); the **Dong Kalo plains**, Xe Pian NBCA, breeding reported in 1992 (Salter 1992); **Ban Xot**, Xe Pian NBCA, two adults and two chicks seen in 1995, a chick and four adults reported nearby, 1996 (Thewlis *et al.* 1998).

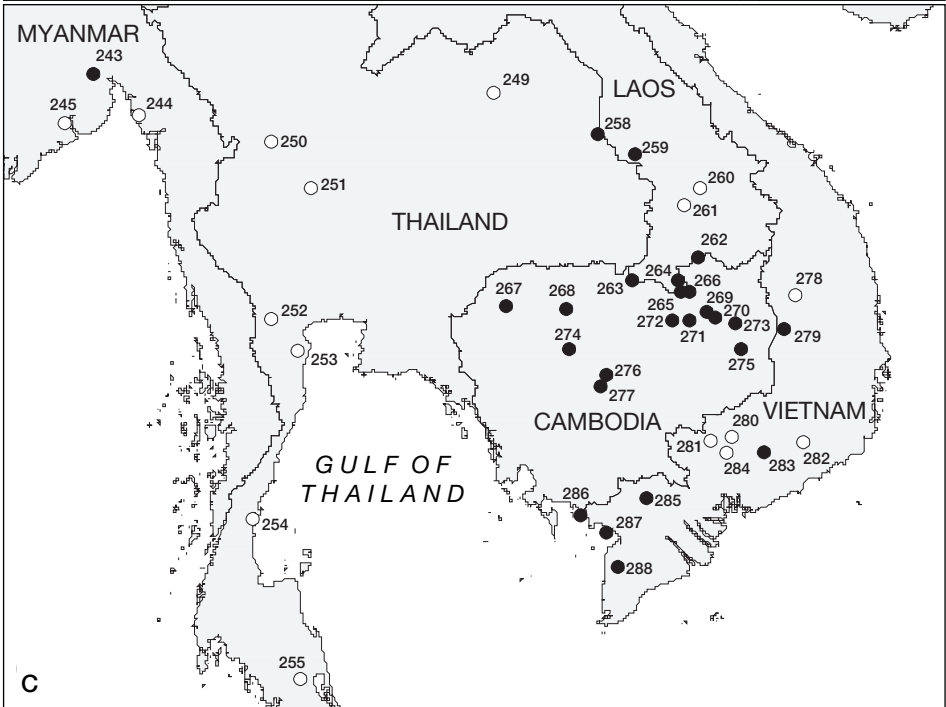
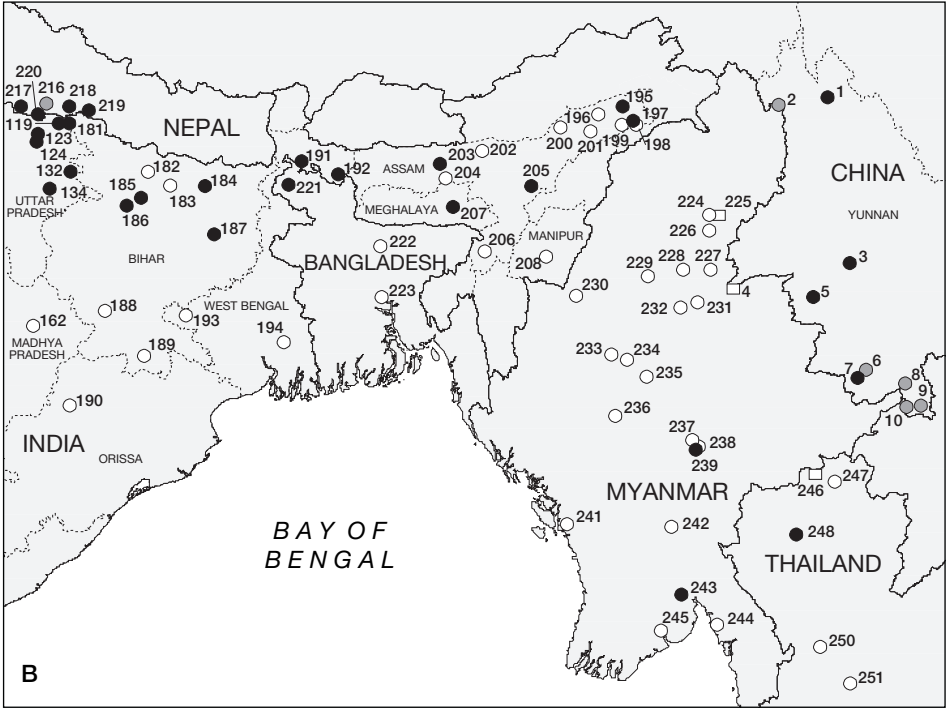
In addition, two birds held the Vientiane Inter Zoo were apparently taken as chicks from Champasak province in the 1980s (Salter 1993).

■ **CAMBODIA** The species was previously known from Svay Rieng, Kampot, Siem Reap, Kratie and Kompong Thom (Thomas 1964). Recent sightings and reports indicate that it remains regular in Banteay Meanchay, Siem Reap, Battambang and Ratanakiri provinces (Sun Hean *in litt.* 1997, C. M. Poole *in litt.* 1999), with breeding populations in Preah Vihear (S. Veasna *in litt.* 1999), Stung Treng (Keo Omaliss verbally 1999) and Mondulakiri provinces (C. M. Poole *in litt.* 1999). Records are from: **Vun Say district**, Ratanakiri province, two killed and a third apparently seen, January 1997 (Goes 1999a); **Ang Trapeang Thmor Reserve** (Phnom Srok), Banteay Meanchey province, 65–169, March 1998 (Anon. 1998, Veasna 1998a,b), 180–201, April 1998 (Veasna 1998b, Veasna *et al.* 1998), maximum of 80, June 1998 (Veasna 1998b), 20, March 1999 (F. Goes verbally 1999), 16, June 2000 (P. Davidson verbally 2000); **Svay Leu**, Siem Reap, 90–400 m, seven pairs in an area 18 km north-east of Phoum Kantout, with chicks collected, October 1993 (Mundkur *et al.* 1995a), breeding confirmed, 1996 (Sun Hean *in litt.* 1996); **Tonle San** (Sesan, San river), Ratanakiri province, breeding confirmed, 1994 (Sun Hean *in litt.* 1997); near Phum Sre Angkrong, **Kom Mum** district, Ratanakiri province, a chick collected 1993 (Mundkur *et al.* 1995a), and south of Trapeang Baye, two, June 1998 (Timmins and Soriyun 1998); **Tonle Srepok** (Srepok river), breeding pairs south of the river at two sites, August 1994 (Barzen 1994; see Timmins and Soriyun 1998); west of **Tonle Kong** (Kong river), August 1994 (Barzen 1994); near **Lomphat**, on Tonle



The distribution of Sarus Crane *Grus antigone* (maps opposite): (1) Nagpag Co; (2) Gongshan county; (3) Yunxian county; (4) Nongdao; (5) Mengjian; (6) Meng'a; (7) Mengzhe; (8) Menglun; (9) Mengla county; (10) Mengpeng; (11) Drigh Lake Wildlife Sanctuary; (12) Mirpurkhas; (13) Jhimpir; (14) Marala; (15) Kashmir valley; (16) Kathua district; (17) Dharmasala; (18) Kangra; (19) Pong Dam lake; (20) Mandi; (21) Banjar; (22) Chamkor; (23) Ambala; (24) Jagadhri; (25) Sirsa; (26) Bhindawas Wildlife Sanctuary; (27) Sultanpur National Park; (28) Palwal district; (29) Delhi; (30) Okhla; (31) Alwar district; (32) Sariska Wildlife Sanctuary; (33) Keoladeo National Park; (34) Aghapur; (35) Raisar; (36) Sambhar; (37) Bharatpur district; (38) Dholpur district; (39) Chaksu; (40) Sawai Madhopur district; (41) Jodhpur; (42) Ajmer district; (43) Tonk district; (44) Ranthambhore National Park; (45) Sonkhaliya; (46) Sareli; (47) Pai Balapur; (48) Talwasa; (49) Bundi district; (50) Bhilwara district; (51) Meja; (52) Mangalwad; (53) Bharda; (54) Mandalgarh; (55) Mandol; (56) Abhedra; (57) Ranpur; (58) Jawai Bandh; (59) Bijapur; (60) Gangrar; (61) Alania; (62) Kota district; (63) Atru; (64) Udaipur district; (65) Chhabra; (66) Chittorgarh district; (67) Jhalawar district; (68) Dungarpur district; (69) Banswara district; (70) Bhimasar; (71) Saberkanta district; (72) Wild Ass Sanctuary; (73) Ahmedabad district; (74) Devisar; (75) Kharaghoda; (76) Thol Lake Sanctuary; (77) Vijaysagar; (78) Panchmahal district; (79) Mahisa district; (80) Timbi; (81) Dakor; (82) Kanewal reservoir; (83) Pariej reservoir; (84) Kheda district; (85) Nalsarovar; (86) Jodiya; (87) Surendranagar district; (88) Anand district; (89) Vadodara district; (90) Sayala; (91) Ajwa; (92) Rajkot; (93) Khambhat; (94) Bhatia; (95) Velavadar National Park; (96) Veri; (97) Bhavnagar; (98) Porbandar district; (99) Hastinapur Wildlife Sanctuary; (100) Dhampur; (101) Udhm Singh Nagar district; (102) Bilaspur; (103) Moradabad; (104) Pilibhit district; (105) Dudwa National Park; (106) Bareilly district; (107) Bulandshahr district; (108) Kheri district; (109) Shahjahanpur district; (110) Aligarh district; (111) Bahraich district; (112) Chhata lakes; (113) Mathura district; (114) Sitapur district; (115) Farrukhabad district; (116) Etah district; (117) Hardoi; (118) Fatehgarh; (119) Sohagibarwa Wildlife Sanctuary; (120) Gonda district; (121) Agra; (122) Mainpuri district; (123) Pharenda; (124) Gorakhpur district; (125) Lucknow; (126) Nawabganj Priyadarshani Sanctuary; (127) Etawah; (128) Faizabad district; (129) Bara Banki district; (130) Kanpur Dehat district; (131) Maharaganj district; (132) Majhuali; (133) Rae Bareli district; (134) Mau district; (135) Hamirpur district; (136) Fatehpur district; (137) Banda; (138) Allahabad; (139) National Chambal Sanctuary; (140) Gwalior district; (141) Morena district; (142) Karera Bustard Sanctuary; (143) Narwar district; (144) Shivpuri district; (145) Madhav National Park; (146) Surwaya; (147) Guna district; (148) Nimach; (149) Mandsaur district; (150) Barhi; (151) Sagar district; (152) Damoh district; (153) Talod; (154) Bandhavgarh National Park; (155) Umaria district; (156) Bhopal district; (157) Sanchi; (158) Shajapur district; (159) Jabalpur district; (160) Sehore district; (161) Raisen district; (162) Surguja; (163) Hoshangabad; (164) Indore district; (165) Mhow; (166) Choral; (167) Mandu; (168) Kanha National Park; (169) Choli; (170) Seoni; (171) Balaghat district; (172) Raipur; (173) Raj Nandgaon district; (174) Bastar; (175) Bhandara; (176) Dhule; (177) Chandrapur; (178) Santa Cruz; (179) Panvel; (180) Bombay; (181) Valmikinagar Sanctuary; (182) Halimpur; (183) Darbhanga district; (184) Saharsa district; (185) Vaishali district; (186) Patna; (187) Bhagalpur district; (188) Lohardaga; (189) Singhbhum; (190) Sambalpur; (191) Jalpaiguri; (192) Koch Bihar; (193) Puruliya; (194) Barrackpur; (195) Dibru-Saikhowa National Park; (196) Dibrugarh; (197) Digboi district; (198) Margherita; (199) Jaipur; (200) North Lakhimpur district; (201) Dehing river; (202) Darrang district; (203) Rangia; (204) Gauhati; (205) Karbianglong district; (206) Hailakandi; (207) Shillong; (208) Logtak lake; (209) Kanchanpur; (210) Royal Sukla Phanta Wildlife Reserve; (211) Kailali district; (212) Dhangarhi; (213) Royal Bardia National Park; (214) Banke district; (215) Dang district; (216) Butwal; (217) Kapilvastu district; (218) Nawalparasi; (219) Royal Chitwan National Park; (220) Lumbini Sanctuary; (221) Thakurgaon; (222) Mymensingh; (223) Dhaka; (224) Pidaung Sanctuary; (225) Myitkyina; (226) Hokat; (227) Bhamo; (228) Hnokkyo; (229) Singon; (230) Kindat; (231) Tonkwa; (232) Mabein; (233) Kinzan; (234) Yeu canal; (235) Kadu lake; (236) Myingyan district; (237) Heho swamp; (238) Mong Hsawk; (239) Inle lake; (240) unallocated; (241) Arakan; (242) Toungoo; (243) Mohingyi Wetland Sanctuary; (244) Thaton; (245) Yangon; (246) Tha Ton; (247) Chiang Rai; (248) Chiang Mai; (249) Muang Fang; (250) Kamphaeng Phet; (251) Nakhon Sawan; (252) Ratturbi province; (253) Petchaburi province; (254) Sawi bay; (255) Songkhla lake; (256) Pattani; (257) Satul; (258) Savannakhet; (259) Nong Louang; (260) Salavan; (261) Xe Don; (262) Xe Kong plains; (263) Ban Kham; (264) Dong Kalo; (265) Ban Xot; (266) Yun Say district; (267) Ang Trapeang Thmor Reserve; (268) Svay Leu; (269) Tonle San; (270) Kom Mum; (271) Tonle Srepok; (272) Tonle Kong; (273) Lomphat; (274) Kompong Chikreng district; (275) Kaoh Nhek; (276) Srayov; (277) Baray district; (278) Pleiku; (279) Chu M'lang; (280) Phu Rieng; (281) Hon Quan; (282) Di Linh; (283) Cat Tien National Park; (284) An Binh; (285) Tram Chim Nature Reserve; (286) Ha Tien plain; (287) Hon Dat district; (288) U Minh Thuong Nature Reserve; (289) Ilocos Norte; (290) Cagayan province; (291) Tabuk; (292) Isabela province; (293) Nueva Ecija province; (294) Candaba marsh; (295) Lopez; (296) Kedah; (297) mainland Penang; (298) Kuala Kangsar.

○ Historical (pre-1950) ● Fairly recent (1950–1979) ● Recent (1980–present) □ Undated



Srepok, two, February 1994 (Henning 1994 in Timmins and Soriyun 1998), four over a seasonal meadow near Trapeang Daycrohom, May 1998, and three at Trapeang Pring, June 1998 (Timmins and Soriyun 1998); **Kompong Chikreng district**, breeding, chicks collected, July 1993 (Mundkur *et al.* 1995a), breeding confirmed, September 1997, birds present July–September (Sun Hean *in litt.* 1997); eastern **Kaoh Nhek** (Kohnhek) district, two heard at 13°0'N 107°06'E, June 2000 (R. J. Timmins *in litt.* 2000); Viel Snor Pen, 20 km west of Pota Oun, **Srayov** commune, Kompong Thom province, April, 1990s (Veasna 1999); Trapeang Rompeak, **Baray district**, Kompong Thom province, four, May 1999 (Veasna 1999); Poi Che Smach (untraced locality), four adults and one juvenile, January 1999 (F. Goes verbally 1999).

Unconfirmed or unspecific records are from: Veal Stoeng Kambot and Veal Rohal Srey, Battambang province, non-breeding populations, by local report (Seng Kim Hout *in litt.* 1998); southern Kompong Thom province, by local report (S. Veasna verbally 1998).

■ **VIETNAM** This species has only been recorded in the southern regions of the country, being absent from at least Quang Tri northward (Delacour and Jabouille 1925). Although it may once have nested in the Tram Chim region (Archibald 1988), there have been no recent confirmed breeding records (J. C. Eames *in litt.* 1997). Records are from: **Pleiku**, Gia Lai, common on the plateau between 1933 and 1936, often forming large flocks (David-Beaulieu 1939); **Chu M'lang**, Ea Sup district, Dac Lac, a fully grown immature at a pool by a logging road, June 1997 (Le Xuan Canh *et al.* 1997); **Phu Rieng** and Binh Phuoc, 1925 (Delacour *et al.* 1928); **Hon Quan**, Binh Phuoc, between 1929 and 1931 (David-Beaulieu 1932); **Di Linh** (Djiring), Lam Dong, 1925 (Delacour *et al.* 1928); **Cat Tien National Park**, Dong Nai, two flying over, February 2000 (J. C. Eames *in litt.* 2000, *Oriental Bird Club Bull.* 31 [2000]: 49–57); **An Binh**, 1925 (Delacour *et al.* 1928); **Tram Chim Nature Reserve**, Dong Thap, where maximum counts (usually December–April) since 1988 have been 1,052 in 1988, 665 in 1989, 741 in 1990, 814 in 1991, 365 in 1992, 187 in 1993, 271 in 1994, 302 in 1995, 631 in 1996, 511 in 1997, 503 in 1998 and 469 in 1999 (Nguyen Van Hung *in litt.* 1999; also see Archibald 1988, Patwahl 1992, Scott 1989), with small numbers in the wet season, e.g. one, August 1999 (Buckton *et al.* 1999); **Ha Tien plain**, Kien Giang, local reports of flocks of over 100 in dry seasons until 1997 (*Oriental Bird Club Bull.* 26 [1997]: 60–66), group of 135, April 1999 (Buckton *et al.* 1999); **Hon Dat district**, Kien Giang, 300 reported to spend the dry season in this area (Nguyen Cu *in litt.*

The distribution of Sarus Crane *Grus antigone* (maps B and C opposite): (1) Nagpag Co; (2) Gongshan county; (3) Yunxian county; (4) Nongdao; (5) Mengjian; (6) Meng'a; (7) Mengzhe; (8) Menglun; (9) Mengla county; (10) Mengpeng; (119) Sohagibarwa Wildlife Sanctuary; (123) Pharenda; (124) Gorakhpur district; (132) Majhauri; (134) Mau district; (162) Surguja; (181) Valmikinagar Sanctuary; (182) Halimpur; (183) Darbhanga district; (184) Saharsa district; (185) Vaishali district; (186) Patna; (187) Bhagalpur district; (188) Lohardaga; (189) Singhbhum; (190) Sambalpur; (191) Jalpaiguri; (192) Koch Bihar; (193) Puruliya; (194) Barrackpur; (195) Dibru-Saikhowa National Park; (196) Dibrugarh; (197) Digboi district; (198) Margherita; (199) Jaipur; (200) North Lakhimpur district; (201) Dehing river; (202) Darrang district; (203) Rangia; (204) Gauhati; (205) Karbianglong district; (206) Hailakandi; (207) Shillong; (208) Logtak lake; (216) Butwal; (217) Kapilvastu district; (218) Nawalparasi; (219) Royal Chitwan National Park; (220) Lumbini Sanctuary; (221) Thakurgaon; (222) Mymensingh; (223) Dhaka; (224) Pidaung Sanctuary; (225) Myitkyina; (226) Hokat; (227) Bhamo; (228) Hnokkyo; (229) Singon; (230) Kindat; (231) Tonkwa; (232) Mabein; (233) Kinzan; (234) Yeu canal; (235) Kadu lake; (236) Myingyan district; (237) Heho swamp; (238) Mong Hsawk; (239) Inle lake; (240) unallocated; (241) Arakan; (242) Toungoo; (243) Mohingyi Wetland Wildlife Sanctuary; (244) Thaton; (245) Yangon; (246) Tha Ton; (247) Chiang Rai; (248) Chiang Mai; (249) Muang Fang; (250) Kamphaeng Phet; (251) Nakhon Sawan; (252) Ratburi province; (253) Petchaburi province; (254) Sawi bay; (255) Songkhla lake; (258) Savannakhet; (259) Nong Louang; (260) Salavan; (261) Xe Don; (262) Xe Kong plains; (263) Ban Khiam; (264) Dong Kalo plains; (265) Ban Xot; (266) Vun Say district; (267) Ang Trapeang Thmor Reserve; (268) Svay Leu; (269) Tonle San; (270) Kom Mum; (271) Tonle Srepok; (272) Tonle Kong; (273) Lomphat; (274) Kompong Chikreng district; (275) Kaoh Nhek; (276) Srayov; (277) Baray district; (278) Pleiku; (279) Chu M'lang; (280) Phu Rieng; (281) Hon Quan; (282) Di Linh; (283) Cat Tien National Park; (284) An Binh; (285) Tram Chim Nature Reserve; (286) Ha Tien plain; (287) Hon Dat district; (288) U Minh Thuong Nature Reserve;

○ Historical (pre-1950) ● Fairly recent (1950–1979) ● Recent (1980–present) □ Undated

1997); U **Minh Thuong Nature Reserve**, Kien Giang, occasional reports of fewer than 10, until 1997 (*Oriental Bird Club Bull.* 26 [1997]: 60–66, Safford *et al.* 1998).

■ **PHILIPPINES** The species was formerly present in marshes and open plains adjacent to rivers on Luzon but this population (possibly an endemic race *G. antigone luzonica*: Hachisuka 1941) was evidently extirpated earlier this century (Dickinson *et al.* 1991). A search of Luzon in 1979 (Madsen 1981) failed to locate any birds and the species was thought probably extinct. Records are from **Ilocos Norte** (Dickinson *et al.* 1991), **Cagayan province** (McGregor 1909–1910), **Tabuk** in Kalinga-Apayao province (Johnsgard 1983), **Isabela province** (McGregor 1909–1910), **Nueva Ecija province** (McGregor 1909–1910), **Candaba marsh** (McGregor 1909–1910) and near **Lopez**, east of Tayabas, Quezon province (Dickinson *et al.* 1991).

■ **MALAYSIA** A former resident in the north-western coastal plains of Kedah and Perak, the Sarus Crane was apparently “occasionally met with” southward to Kuala Kangsar (Robinson and Kloss 1921–1924), but it is now extinct in the country (Wells 1999). Records are from: **Kedah**, one apparently sent live to London Zoo around 1900 (AMNH label data, Wells 1999); on the west coast plain south to **mainland Penang**, up to the 1920s and possibly later (Madoc 1950–1951, Glenister 1951; but see Remarks 4); **Kuala Kangsar**, Perak river, undated (Robinson and Chasen 1936).

POPULATION On the basis of the qualitative evidence accumulated over the past 150 years, it seems entirely plausible to suggest that the global population of the Sarus Crane has diminished to at best 10% and very probably 5% or even 2.5% of its numbers in 1850. The subspecies *sharpii* was once widespread and fairly common in South-East Asia and undoubtedly suffered a major decline in the last few decades (Scott 1992, Duckworth *et al.* 1999, Wells 1999). India has for many years been the species’s stronghold, but even here it is declining, primarily through the loss and modification of wetland habitat, compounded by the breakdown of traditional customs which once prevented persecution of the species (Gole 1989a, Parasharya *et al.* 1996; see Threats). Conversely, the Australian subspecies *G. a. gilliae* appears to be extending its range and population as a result of land-use changes, since increased cattle-grazing has caused a reduction of shrub cover and increased grass growth in and around temporary wetland depressions (Marchant and Higgins 1993, Meine and Archibald 1996); this may have allowed the population to expand eastward to the grain fields of the Atherton Tablelands, which serve as a dependable food source in the dry season (Meine and Archibald 1996). However, the exact trend is not clear.

The most up-to-date population estimates are: (1) *G. a. antigone*: 8,000–10,000 individuals and declining; (2) *G. a. sharpii*: 500–1,500 individuals and likely to be declining; (3) *G. a. gilliae*: fewer than 5,000 and trend uncertain (Meine and Archibald 1996, Rose and Scott 1997). Given the ongoing decline in the Indian population, it is quite possible (indeed probable) that the number of mature adults has fallen below 10,000 birds worldwide.

Mainland China The species is known in China by a few records from south-west Yunnan, but it was last seen in the early 1990s (Yang Lan *et al.* 1995; see Distribution), and any surviving population is presumably tiny.

Pakistan The Sarus Crane appears always to have been rare in Pakistan. Hume (1872–1873) only saw “one single specimen” in Sind during a trip down the Indus (with visits inland) in 1871–1872 and concluded that the species was “very rare in the province”. It was certainly absent from the northern and trans-Indus portions of this state (A. O. Hume, footnote to Butler 1875–1877). Whilst Hume did not visit the eastern portions of Sind, where the species may then have been commoner, other authors (usually on his authority) followed his precedent in pronouncing the species “rare” in the Indus region (Inverarity 1886–1888), and “very rare” (Barnes 1885) or “rather rare” (Ticehurst 1922–1924) in Sind. The assertion that it was apparently common in the dry season in Pakistan until the 1960s (Meine and Archibald

1996) is therefore inadmissible without fresh evidence. It once bred in small numbers in Pakistan but was recently considered extinct as a breeding bird (Roberts 1991–1992). However, since 1993 a few birds have been seen near the border with India (Meine and Archibald 1996), and in the late 1990s a very small breeding population was rediscovered in Sind (Sundar and Choudhury 1999, C. Mirande *in litt.* 1999).

India On the basis of early reports it seems likely that 150 years ago the Indian population of this species was in the order of hundreds of thousands of birds (see Distribution). A survey in the 1980s, however, suggested that only 10,000–12,000 survived (Gole 1989a). Further declines took place during the 1990s leading to a sense of unease about the status of the species in India (see B. C. Choudhury 1998, Sundar and Choudhury 1999). Between May 1998 and March 1999, two fairly comprehensive surveys were conducted throughout the country, covering a total of 112 districts in 11 states. The first survey enumerated 772 birds, and the second 989 birds (Sundar *et al.* *in press*). More recently, a nationwide census of the species was organised by the Wildlife Institute of India: the first count (June 1999) produced a total of 1,991 throughout India (B. C. Choudhury *et al.* 1999). It is not clear what proportion of the national total of Sarus Cranes this comprises, but it certainly suggests that the overall total is well below 10,000 individuals.

Population data are considered below by state. *Jammu and Kashmir* Although it was estimated that only four pairs remained in the state in 1999 (Sundar *et al.* *in press*), B. C. Choudhury *et al.* (1999) reported over 20 in Khatua district in the same year. The population is evidently small. *Himachal Pradesh* Early in the twentieth century the species was “not very rare” in some regions (Babault 1920). Through the remainder of the twentieth century, very few birds were encountered in the state; the total population is probably very small as local reports are infrequent and tentative (Sundar *et al.* *in press*). However, a small (and apparently increasing) population has recently been found in the Pong dam area (Sundar *et al.* *in press*). *Punjab* The species seems to have always been rare in Punjab and it has now apparently disappeared altogether (Sundar and Choudhury 1999, Sundar *et al.* *in press*). *Haryana* Beavan (1865–1868) described it as “especially common” in the neighbourhood of Ambala, although half a century later Whistler (1918) only saw two pairs during six months in this district. The state still supported a major population (c.500 individuals) in the 1980s, albeit largely restricted to protected areas (Gole 1989a). However, a prolonged drought in the 1990s desiccated the few wetlands surviving in a highly agricultural landscape with disastrous results. Flocks of up to 80 birds that regularly visited what is now Sultanpur National Park dwindled to a few individuals, and the current total population of the state appears to be in the region of 100–300 birds (Sundar and Choudhury 1999, Sundar *et al.* *in press*). *Rajasthan* It was once a “common resident” throughout the state (Barnes 1885), and “very common” around Sambhar lake (Adam 1873). By the 1980s, it was “confined to eastern and central parts” of Rajasthan, becoming “rarer further west” (Gole 1984). Its decline in numbers is highlighted in Keoladeo National Park, a site that supposedly once hosted the largest dry-season roost in India, with 400–600 non-breeding individuals regularly recorded during the 1960s–1980s (Walkinshaw 1973, Holman 1987, Scott 1989), and a fairly constant resident population of around 25 cranes (Ramachandran and Vijayan 1994). Unfortunately, while the breeding population has remained relatively stable, the number of visiting birds has dropped dramatically and large numbers are no longer recorded (V. Prakash verbally 2000). This reflects the decline in habitat availability in the extensive agricultural portion of the state (see Threats). In May 1998–March 1999, a ratio of 15 juveniles to 100 adults was estimated in Rajasthan, suggesting that recruitment rates remain fairly healthy (Sundar *et al.* *in press*). In 1998–1999, around a third of all individuals counted in a nationwide survey were observed in Rajasthan (Sundar *et al.* *in press*), confirming the importance of the state for the species. The total population is probably in the low thousands. *Gujarat* In the nineteenth century it was a “common resident” throughout the state (Butler 1875–1877, Barnes 1885), “breeding plentifully” in the marshes between Deesa and Ahmedabad (Hume and Oates

1889–1890), and was “common” in the Kathiawar peninsula (Lloyd 1873). Although Dharmakumarsinhji (1955) later stated that it was “commonly found” in Saurashtra (a former Indian state roughly equating to the Kathiawar peninsula), a more recent judgement is that it was “by no means common” in the area (Gole 1985). By the 1940s it had become uncommon in Kutch, but was still plentiful in the cultivated plains to the north (flocks of up to 18 were seen in winter) where it was tame and protected by local people (Ali 1954–1955). It was not recorded in Kutch during surveys in the 1980s (Gole 1989a) but during December 1998–March 1999 a “very high encounter rate” was reported from the area (Sundar *et al.* in press), suggesting that it may have increased recently. However, given the accumulation of potential threats to the species, a sharp decline is likely to occur in the near future (Khacher 1996). Recent evidence suggests that this decline has commenced, largely through conflict with farmers who persecute the species for the damage it causes to rice crops (Parasharya *et al.* 1996). Between 1989 and 1995, Sarus Crane density in areas of Kheda district declined from 0.370 birds/km² to 0.314 bird/km², and annual recruitment was very low (Parasharya *et al.* 1996). In 2000, 573 cranes were counted in this district, the drop in population being estimated at an alarming 62% since 1989 and 80% since 1984 (Mukherjee *et al.* 2000). Nevertheless, this state remains one of the most important for the species in India (Khacher 1996, B. C. Choudhury *et al.* 1999), and thus the world. The key districts in Gujarat for the species are Kheda, Ahmedabad and Ahmednagar (Sundar and Choudhury 1999). *Uttar Pradesh and Delhi* In the nineteenth century, this species was “generally distributed” in the wet season, but occurred in small scattered flocks wherever water remained in the dry season (Reid 1887). In the 1930s–1940s it was “very common” in the Bareilly district (Bates 1935) and “common” around Delhi, especially east of the Yamuna (Frome 1947–1948). More recently (c.1990), dry-season roosts near Hardoi contained around 500 individuals (Prasad *et al.* 1993), confirming that a large populations still survived at least locally. In the 1980s the adult/juvenile ratio (i.e. annual recruitment) was the lowest of all known populations (Gole 1989a). In May 1998–March 1999, a ratio of 12 juveniles/100 adults was estimated in Uttar Pradesh (Sundar *et al.* in press). Nevertheless, Uttar Pradesh apparently supports the largest existing population of the species in the world (Gole 1989a); the districts of Mainpuri, Etawah, Etah and Aligarh seem to be the most populous, with cranes often seen along roads and encounter rates of up to one per kilometre recorded during transects in 1998–1999 (Sundar *et al.* in press). *Madhya Pradesh* In the first half of the twentieth century the species was locally “fairly common” (Hewetson 1956), “abundant” at Sehore (Whitehead 1911), “numerous at all seasons” at Mhow (Briggs 1931) and “very plentiful” in parts of Balaghat district (D’Abreu 1912). A flock of 250 was counted in 1987, although this number was thought perhaps to include Demoiselle Cranes *Anthropoides virgo* (Perennou and Santharam 1990). In general, it has become “hard to come by” in the state, with numbers “generally low” perhaps because the chief crop is soyabeans rather than rice (Sundar *et al.* in press). A non-breeding population of around 50 birds still visits the National Chambal Sanctuary area (Sundar *et al.* in press). *Maharashtra* In Dhule district the species was regarded as a straggler even in the 1880s, although at least one pair may have bred (Davidson 1882). It remains rare (Abdulali 1981), with only a “small pocket” of breeding birds known (Sundar *et al.* in press). *Bihar* In Darbhanga district it was “occasionally seen during the cold weather” (Inglis 1901–1904, Dalgleish 1902), while at Singbhum (Dhalbum) it was “tolerably common” (Tickell 1848). Recently only very low numbers have been recorded, although this is at least partly because survey work has been hampered by security problems (Sundar *et al.* in press). A few very small breeding populations have been discovered in districts adjoining the Ganges, and these are augmented in the dry season by immigrants, presumably from Uttar Pradesh (Sundar and Choudhury 1999). *West Bengal* In Puruliya (Manbhum), the species was considered “tolerably common” by Tickell (1848), but later “rare” by Ball (1874), who found it mostly in the open valleys of Surguja. There were no records in the 1980s in the state (Gole 1989a), but in the 1990s “small populations” were reported in Koch Bihar and Jalpaiguri districts (Sundar *et al.* in

press), with further pairs migrating into Atiomochar district late in the monsoon (September–December) (Sundar and Choudhury 1999). *Assam* It was always relatively uncommon in the state (Baker 1894–1901, 1922–1930), although some early reports suggest that numbers were much higher than they are today; thus Hume (1888) described it as “common as far as the Darrang district” but rarer to the east. It is now “extremely rare” (Choudhury 1995). *Meghalaya* There are only two recent records of small numbers in the state (B. C. Choudhury *et al.* 1999). *Manipur* The subspecies *sharpii* was described as “not uncommon” by Higgins (1933–1934), who once saw a flock of 20–30. There are no recent records, although very little ornithological work has been undertaken.

Nepal In the 1870s the species was apparently “common in the Terai, and often kept in confinement in the Nepal valley” (Scully 1879). It is now largely confined to the south-central and south-western lowlands where recent surveys concluded that it was sparsely distributed, uncommon and declining on the basis of local reports, perhaps because of wetland loss and hunting (Suwal and Shrestha 1988a, 1992b). In Rupandehi and Kapilvastu districts 73 individuals were counted in 1990, and 79 in 1992 (Suwal and Shrestha 1992b). It is uncommon and local (Grimmett *et al.* 1999) with a population estimated as “small (200–500) and declining” (Meine and Archibald 1996) or fewer than 500 (Beilfuss 1999).

Bangladesh Simson (1882) reported that the species was “not uncommon” in the regions of Dhaka and Mymensing. Despite having once being “seen in quite good numbers”, it is now considered “rare” and “endangered” (Karim 1983a), there being very few recent reports and no recent records of breeding (P. M. Thompson *in litt.* 1999).

Myanmar In the nineteenth century, Oates (1882) described the Sarus Crane as “common in the vast plains of Lower Pegu” (southern Bago state), although even then he remarked that it was becoming “less common every year”. Similarly, Wardlaw Ramsay (1877) found it to be “tolerably common in the valley of the Sittang”. Smythies (1986), however, remarked that it was commonest in the northern parts of the country. Early in the twentieth century it (identified as *G. a. antigone*) was “not common” in Arakan province (Hopwood 1912b), while *G. a. sharpii* was “a rare and irregular visitor” to Myingyin district (Macdonald 1906), but “quite a common crane” in the Shan hills (Wickham 1929–1930). More recently, only irregular ones and twos have been reported, mostly in the south of the country, and it appears to have become very rare (Khin Ma Ma Thwin *in litt.* 1998). In the early 1980s there was a small population south of Inle lake (between there and Mong Pai lake) but this was declining markedly according to local reports and, if it still exists, it must be “seriously endangered” as there is now a dense human population in the area (Sayer and U San Han 1983; also Scott 1989).

Thailand The Sarus Crane was once widespread (Deignan 1936a, 1945), occurring “throughout the whole country, though always in limited numbers” (Gyldenstolpe 1920). Although Gyldenstolpe (1913) “seldom met with” it in northern Thailand, it was “plentiful” in the 1920s on the Chiang Rai plains (Meyer de Schauensee 1930). Indeed it was a “common permanent resident” in this area, and “often seen from the highways” (Deignan 1945). In addition, flocks comprising 8–40 birds were seen at intervals over Chiang Mai flying southward in winter in the 1930s (Deignan 1931, 1945). They never seemed to land around Chiang Mai, however, and Meyer de Schauensee (1930) described the area as intensively cultivated and therefore no longer suitable. This suggests that a population (probably of birds that bred in Myanmar) may have once visited the marshy central plains to the south, although these are now devoid of cranes. While there are no definite breeding records from the peninsula, tame captive birds seen by W. L. Abbott in Trang in the 1890s (Riley 1938) were likely to have been raised in the vicinity (Wells 1999) and the species was still “common at two or three places” in Trang around 1900 (Riley 1938) and “not uncommon” in the northern Thai-Malay peninsula (probably in reference to Trang) (Robinson and Chasen 1936). Despite historically being so widespread and numerous in the region, it is now extinct in the country (Treesucon and Round 1990).

Laos The species was encountered regularly in the late 1920s and early 1930s in groups of 4–5 in the open forests of the southern provinces (Delacour *et al.* 1928, Engelbach 1932). As far north as Savannakhet, it arrived in the wet season to feed in seasonal marshes, although it seemed to be quite scarce and very localised (David-Beaulieu 1939–1940). Numbers evidently crashed in the next 60 years, leaving very few individuals by the 1990s. A tiny breeding population remains in Dong Khanthung proposed NBCA and Xe Pian NBCA; the Dong Khanthung population is feared to have declined from 5–6 pairs in 1990 to perhaps a lone individual in 1998 (Round 1998), and the species is fast approaching extinction in the country.

Cambodia Early twentieth-century reports described the Sarus Crane as less numerous than Woolly-necked Stork *Ciconia episcopus* (which itself was “incredibly numerous”), but nevertheless “very abundant” in the region of Phnom Penh, Siem Reap, Kompong Thom and Angkor, constantly seen in wetlands along the roads (Delacour 1924b, 1928). It was also reportedly “abundant” in the north-west of the country in the 1920s (Delacour 1929b). By the 1960s, however, it was thought “uncommon but widespread, occurring wherever the broad grassy plains it inhabits are found” (Thomas 1964), and in the next three decades it became apparent that an alarming decline was under way (C. M. Poole *in litt.* 1998). In the 1990s, an important gathering place was discovered at Ang Trapeang Thmor, Banteay Meanchay, where up to 200 cranes were recorded (Anon. 1998, Veasna 1998a,b). During a recent survey of Ratanakiri, birds were encountered infrequently and in small numbers, such that Timmins and Soriyun (1998) concluded that there are no large breeding concentrations in north-east Cambodia. Breeding was confirmed in March 1961 (Thomas 1964), and several nests have been recorded recently (Barzen 1994, 1995). Sun Hean (*in litt.* 1997) guessed that 350 pairs might survive in the country, and this is probably fairly accurate, as around 700 individuals congregate at non-breeding sites in Cambodia and Vietnam and almost all of these must breed in Cambodia (R. J. Timmins *in litt.* 2001).

Vietnam Historically, the species occurred in pairs or small parties in south Annam (central Vietnam), and Cochinchina (south Vietnam; Delacour *et al.* 1928). In 1924, for example, it was often seen from the road in south Vietnam (Delacour and Jabouille 1925), and locals reported that in the 1950s cranes were breeding commonly in the Mekong delta (Le Dien Duc 1987). It has clearly declined dramatically throughout Vietnam, as it is now scarce and highly local (see Distribution). By 1980 it was believed to be extinct in the Mekong delta, largely as a result of wartime conflict, but in 1984 local officials reported that it had returned to the Plain of Reeds (Meine and Archibald 1996). This was confirmed in 1986 when a flock spent the dry season at an impoundment known as Tram Chim (Meine and Archibald 1996). The wintering flock that centres on what is now Tram Chim National Park has numbered between 400–600 in recent years (Nguyen Van Hung *in litt.* 1999). Satellite-tracking has shown that at least some of the Tram Chim birds spend the wet season in the Preah Vihear province and Lompat (Ratanakiri province) areas, Cambodia, where they presumably breed (S. T. Buckton *in litt.* 2000). Locals in the Ya Lop and Chu M’Lang areas of Dac Lac province are familiar with the species and report that it is still a regular visitor in small numbers to this region (Le Xuan Canh *et al.* 1997).

Malaysia Although said to range from Thailand south along the western plain to the Perak river (Robinson and Chasen 1936), the species was not mentioned by Kelham (1881–1882) who worked in the Perak valley in the late 1870s, suggesting that it was at best only occasional that far south (Wells 1999). The population on this plain persisted until at least the 1920s (Hamilton 1923) and possibly later (Madoc 1950–1951, Glenister 1951), but it is now extinct (Wells 1999).

Philippines It was formerly present in marshes and open plains adjacent to rivers on Luzon but this population was evidently extirpated in the twentieth century (Dickinson *et al.* 1991). Searches in the 1970s and 1980s were unsuccessful (Madsen 1981, Dickinson *et al.* 1991).

ECOLOGY Habitat The species frequents a variety of wetland habitats, as well as cultivation and meadows, apparently preferring a mixture of flooded, partially flooded and dry ground (Desai 1980, Gole 1989a, 1991b, Ramachandran and Vijayan 1994, del Hoyo *et al.* 1996). It is more able to utilise dry habitats than many other crane species (Hume 1868, Baker 1922–1930, Ali and Ripley 1968–1998, Gole 1991b) and this flexibility is partially responsible for its successful adaptation, until recent decades, to the changing environment (Ramachandran and Vijayan 1994). Moreover, as natural wetlands have diminished in extent, the species has adopted man-made wetlands as its home (see below).

In Keoladeo National Park, Rajasthan, observations revealed that individuals spend most time in “moderately wet grassland”, followed by “dry grassland” and then “flooded grassland”, and the frequency with which these different habitats are utilised varies seasonally (Ramachandran and Vijayan 1994). In Nepal, a study at Lumbini also showed that habitat preferences varied with season, and partly according to crop rotation (Suwal 1994a,b). In addition, wetlands such as paddyfields, streams and mud pools are important during the monsoon and dry season; after the rice harvest, birds spend more time on stubble (Suwal 1994a). In general, the species favours wetland habitats during the breeding season, and indeed will not breed if water levels are insufficiently high (Reid 1881, Smythies 1986, Ali and Ripley 1968–1998). The quantity of water in Keoladeo National Park plays a major role in determining the breeding population of the species from year to year (Ramachandran and Vijayan 1994).

The majority of sightings during 1998–1999 Indian surveys were made in agricultural fields (particularly rice and wheat, birds tending to avoid soyabean and sugarcane), revealing the importance of man-made habitats (Sundar *et al.* in press). In Kota district, Rajasthan, the quantity of water extracted from the Chambal river for agricultural purposes has led to reduced flow and the drying up of many wetlands previously used by Sarus Cranes (Vyas 1996). These have been replaced by man-made tanks (i.e. reservoirs), dams, seepage marshes and inundated crop-fields, habitats now used by the species for feeding, breeding and roosting (Vyas 1996). The commonest foraging sites in the region are now inundated fields (55.9%) followed by seepage marshes (21.6%), tanks (10%), dams (7.5%) and canals (5%) (Vyas 1996). While artificial wetlands are thus important, the bunded tanks, ponds and canals that abound in certain regions are often unsuitable as they have steep bare banks; thus natural wetlands are much more often used (Sundar *et al.* in press). Bird appears to tolerate a fairly broad range of water acidity: Walkinshaw (1973) found that water at Keoladeo National Park was quite alkaline (pH 9.0) while a nest in a sewer pond at Vadodara (Baroda) was surrounded by almost neutral water (pH 7.2.).

The eastern subspecies *sharpii* occurs on both the level lowlands and high plateaus of South-East Asia, usually preferring grassy plains to paddyfields or marshes (Delacour *et al.* 1928, Smythies 1986). Baker (1922–1930) suggested that this subspecies inhabited less open wetlands than the nominate form, preferring smaller marshes, often surrounded by forest. Certainly the grassy plains and marshy pools which the species visited in Myanmar were sometimes surrounded by thick cover (Smythies 1986), while it appeared to prefer dry, park-like country with a few ponds in Cambodia (Delacour 1929b), and in Vietnam it was mostly encountered in shrubby marshes (David-Beaulieu 1932). The current Cambodian breeding grounds are on seasonally flooded natural grassland bordered by dipterocarp forest (Sun Hean *in litt.* 1997, Timmins and Soriyun 1998). However, observations in Tram Chim National Park indicate that (at this non-breeding site) it prefers areas with fluctuating water levels and consequently lower vegetation height (Patzwahl 1992), and some recent records in Cambodia have been from burnt ricefields (F. Goes verbally 1999). This suggests that *sharpii*, like *antigone*, probably uses a variety of habitats, partly in response to seasonal variations in availability and foraging requirements. During the wet season in Australia birds of the race *gilliae* are “most common in woodlands adjoining shallow flooded plains, especially low woodlands of paperbark *Melaleuca* with grassy understory” (Marchant and Higgins 1993).

In Keoladeo National Park, individual home ranges of the nominate subspecies were estimated to cover 40–61 ha (Walkinshaw 1973). The mean daily range of five cranes (two pairs and a singleton; i.e. $n=3$) studied at Lumbini, Nepal, was slightly larger at 71.5 ha, while the mean daily distance covered was 3.1 km (Suwal 1994a). During the nesting period the mean home range for these birds dropped to 40 ha, while in the non-breeding season it was much larger, around 763 ha, as birds wandered widely in search of food (Suwal 1994a).

Food Sarus Cranes are omnivorous and have been recorded eating seeds, grains and small fruit of various kinds, vegetable matter including shoots of grasses, the roots of aquatic plants and the pods of ground nuts *Aracharis*, amphibians (mainly frogs), reptiles (mainly lizards, but also water snakes), insects (particularly grasshoppers) and molluscs, including terrestrial and aquatic snails (Hume and Marshall 1879–1881, Baker 1922–1930, Dharmakumarsinhji 1955, Ali and Ripley 1968–1998, Walkinshaw 1973, Johnsgard 1983). Their diet sometimes includes freshwater fish of various sizes (Hume and Marshall 1879–1881, Law 1930), and they have also been reported eating the eggs of birds, including Spotted-billed Duck *Anas poecilorhyncha* (Gole 1987), Laughing Dove *Streptopelia senegalensis* (Gole 1989a) (by “dislodging an incubating” adult: Gole 1999) and Spotted Dove *Streptopelia chinensis* (Sundar in press). There is also a report of cannibalism or cronism; an adult feeding on the remains of its chick in Uttar Pradesh, India (Xavier 1995). In Vietnam, during the non-breeding season, birds consume the rhizomes of *Eleocharis ochrostachys*, but apparently will not eat the much commoner but acid-tolerant *E. dulcis* (Tran Triet verbally 1999). In Australia, they apparently spend much time in cornfields consuming the shoots and seeds of native grasses (Lavery and Blackman 1969). When feeding in water, they tend not to wade deeper than 30–45 cm (Baker 1922–1930, Johnsgard 1983).

Diet is, of course, dependent on foraging site. In Keoladeo National Park individuals were observed probing in wetlands for molluscs, snakes and the rhizomes of *Nymphaea*, *Scirpus tuberosus* and *Eleocharis plantaginea*, but on dry land they foraged for insects and seeds picked from grasses (Ramachandran and Vijayan 1994). During the non-breeding season Indian birds tend to move into agricultural areas and feed on wheat husks and waste gram *Cicer arietinum* (Walkinshaw 1973, Ramachandran and Vijayan 1994), or strip grains from paddy rice, occasionally causing extensive crop damage (Parasharya *et al.* 1986, Parasharya *et al.* 1996).

Breeding Season Breeding seasonality is variable according to climatic conditions, with almost all breeding activity coinciding with periods of high rainfall (Anderson 1871a, Reid 1881, Smythies 1986). Given this flexible breeding season, and the lack of long-distance migration, the reproductive potential of the species is probably higher than most other crane species (Johnsgard 1983).

In the Indian subcontinent the main breeding season is after the monsoon rains, between July and October (Reid 1887, Ali 1954–1955, Ali and Ripley 1968–1998), although breeding has been recorded throughout the year except for May–June (del Hoyo *et al.* 1996). In many areas, two breeding peaks have been reported, namely the main “post-monsoon” season and a secondary “spring” season with some nests active between January and April (see, e.g., Anderson 1871a, Barnes 1887, Bulkley 1893, O’Brien 1909, Mosse 1910, Moss King 1911, Baker 1922–1930, Bates 1924–1926, Walkinshaw 1973, Vyas and Kulshrestha 1989, Ramachandran and Vijayan 1994, Vyas 1999b). Spring breeders are thought perhaps to consist of pairs whose nests failed in the post-monsoon period (Vyas 1999b), but it seems likely that if water levels are suitable the species will breed at any time of year (Bates 1924–1926, Gole 1989a).

The breeding season of *G. a. sharpii* is synchronised with the South-East Asian monsoon. Breeding by this race in Assam has been recorded in June, perhaps because of the earlier onset of rains in that region (Baker 1922–1930). In Myanmar, it generally occurs between July and October (with another record from March) and there is a Thai record from July (Walkinshaw 1973). An egg and a newly hatched chick were found in late September in Pegu (Bago) state, Myanmar (Wardlaw Ramsay 1877, Hume and Oates 1889–1890). Breeding in

Cambodia is also likely to follow the wet season, July–October (Mundkur *et al.* 1995a), this assertion being supported by eggs and a well-grown chick in August in the north-east (Barzen 1994). In Vietnam, birds previously nested in the Mekong delta during the rains, which generally fall between May and October (Archibald 1988). Eggs and young have been found in northern Australia from January to July (Walkinshaw 1973, Marchant and Higgins 1993).

Nest site Nests are usually in exposed positions in temporary or permanent shallow swamps, allowing a good view of the surroundings (Reid 1887, Baker 1922–1930). At Keoladeo National Park, nests are usually built in raised portions of the landscape, often in the corner of territories and invariably surrounded by water 15–150 cm deep; in 1985, nine of 11 nests were on thick grass while two were on *Acacia* mounds (Ramachandran and Vijayan 1994). Sites were apparently selected so that open grass expanses lay in one or two directions, allowing good visibility, although nests on grass mounds were surrounded by sprouting grasses such as *Paspalum distichum* and the incubating bird could only be seen when it raised its head; at all nests studied, shallow-water feeding areas were available within 100–150 m of the nest site (Ramachandran and Vijayan 1994). In Kheda district, Gujarat, 11 (52.4%) of 21 nests in two years were sited in paddyfields, while the rest were in marshy areas (Parasharya *et al.* 1996); further research showed that 97.14% of nests in this region were in “agricultural marshland”. In Rajasthan, birds were reported breeding primarily in man-made wetlands (Vyas 1996).

Nest structure The nest is usually a “huge irregular mass of vegetation pulled up by the roots” (Smythies 1986) and varying greatly in size; it may be c.3 m broad at the base, c.1 m broad at the top and c.0.9–1.2 m high (Baker 1922–1930). Nesting materials vary from site to site depending on the available vegetation; material is seldom brought to the nest from any distance, adults more frequently reaching from the nest area and pulling whatever vegetation they can reach within a 1–1.5 m radius (Ramachandran and Vijayan 1994). In Keoladeo National Park, the commonest nesting material is *Paspalum distichum*, which is also the commonest grass in the park; other materials included *Acacia* twigs and *Sporobolus helvolus* (Ramachandran and Vijayan 1994). Rushes are sometimes woven to form a raft that floats on fairly deep water (e.g. Hill 1930). In Uttar Pradesh and Gujarat, nests in paddyfields sometimes had the platform constructed entirely from rice stalks (K. S. G. Sundar *in litt.* 1999). Other detailed descriptions of nests are given by Anderson (1871a), Reid (1887), Hume and Oates (1889–1890) and Baker (1932–1935).

Behaviour, clutch size and incubation The species is sexually mature at 2–3 years (del Hoyo *et al.* 1996). As with other cranes, it is monogamous, pairs generally staying together for life and behaving as “inseparable companions” (Baker 1922–1930, Smythies 1986). Both pair members tend to remain in the vicinity of the breeding territory for around one month before nest building begins (Ramachandran and Vijayan 1994).

Between one and three eggs are laid (Smythies 1986). Baker (1922–1930) stated that clutches of only one egg occur “frequently”, although more recent studies suggest that they might be relatively uncommon. Of 132 nests in India, four (3%) contained one egg, 126 (95%) contained two eggs and two (2%) contained three eggs (Walkinshaw 1973). At Keoladeo National Park, nine (82%) contained two eggs and two (18%) contained only one egg (Ramachandran and Vijayan 1994). Of 33 nests in south-east Rajasthan, 23 (70%) contained two eggs while the remainder had only one egg and none had three eggs (Vyas 1999b). Twenty-three nests studied in Gujarat contained a total of 25 eggs (c.0.5 per nesting attempt), suggesting low clutch sizes in the area, perhaps as a result of persecution and nest robbery by people (Parasharya *et al.* 1996). Although the sample sizes are a little small to draw any broad conclusions, three-egg clutches appear to be becoming scarcer and one-egg clutches more frequent in India: no three-egg clutches have been reported since 1973, although K. S. G. Sundar (*in litt.* 1999) observed a family with three juveniles in Barthara, Uttar Pradesh, in September 1999. On this evidence it has been suggested that average clutch size is decreasing as a result of deteriorating habitat quality (Ramachandran and Vijayan 1994).

There is an interval of around 48 hours between the laying of first and second eggs (Ali 1927). Both sexes contribute to incubation (although the female apparently takes the larger share: Walkinshaw 1973), and this period usually lasts 31–36 days, sometimes as little as 28 days (Ali 1927, Lahiri 1955, Archibald 1974, Breeden and Breeden 1982, Ramachandran and Vijayan 1994). After hatching, the juvenile accompanies the adults on the first day, the first-hatched chicks remaining within 1 m of the nest while the second egg is incubated to hatching (Ramachandran and Vijayan 1994). Juveniles fledge at 85–100 days (del Hoyo *et al.* 1996) and then usually remain with their parents until they are “nearly full grown” (Baker 1922–1930), which has been estimated at three months in captivity (Rothschild 1930), around six months (Ramachandran and Vijayan 1994), or 10 months (Walkinshaw 1973). While chicks can feed independently when only two days old (Klika 1974), they are fed by their parents for a prolonged period (Johnsgard 1983).

Breeding success Baker (1922–1930) remarked that “even when two young are hatched it is seldom that more than one survives for more than a few days”. However, two offspring are successfully raised with some regularity in various regions. For example, 23 (70%) of 33 pairs laid two eggs in Rajasthan, and eight of these pairs (35%) were seen with two chicks (Vyas 1999b). Occasionally, three juveniles are seen with adults (K. S. G. Sundar *in litt.* 1999) suggesting that it is possible for all to be raised successfully. However, of 21 eggs at Keoladeo National Park in 1984–1985, only eight (38%) hatched and seven (33%) fledged (Ramachandran and Vijayan 1994), suggesting that breeding success is fairly low. Sundar *et al.* (in press) reported seven juveniles/100 adults (n=772) in summer (May–October) and 13 juveniles/100 adults (n=989) in winter (December–March) throughout the species’s range in India. Gole (1989a) reported 14 juveniles/100 adults in an earlier survey, and Vyas (1999a) reported 19 juveniles/100 adults, largely in Rajasthan. These data suggest relatively high recruitment when compared with earlier studies on Sandhill Crane *Grus canadensis*, in which 3.5–4.3 juveniles/100 adults were recorded in 1972–1973 in Canada (Miller and Hatfield 1974). The proportion of post-breeding pairs with two chicks was also calculated in Gujarat (14.8%), Rajasthan (16.7%) and Uttar Pradesh (23%) (Sundar *et al.* in press), figures which tally well with studies on other crane species that generally lay two eggs, such as Whooping Crane *G. americana* (14.5%), Common Crane *G. grus* (24%) and White-naped Crane *G. vipio* (27%) (Johnsgard 1983).

Migration In India, the species is largely resident though subject to local seasonal movement, in particular through shifts in habitat preference and availability (Baker 1922–1930, Ripey 1982, Sundar *et al.* in press; see Habitat). In Lucknow, for example, it was widely distributed in the wet season and concentrated on a few wetlands during the dry season, but was essentially resident (Reid 1887), while recent nationwide surveys have tended to report it in similar districts in both wet and dry seasons (Sundar *et al.* in press). More substantial movements occur only in response to monsoons and droughts (Ali and Abdulali 1936–1939, Walkinshaw 1973, Meine and Archibald 1996).

Early reports suggested that the species was resident in Indochina (Laos/Cambodia/Vietnam) (Delacour and Jabouille 1925) but it is now known to make regular seasonal movements. The bulk of the population evidently spends the dry season (January to April) at Tram Chin in Vietnam and Ang Trapeang Thmor Wildlife Reserve, Cambodia (see Distribution), breeding in northern and eastern Cambodia (Timmins and Soriyun 1998, R. J. Timmins *in litt.* 2001) and in extreme southern Laos (Round 1998). In nineteenth-century Myanmar, flocks arrived during the mid-monsoon (August) near Thaton and also flew over Pye (Prome) (Hume and Marshall 1879–1881). It has been suggested that the Pye and Thaton birds comprised “numbers of the Upper Burma [northern Myanmar] birds, coming south near the Gulf of Martaban to breed” (footnote to Livesey 1937). In the 1930s it was frequently recorded between 8 December and 23 March flying high, “north or south”, over Chiang Mai, Thailand, during cold weather (Deignan 1936a). The latter evidence suggests that some populations once moved south into Thailand for the winter/non-breeding season (i.e. the

converse of the previous suggestion), although it was apparently also a “permanent resident” on the Chiang Rai plains of Thailand (Deignan 1945); cold-weather movements might thus have merely involved local Thai breeders. The migration patterns (seasonal or otherwise) of the Thai and Myanmar populations are difficult to judge, and, now that the species is extinct in Thailand and very rare in Myanmar, they will probably never be known.

Some Australian birds undertake regular seasonal migration between their breeding grounds on the Cape York peninsula and non-breeding grounds in the eastern part of the peninsula, a distance of about 400 km (Marchant and Higgins 1993).

Flocking and roosting The species is somewhat less sociable than other crane species, usually living in pairs or small family groups (Walkinshaw 1973, Johnsgard 1983). In the non-breeding season, however, it sometimes congregates in large numbers at certain wetlands, mostly when wetlands are scarce in the dry season and for the purpose of roosting, an activity that involves gathering at secure sites (usually in shallow water) where predation is minimised (Walkinshaw 1973; also footnote to Livesey 1937, Ramachandran and Vijayan 1994; see Remarks 5). Even at these large gatherings, pair or family units are maintained (Walkinshaw 1973, Sundar *et al.* in press). Congregations of over 400 *G. a. antigone* have, on occasion, been recorded at Keoladeo National Park (Breedon and Breedon 1982, Holman 1987), while groups of over 200 have been recorded regularly in Uttar Pradesh and Gujarat (Acharya 1931, Sundar *et al.* in press). In South-East Asia, *G. a. sharpii* has been observed in non-breeding flocks of up to 60 in Myanmar (Hume and Marshall 1879–1881) and at least 300 (totalling up to 1,000 at a single site) in Vietnam (Archibald 1988, Scott 1989). Roosts at Keoladeo National Park tend to be occupied from sunset (between 18h45 and 19h50 in summer) until 30–45 minutes before sunrise, at which time the birds disperse to foraging areas (Ramachandran and Vijayan 1994). Walkinshaw (1973) reported that around 80% of roosting birds departed before sunrise. Roosting also varies with water levels, numbers dispersing from the park in June when the rains arrive (Ramachandran and Vijayan 1994). The species tends not to mix with other cranes, although has occasionally been recorded flocking and roosting with Siberian Cranes, Common Cranes (Johnsgard 1983) and Brolgas (Lavery and Blackman 1969).

THREATS The Australian population of this crane is less threatened than those in Asia because of beneficial land-use changes and favourable attitudes to conservation in the country (Meine and Archibald 1996; see under Population). In Asia, as with many other large waterbirds, the species is primarily threatened by a combination of habitat loss and modification (owing primarily to agricultural expansion), pollution and persecution, and it has been extirpated from large proportions of its historical range and hugely reduced in numbers in the areas which it still occupies.

Habitat loss, modification and disturbance *India* The primary threat is the conversion of wetlands to agricultural use, a factor which reduces the number and extent of sites suitable for feeding and breeding (Gole 1989a, 1991a). During the 1999 Sarus Crane census throughout India, the major threat listed by participants was the spread of agriculture to the shores of wetlands (B. C. Choudhury *et al.* 1999). Habitat availability is also reduced by mud removal activities, vegetation clearing, vegetation overgrowth and reclamation (B. C. Choudhury *et al.* 1999). At least until recently, large numbers of Sarus Cranes depended on Keoladeo National Park in the dry season because most other wetlands in the region had been drained or disturbed; this contraction of available habitat reduced the carrying capacity of the area (Ramachandran and Vijayan 1994). These large numbers now no longer occur at the park (V. Prakash verbally 2000) and it appears that habitat loss has caused a population collapse in the region. In Gujarat the species is threatened by intensive cultivation of rice (Khacher 1996) and it has apparently disappeared from Punjab largely owing to massive conversion of wetlands to cultivation, such as sugarcane (Sundar *et al.* in press). Another threat in Gujarat is the rapid industrialisation of wetlands and the consequent decline in available habitat

(Mukherjee *et al.* 2000). Wetland drainage and conversion to agriculture has also been blamed for the recent reduction in breeding success in south-east Rajasthan with “increased human movement, population pressure and loss of suitable breeding grounds” being implicated (Vyas 1999b). However, while the species has undoubtedly suffered from the disappearance of wetlands, it has to some extent been compensated by agricultural activities that provide food in the form of waste grain. In several regions (e.g. southern Uttar Pradesh and central Gujarat), Sarus Cranes have tolerated conversion of wetlands to agricultural use where the cropping pattern involves a summer rice crop and cultivation of wheat in winter; but where the cropping pattern involves sugarcane cultivation in summer (e.g. northern Uttar Pradesh), populations are correspondingly low, and in areas where cropping patterns have shifted from rice to soyabeans (e.g. most of Madhya Pradesh) crane habitat has become severely restricted or has been lost altogether (K. S. G. Sundar *in litt.* 1999).

The threats faced by wetlands in India often derive from their situation in a heavily populated landscape (Scott 1989). Another of the main threats to the species mentioned by participants of the 1999 Sarus Crane Survey in India was the disturbance caused by fishing at its favoured wetlands (B. C. Choudhury *et al.* 1999). As another example, maintenance of an adequate water supply during drought conditions in the face of competition for aquatic resources by human populations is a major problem at Keoladeo National Park, and has led to heavy siltation of the canal feeding the park (Ramachandran and Vijayan 1994) and an erratic water supply to the wetland (Samant *et al.* 1995). Sultanpur National Park is threatened by increasing siltation caused by soil erosion in the catchment area, excavation of sand for nearby lime and brick industries, cutting of vegetation for fuel and fodder by large numbers of people, and heavy cattle-grazing (Scott 1989); these factors, combined with a recent drought in Haryana, have resulted in the sanctuary drying up and the number of Sarus Cranes recorded declining correspondingly (K. S. G. Sundar *in litt.* 1999). Although man-made wetlands are very important for the species in Rajasthan, commercial exploitation of *Typha* and wasteful use of stored water are additional threats (Vyas 1996). In Madhya Pradesh, Dihaila jheel was considered threatened by peripheral intensive land use, siltation, disturbance, overfishing and heavy grazing, while Chandpata lake was disturbed by boating and road traffic (Scott 1989). The low (33%) fledging success reported at Keoladeo National Park in 1984–1985 was largely due to egg loss through predation by “crows” (one case), trampling by cattle (one case), human disturbance (two cases) and unknown causes (two cases) (Ramachandran and Vijayan 1994). Recent research also suggests that annual recruitment in the Uttar Pradesh population has been unusually low in recent years (Gole 1989a, Sundar *et al.* *in press*), although reasons for this remain unclear. As this region supports the largest remaining population of the species, these trends are particularly alarming.

Some threats to wetlands result from poor management: at Keoladeo National Park the spread of aquatic vegetation after grazing control was initiated in 1982 caused a drastic reduction in the amount of open water; management of vegetation (e.g. *Paspalum distichum*, *Vetiveria zizanioides*, etc.) is now necessary, possibly through controlled grazing (Scott 1989). At Singhrana taal (in Sohagibarwa Wildlife Sanctuary) and where up to 50 Sarus Cranes once gathered, the authorities lifted a ban on fishing in order to reduce the amount of water hyacinth on the lake; as a result, fishermen indeed removed the plant in large quantities, leaving it rotting on the banks, but simultaneously also removed most of the aquatic fauna with nets of illegally small mesh-size and apparently disturbed most of the waterbirds from the lake (Rahmani and Qurieshi 1991).

Nepal The eradication of malaria, and subsequent colonisation of the terai in the 1960s brought about massive diminishment in the area of natural habitat available to the species (Peet 1997, Harris *et al.* 1998). Drainage of wetlands and their conversion to agriculture is thought to be the most important factor underlying the decline in Nepal (Prentice and Shrestha 1989). Where the agriculture involved is rice cultivation, however, and where disturbance by

people is sufficiently low, cranes still survive (R. N. Suwal *in litt.* 2000). The conversion of agricultural fields to village settlements, housing and other developments is thus a more damaging trend (H. S. Baral *in litt.* 2000). Furthermore, a highway constructed between Bhairahawa and Kapilvastu is thought to have caused disturbance (Suwal and Shrestha 1992b), and livestock are thought to pose a threat to nesting cranes, occasionally eating or trampling their eggs (Suwal and Shrestha 1988a). There are apparently plans to plant trees in the wetlands at the Lumbini Sanctuary, proposals that might reduce habitat availability (Prentice and Shrestha 1989). *Bangladesh* Massive human population expansion in Bangladesh into the twenty-first century (110 million inhabitants in 1990, apparently destined to double by 2020) will undoubtedly exert huge pressure on wetlands and their resources, with potentially disastrous effects on their associated fauna (Scott 1989, Wallace 1993). This process has already seemingly eradicated the species from Bangladesh and, unless suitably large areas are properly protected, it is unlikely to return. *Myanmar* Disturbance by people and loss of habitat in the remaining areas where pockets of Sarus Cranes still occur continue to reduce its population in the country (Scott 1989). *Thailand and Malaysia* In Thailand wetlands are heavily disturbed and drained (Round 1988a, Round *et al.* 1988, TISTR 1991); in reference to the main area in peninsular Thailand where the species once occurred, Round (1988b) stated that "the swamps of Trang have disappeared almost without trace". Indeed it seems that all suitable wetland areas in the Thai-Malay peninsula have become so disturbed or reduced in extent that none is likely to have the capacity or security to sustain even captive-bred birds (Wells 1999). *Cambodia* As well as conversion of their wet grassland habitat to rice paddy, Sarus Cranes are threatened by human disturbance in the dry season (Sun Hean *in litt.* 1997, Timmins and Soriyun 1998). Temporary settlements during the dry season along the margins of rivers and wetlands cause considerable disturbance to large waterbirds (Veasna 1999). In Kompong Thom province, for example, around 30% of wetlands were thought to be seasonally settled by people from other regions who came to plant crops such as pulses, melons, maize and pumpkin (Veasna 1999). These areas tended to be avoided by feeding large waterbirds, a situation that looks likely to deteriorate with the increase in the number of settlers (Veasna 1999). One of the key threats to the main breeding population in South-East Asia is the inexorable spread of human settlements into remote regions; this tends to proceed along rivers and involve the ploughing and cultivating of the seasonal meadows favoured by the species for foraging and nesting (R. J. Timmins *in litt.* 2001; see Threats under Giant Ibis *Thaumatibis gigantea*). *Vietnam* The Mekong delta region was subject to intensive bombing with explosives and toxins during the Vietnam War and huge areas of wetland habitat were destroyed (Le Dien Duc 1987). After the war, widespread drainage of wetlands occurred, further diminishing areas suitable for cranes (Le Dien Duc 1987). The main threat posed is the continued conversion of seasonally inundated grassland to rice cultivation; this not only results in loss of available habitat, but also leads to deterioration of adjacent areas, through changing water levels (and subsequent acidification of soils) and increased disturbance (Buckton *et al.* 1999). At Tram Chim National Park the lack of breeding records has been attributed to high year-round water levels caused by a dam that surrounds the wetland, resulting in vegetation too dense and tall for nesting attempts (Patzwahl 1992). An account of further problems at the park appears under Bengal Florican *Houbaropsis bengalensis*. *Laos* Wetlands have been largely modified in the historical (and potential) range of the species; in particular, they are frequently settled by human populations and used for fishing, rice cultivation (most of the Mekong floodplain in southern Laos has been converted to rice paddy), livestock grazing and grass harvesting (Thewlis *et al.* 1998, Duckworth *et al.* 1999). If Dong Khanthung proposed NBCA is established as a protected area as planned, it faces difficulty through increased immigration leading to agricultural development and habitat loss (Round 1998). *Philippines* Habitat destruction, especially the drainage and disturbance of wetlands, is thought to have been a significant factor in the species's demise (Dickinson *et al.* 1991).

Pollution India During the 1999 India-wide Sarus Crane census many participants noted the pollution of wetlands with domestic and industrial waste, pesticides and fertilisers (B. C. Choudhury *et al.* 1999). The use of pesticides on agricultural lands surrounding Bharatpur is believed to have caused a reduction in the numbers of cranes in the area (Muralidharan 1992). Eighteen individuals found dead in the 1989–1990 winter were found to contain high residues of aldrin in the intestinal tract (Muralidharan 1992). Industrial effluents also poison the waters of the national park (Ramachandran and Vijayan 1994). In Gujarat the species is threatened by refuse disposal at some sites, with toxic effluent and fertiliser run-off increasingly disrupting wetland ecology and reducing breeding success (Khacher 1996, Mukherjee *et al.* 2000). Logtak lake in Manipur is threatened by an inflow of domestic sewage, pesticides and fertilisers that has caused severe eutrophication (Scott 1989). Both Demoiselle Cranes and Common Cranes wintering in the Kathiawar peninsula, Gujarat, have recently been recorded suffering from disease, probably mycotoxicosis caused by the fungus *Aspergillus flavus* contracted by foraging on infected groundnuts *Arachis hypogea* (Soni *et al.* 1999). Sarus Cranes in the area are perhaps liable to suffer the same fate. **Nepal** The use of agrochemicals in the terai of western Nepal is probably threatening the small remaining population of the species in the country, although this has proved difficult to verify (Prentice and Shrestha 1989).

Persecution Although protected by local custom in some areas, hunting of this species is still common in others (see Remarks 6). Furthermore, cranes are at significantly higher risk than most other large waterbird species while breeding, as they nest on the ground (Duckworth *et al.* 1999). **Pakistan** Roberts (1991–1992) asserted that the birds’ “absence from Pakistan is testimony to their vulnerability to, and intolerance of, human interference”; hunting levels in the country are high and this is thought to be a major cause of the species’s rarity, although it has apparently never been common. **India** It was once generally thought that local sentiments, religious or otherwise, kept this species safe from persecution in most parts of its range (Ali and Ripley 1968–1998, Archibald *et al.* 1981, A. R. Rahmani *in litt.* 1998; see Remarks 6). However, traditional taboos against hunting or killing cranes are breaking down (Meine and Archibald 1996, Sundar and Choudhury 1999). Sporadic poaching incidents occur almost throughout, while eggs are apparently consumed as a cure for tuberculosis in Rajasthan (Sharma 1996); increasing levels of egg collection for food and medicinal purposes has been suggested as a cause of declining recruitment (K. S. G. Sundar *in litt.* 1999). Furthermore, the proportion of India’s human population holding the species in a favourable light for religious or cultural reasons is now matched (and in Uttar Pradesh, one of the most important states for the species, exceeded) by one that considers it to be an agricultural pest (Sundar *et al.* in press). In Gujarat, where it was once “clothed in sanctity and protected by the inhabitants” (Ali and Abdulali 1936–1939), the population decline is attributable to persecution by farmers who blame their reduced rice crops on cranes (Parasharya *et al.* 1996). The species has been shown in some areas to strip ripening grains for food and collect large quantities of freshly transplanted paddy rice stems to construct nests, and this is a source of growing conflict (Parasharya *et al.* 1996). Hunting of cranes has recently been recorded in both Jammu and Kashmir and Punjab, two states from which the species has almost disappeared, but farmers more commonly remove eggs to control crane populations (Sundar *et al.* in press). According to Parasharya *et al.* (1996), about 50% of eggs laid in 23 nesting attempts in Gujarat were stolen by animals or people. Hunting is especially common in north-east India (Choudhury 2000c); it has apparently reduced waterbird populations at Logtak lake, Manipur (Scott 1989), and Sarus Crane is probably now extinct in the area. **Nepal** Prentice and Shrestha (1989) reported that cranes in the Lumbini area were very tame, concluding that it was “unlikely that local people pose a threat ... through hunting and persecution”. However, modern settlers and visitors are less charitable (Suwal 1994a): “rampant hunting” of cranes and other waterbirds now occurs, and regular hunting visits are made by “foreigners” to Kapilvastu district, sometimes resulting in crane mortalities, although the major threat there is nesting failure, apparently often caused by children stealing eggs from nests or

trapping chicks (Suwal and Shrestha 1992b). In 1992–1993 recruitment was calculated at 4.5% in the Lumbini population, a very low figure thought probably to relate to man-induced nest failure (Suwal 1994a). *Bangladesh* Local people used to believe that “great misfortune will happen to any person who kills one” (Simson 1882), but the strength of this belief must have waned as the species was apparently driven to extinction in the country by a combination of habitat loss and persecution (Karim 1983a). *Myanmar* Few people carried guns until the 1920s and most birds were therefore “tame as tame” (Stanford 1954). Little is known about current hunting practices in the country, but it is thought that persecution and poaching increased dramatically with the widespread availability of firearms (U Tun Yin 1954). Hunting is thus likely to be a threat, particularly in northern and eastern areas where firearms are widely available owing to security problems, and indiscriminate hunting is frequent, including inside protected areas (Scott 1989, Rabinowitz *et al.* 1995, Saw Han 1996). *Thailand* As with all other large birds, the Sarus Crane is routinely shot by villagers if encountered, the casualties being offered for sale to zoos (P. D. Round *in litt.* 1999). It is unlikely that it could ever become re-established in the country given the current high level of persecution (P. D. Round *in litt.* 1999). *Laos* All waterbirds have suffered grievously during the twentieth century in Laos because of high levels of hunting and intense disturbance of almost all wetlands; nests of Sarus Crane in particular are easily accessible and very few local people would hesitate to collect the eggs or young (Thewlis *et al.* 1998, Duckworth *et al.* 1999). The eggs and chicks of the few remaining pairs are plundered annually for food or sale (Thewlis *et al.* 1998). Even if the last surviving individuals in Dong Khanthung proposed NBCA were to breed successfully, human pressure is probably now too intense for a population of the species to survive (Round 1998). If the site is established as a protected area as planned, it faces difficulty through increased hunting (see also Round 1998). The practice of keeping captive cranes in southern Laos (Engelbach 1932) probably also contributed to the decline. *Cambodia* Eggs and chicks are regularly taken from nests in Cambodia (Sun Hean *in litt.* 1997, Timmins and Soriyun 1998). In Prey Veng province, the species was apparently caught by villagers with dogs during the annual moult (Le Dien Duc 1987). The non-breeding congregation at Ang Trapeang Thmor are seriously threatened by hunting, with birds being shot for food, poisoned or trapped for trade to Thailand (Anon. 1998). Ominously, recent information reveals that, along with several other large waterbirds, it is trapped at night in some areas (including Kompong Thom province) using torches to dazzle roosting birds; casualties are then kept as pets, zoo exhibits or eaten (Veasna 1999). This threat, along with the ubiquity of guns, has led to precipitous declines in large waterbird populations in the country (Veasna 1999). *Vietnam* In the 1950s local people used to hand-rear the species in the Mekong delta and keep them as captive (or free-flying) pets; between 1968 and 1975 military personnel apparently hunted cranes from helicopters for food and sale in Ho Chi Minh city (Saigon) (Le Dien Duc 1987). Eggs and chicks are (or were when the species bred in the country) regularly taken from nests (Le Xuan Canh *et al.* 1997). *Philippines* There is a report of individuals moulting their flight feathers being pursued by hunters on horseback and lassoed (McGregor 1909–1910). In combination with habitat destruction, hunting is thought to have been responsible for the species’s demise here in the country (Dickinson *et al.* 1991).

Miscellaneous Sarus Crane fatalities occasionally result from collisions with high-tension power cables (see Suwal and Shrestha 1992b, Vyas 1996, Shrestha 1999, Sundar and Choudhury 1999, Mukherjee *et al.* 2000), and this may be a serious cause of mortality in some areas. Trading in adults has been recorded from India, Cambodia and Thailand (Hill *et al.* 1996) but is not thought to constitute a major threat.

MEASURES TAKEN *Legislation* The species is listed on Appendix II of CITES. It receives full legal protection in all range countries (although appearing only on Schedule IV of the Indian Wildlife Act 1972). Of the 10 Asian countries where it is found, eight are signatories to Ramsar (the exceptions are Laos and Myanmar).

Protected areas *Extralimital* Australia's Sarus Cranes occur mainly outside protected areas, although they winter and breed in Lakefield National Park and have been occasionally reported from Kakadu National Park (Meine and Archibald 1996). *India* Sarus Cranes are found scattered throughout private and village lands with only a small proportion of the population occurring in protected areas (Meine and Archibald 1996, Sundar *et al.* in press). Those in which the species has been recorded are as follows: Pong Lake Sanctuary in Himachal Pradesh; Keoladeo National Park, Ranthambhore National Park and Sariska Wildlife Sanctuary in Rajasthan; Bhindawas Wildlife Sanctuary and Sultanpur Bird Sanctuary in Haryana; Thol Lake Sanctuary, Velavadar National Park and Wild Ass Sanctuary in Gujarat; Dudwa National Park, Hastinapur Wildlife Sanctuary, Nawabganj Priyadarshani Sanctuary, Okhla Barrage Bird Sanctuary (Delhi/Uttar Pradesh), Parrate-Arga Sanctuary, Patna Sanctuary, Saman Sanctuary, Samaspur Sanctuary and Sohagibarwa Wildlife Sanctuary in Uttar Pradesh; Karera Bustard Sanctuary, Madhav National Park and National Chambal Sanctuary in Madhya Pradesh; Valmikinagar Sanctuary in Bihar; Dibru-Saikhowa National Park, Assam. The Uttar Pradesh forest department has decided to designate Saman Sanctuary as a special sanctuary for the Sarus Crane, and proposes to redirect its management accordingly (K. G. S. Sundar *in litt.* 1999). As protected areas play a relatively minor role in the conservation of this species, the management of agricultural land and the provision of artificial wetlands assumes added significance. The construction of artificial waterbodies (dams, reservoirs and percolation tanks) and seepage of irrigation canals (e.g. the Upper and Lower Ganga canals, Sharda Canal and their distributaries) has created numerous wetlands (e.g. Sheka jheel and Qasimpur Bamba in Aligarh district) which partly compensate for habitat losses; in Uttar Pradesh alone, the length of major irrigation canals is about 1,957 km, covering an area of 8,818 km² (Gole 1989a). These man-made wetlands are one of the major hopes for the species's continued survival. *Nepal* The Sarus Crane occurs occasionally in Royal Sukla Phanta Wildlife Reserve (155 km²) and Royal Bardia National Park (968 km²). A small breeding population of the species exists in the holy gardens of Lumbini (the traditional site for the birth of Siddhartha Gautama) where wetlands have been artificially restored and 120 ha has been leased by ICF (Harris 1992, Suwal 1994a, Shrestha 1999). The Lumbini Development Trust, in association with ICF and Nepalese crane conservationists, are carrying out community aid programmes in combination with ecosystem management in the area (Beilfuss 1999). Recently ICF took out a 50-year lease on 265 acres (unclear whether this includes or is in addition to the 120 ha mentioned above) to establish the Lumbini Crane Conservation Centre; this project is extending in scope and is now working to restore wetlands in the surrounding areas (Beilfuss 1999). *Myanmar* The species has been recently recorded at Moyingye Wetland Reserve. *Laos* It occurs at Xe Pian NBCA and Dong Khantung proposed NBCA (but see Remarks 4 under Masked Finfoot *Heliopais personata*). *Cambodia* A 126 km² wetland reserve at Ang Trapeang Thmor was established in 2000, to the north of a 21 km dam built during Khmer Rouge rule; fortunately, this dam has created a large area of suitable habitat for the species and several other scarce wetland and grassland birds, although there are some pressing threats which might undermine this protected area (*Bird Conserv. Internatn.* 9: 283–286, Veasna 1999, C. M. Poole *in litt.* 1999). *Vietnam* A protected area was established at Tram Chim as a result of its importance for cranes, and this was granted national park status in 1998 (Buckton *et al.* 1999); the primary management goal is to meet the requirements of both the cranes and the surrounding human population. One of the only other areas in Vietnam where Sarus Cranes are still regularly recorded is the Ha Tien plain, Kien Giang province, where local authorities have some sympathy for the conservation of this species (Buckton *et al.* 1999). To date, however, no specific measures have been taken (S. T. Buckton verbally 2000).

Research and education *India* The Wildlife Institute of India has taken a lead role in organising a nationwide collaborative census of this species to provide synchronised population counts from hundreds of wetlands throughout the country, the first such effort taking place in June 1999 and involving 609 participants at 389 wetland sites in 16 states (B. C. Choudhury *et*

al. 1999). *Thailand* Efforts to re-establish the species through a captive-breeding project jointly developed by ICF and the Royal Forest Department (Round *et al.* 1988) were unsuccessful (P. D. Round *in litt.* 2001). *Laos* Posters highlighting the plight of large waterbirds and an appeal to stop hunting have been distributed in southern Laos by WCS, and amongst other species these feature an illustration of the Sarus Crane (W. G. Robichaud verbally 1997). *Cambodia* The species is included in awareness material (books and posters) produced and distributed by Wildlife Protection Office as part of an ongoing campaign to reduce waterbird exploitation (Veasna 1999, C. M. Poole *in litt.* 1999). Educational videos have also been shown to villagers, emphasising the laws prohibiting hunting and the need to conserve large waterbirds (Veasna 1999).

Miscellaneous In India aldrin, which has been implicated in cases of Sarus Crane poisoning, was added to the list of illegal pesticides in the India in January 1994 (Muralidharan 1992). In Laos the government is having notable success in controlling gun ownership in some regions, a measure that in Vietnam may have benefited populations of large waterbirds (J. W. Duckworth *in litt.* 1999).

MEASURES PROPOSED The most important measures to ensure the survival of the species are the preservation of relatively undisturbed wetlands or wet grasslands, the maintenance of suitable agricultural practices and the minimisation of persecution. Conservation programmes for the South and South-East Asian populations should be viewed separately as there are two quite divergent taxa involved. If a concerted effort to achieve the following proposals is made, and if they are publicised, modified where necessary and built on, then there is every chance that this magnificent bird can live alongside the human population of the Asian lowlands.

Legislation Meine and Archibald (1996) suggested that the species be upgraded from CITES Appendix II to Appendix I (this normally requires concrete evidence of international trade as more than an incidental threat), and that countries yet to ratify the Ramsar Convention (i.e. Laos and Myanmar) should be encouraged to do so. Trade restrictions are required with strong penalties to discourage dealers who capture wild Sarus Cranes in Cambodia (Meine and Archibald 1996), and elsewhere. In India, the species should be moved from Schedule IV to Schedule I of the Wildlife Act (Mukherjee *et al.* 2000). In Thailand the Wildlife Conservation Division is responsible for publicising existing legislation, and this should be conducted more comprehensively with a view to informing villagers, police and government officials that this species, and most other wetland birds, are protected by law (Scott 1989).

Education Given the traditional association between the Sarus Crane and people, and in view of the fact that most modern habitat for it is rural agricultural land, perhaps the most important step towards conserving the species involves education campaigns targeted at key regions throughout its range and focused on highlighting its value, its endangerment and the role of people in its conservation (Sundar *et al.* in press, H. S. Baral *in litt.* 2000). In India this type of activity should be focused towards areas where conflict with farmers is deemed a problem. In Nepal, Suwal (1999a,b) suggested that an awareness campaign should be implemented both nationally and locally. Rural education programmes were long since proposed to help conserve waterbirds in Bangladesh by reducing habitat alteration and hunting (Forest Department 1974) but the outcome is unknown. Current awareness campaigns in Laos and Cambodia should be consolidated and continued (J. W. Duckworth *in litt.* 1999). Further proposals throughout the range of the species appear under Lesser Adjutant *Leptoptilos javanicus*.

Protected areas Protected areas are rarely of sufficient size to protect large breeding populations of this species; however, increased protection and thoughtful management of reserves (to eliminate persecution and to maintain appropriate habitat; see below) is urged, as this would increase their value to the species. Protected areas are of great importance to the Sarus Crane in South-East Asia, particularly where non-breeding congregations gather. It is worth noting that there is a widely perceived need for strengthening the institutions responsible for reserve

management throughout the range of this species (see Measures Proposed: Institutional Strengthening under White-winged Duck *Cairina scutulata*). *Pakistan* The recently rediscovered (and reputedly tiny) breeding population of the species should be carefully conserved and a new protected area established for this purpose. *India* A nationwide network of small wetland bird sanctuaries would be of value; prescriptions for the establishment and (potentially community) management of such areas should be compiled, and the presence of Sarus Cranes (especially breeding pairs) used identify the areas. Dihaila jheel in the Karera Bustard Sanctuary might qualify for Ramsar status, and activities needed at this site include the control of grazing and water use, acquisition by the Forestry Department and development of tourist and research facilities (Rahmani 1987c) (but see Measures Taken under Great Indian Bustard *Ardeotis nigriceps* for information regarding the deregulation of the sanctuary). The scope for harnessing the educational potential of Keoladeo National Park has not been fully realised; as it is ideally placed near major population centres, and visited by huge numbers of tourist, efforts should be made to provide as much information as possible regarding conservation issues (including this species) and threats to local people and foreign visitors (Scott 1989). *Nepal* The ICF programme at Lumbini should be expanded if possible to help protect a larger area of wetland important to the Sarus Crane. *Bangladesh* A management plan has been called for to protect the wetland habitats of the species in Bangladesh (if it is found to survive there) and to preserve the species from hunting practices (Karim 1983a). In particular, the freshwater marshes in the Haor basin should be protected to provide habitat for the species in the future (Rashid 1993); see the equivalent section under Pallas's Fish-eagle *Haliaeetus leucoryphus* for further proposals in this area. *Myanmar* A system of wetland reserves needs to be incorporated into the national framework of protected areas (Lwin 1995); clearly any remaining breeding populations of this crane should be a major consideration in any extension of the existing system. *Laos* Dong Khanthung proposed NBCA and Xe Pian NBCA are considered the two most significant areas for bird conservation in the country because of the populations of highly threatened waterbirds they contain, and as such they deserve immediate conservation action and long-term protection (Thewlis *et al.* 1998, Duckworth *et al.* 1999). Both areas should receive full legal protection alongside effective management, hiring and subsequent training of staff (see Remarks 3 under Crested Argus *Rheinardia ocellata*) and education programmes geared at reducing wetland disturbance and the exploitation of waterbirds. Round (1998) proposed a suite of management recommendations for Dong Khanthung, including establishing boundaries as an NBCA, a moratorium on immigration, and control of hunting, wildlife trading, and infrastructural and agricultural development. Duckworth *et al.* (1999) urged a high level of international donor support for both these sites in view of their conservation significance and suggested that appropriate protective measures should be drafted and enforced with stiff penalties for violators. Without this action, there is little chance that a population of these cranes could survive in Laos (J. W. Duckworth *in litt.* 1999). Given the susceptibility of nesting cranes to disturbance or theft of eggs and nestlings, strict control of known breeding sites may be warranted (here and in Cambodia), including regulation of entry or passage for any purpose (Duckworth *et al.* 1999). Similarly, a network of "safe havens" (see Measures Proposed under White-shouldered Ibis *Pseudibis davisoni*, and below) for roosting and foraging large waterbirds has been proposed in north-east Cambodia (Timmins and Soriyun 1998) and should be expanded to cover as many sites as possible in northern Cambodia and southern Laos (J. W. Duckworth *in litt.* 1999). *Cambodia* The roosting grounds at Ang Trapeang Thmor Wildlife Reserve should be properly protected and managed, especially as White-shouldered Ibis and Bengal Florican have recently been recorded there. Conservation action is urgently required including education and community development programmes and possible relocation of enclave villages (*Cambodia Bird News* 4 [2000]: 59). Protection is also required in suitable wetland areas of Kompong Thom province such as around Trapeang Rompeak (Veasna 1999; see equivalent section under White-shouldered Ibis). Timmins and Soriyun (1998) proposed that "safe havens" should be established for large

waterbirds in northern Cambodia; this scheme involved the exclusion of human activity around important foraging and roosting sites for storks, ibises and cranes, particularly in the dry season when habitat availability is most limited and birds consequently most vulnerable to disturbance and hunting. As local people require wetlands for various purposes, a zoning system is required to allow for this need, while a minority of important wetlands are classed as strict no-entry zones for a few months during the dry season. This idea should be expanded to cover as many sites as possible in northern Cambodia and southern Laos (J. W. Duckworth *in litt.* 1999). Further discussion of conservation options in northern and eastern Cambodia (an area vital to the survival of several large waterbird species in South-East Asia) appears in the equivalent sections under Giant Ibis and White-shouldered Ibis. *Vietnam* Tram Chim National Park has been proposed as a Ramsar site by the provincial authorities, and is awaiting national government approval for designation (S. T. Buckton verbally 1999). In 1986 Vietnam and Cambodia began planning cooperative research on the status of the eastern subspecies as a foundation for establishing new protected areas, but to date progress in this effort has been limited (Meine and Archibald 1996). Plans to identify and protect 3–4 additional areas used by cranes during the dry season were progressing under the direction of FIPI (Meine and Archibald 1996), but no further news has come to light. If any other sites used by the species are identified, they should receive maximum protection.

Wetland management Effective wetland management is crucial to maintaining populations of the species. *India* Protected wetlands should ideally be managed to provide a variety of water levels so that the varied seasonal habitat requirements of the species (see Ecology) might be met. In large commonly fished wetlands the attendance of fishermen should possibly be restricted to certain seasons or their distribution controlled or rotated so that disturbance is minimised (Scott 1989). Water hyacinth infestation is a problem on many wetlands in northern India and some form of control, preferably mechanical rather than biological, needs to be exercised to preserve wetland ecosystems (Scott 1989). As shallow wetlands are required by the species, artificial tanks and canals should be designed where possible without steep banks so that they provide suitable habitat. Where possible, small patches of non-cultivable marshland should be maintained within agricultural landscapes to boost breeding success (Borad et al. 2001). *Nepal* Further wetland restoration projects following on from the success of the Lumbini Sanctuary should be attempted in the terai (Suwal 1999a,b). *Vietnam* The water levels in Tram Chim National Park need monitoring and managing so that they fluctuate naturally, ensuring low vegetation height and possibly attracting the species to breed there once more (Patzwahl 1992). Water-level management should also aim to maintain soil moisture during the dry season, to prevent drying out and oxidisation of the acid-sulphate soils found in the area, which in turn leads to acidification of surface water with commensurate changes in the aquatic floral community (Buckton et al. 1999).

Control of pollution In India the use of pesticides on agricultural land and effluent runoff from industries should be strictly controlled wherever possible (Muralidharan 1992, Khacher 1996); this proposal is relevant to all Asian countries in the range of this species. Suwal (1999a,b) suggested that to control the use of chemical fertilisers in the terai of Nepal, native composting techniques should be re-taught and implemented so that farming is more organic (the associated call for biological pest controls should, however, be ignored). Again, this is a suggestion that could usefully be applied to rural areas throughout the range of the species, and farmers deserve maximum support in this venture; education and training in alternative methods and technical expertise would be particularly helpful.

Research Further research would be useful to “expand and strengthen the knowledge base for conservation” (Meine and Archibald 1996), but it should be stressed that practical action is now clearly a priority and research should be viewed, in almost all cases, as a secondary requirement. *India* As its numbers are declining an intensive ongoing study of the ecology, behaviour, habitat requirement and status of the species in India has been called for

(Sundar *et al.* in press); this should assess and monitor its status and distribution, and provide information on its habitat and breeding requirements in relation to the effects of agricultural pesticides, land-use patterns and livestock populations. Little is known about the social organisation, mating system, breeding biology, specific habitat requirements for breeding, population dynamics, annual recruitment rates, mortality, or local and long-distance movements. Moreover, no long-term study has been conducted on any population, with the exception of that in Keoladeo National Park, and these omissions should be addressed if possible. *Bangladesh* Proposals for surveys in the wetlands of Bangladesh are presented in the equivalent section under Lesser Adjutant. *Laos* Surveys are required to identify important wetlands for foraging waterbirds during the late dry season when resources are most limited (Duckworth *et al.* 1999). *Cambodia* Additional surveys in northern and eastern Cambodia should try to identify any concentrations of breeding birds so that the possibility of protection can be assessed and some form of reserve established if necessary. Surveys have been called for in Svay Leu and Chikreng in Siem Reap, and in Sandan district in Kompong Thom (Veasna 1999). A regional wildlife research and conservation team should be established in northern Cambodia, including a training centre to increase the capacity of local officials and to coordinate research, conservation and education (Veasna 1999).

Miscellaneous An attempt should be made to attach visual markers to overhead power cables in important areas for Sarus Cranes, or to lay cables underground. In Nepal, these should be placed on the 132 kV and 11 kV cables where necessary, while cables around the Lumbini Sanctuary should ideally be laid underground (Suwal 1999a,b). Meine and Archibald (1996) made recommendations for the management of Sarus Crane populations in captivity to maximise their conservation value.

REMARKS (1) This species is closely related to the Brolga *Grus rubicundus* of Australia and New Guinea and possibly forms a superspecies (Johnsgard 1983). (2) "Flocks of 600 strong" were reported at Ponsee (probably Bangxi, Yingjiang county: Cheng Tso-hsin 1987), 1860s/1870s (Anderson 1879; also Rothschild 1926), but these were considered more likely to be Common Cranes *Grus grus* (Stanford and Ticehurst 1938–1939). (3) Thewlis *et al.* (1998) mistranslated this entry as "three pairs on drying rivers in the Kong Kok area". (4) Specimens in BMNH marked "Penang" were thought unlikely to derive from so far south, as no authentic records were at that time known from the region; their provenance was thought almost certainly to be Trang in peninsular Thailand or Perlis in Malaysia (Robinson and Kloss 1921–1924). While the paucity of early records indicates that the species was always rare in Malaysia, reported localities are mapped. (5) Livesey (1937) proposed that gatherings functioned as "marriage marts" where pairs formed before the breeding season, but it appears more likely that the species congregates in response to habitat conditions and for the purposes of nocturnal roosting. (6) Adam (1873) commented that "although the people of Rajputana [roughly = Rajasthan] do not worship the bird, they object to its being shot". He added, "they look upon the killing of the pair as a lesser sin than the killing of one", as the bereaved individual was thought to call all night and beat its head upon the ground until it died. Versions of these beliefs are frequent throughout the range of the species and even contain an element of truth. Irby (1861) mentioned that after shooting a Sarus Crane he had "heard the survivor calling all night for its mate, and since then I never would shoot them". Furthermore, if one of a pair is killed or injured, the second individual often remains with its crippled companion even when closely approached. Even in wintering flocks the same appears to be the case: Meyer de Schauensee (1929) related that "if one bird is wounded the others then seem to lose all fear and refuse to leave their companion. They run along with the wounded bird, if it is able to run, and take short circling flights above it". This behaviour of the species, while a touching reflection of its powerful pairing and grouping instincts, has doubtless increased the impact of persecution in the many regions where cranes are shot without objection.