Threatened Birds of Asia:
The BirdLife International Red Data Book

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Recommended citation
BirdLife International (2001) *Threatened birds of Asia: the BirdLife International Red Data Book.* Cambridge, UK: BirdLife International.

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BirdLife International is a UK-registered charity

ISBN 0 946888 42 6 (Part A)
ISBN 0 946888 43 4 (Part B)
ISBN 0 946888 44 2 (Set)

British Library-in-Publication Data
A catalogue record for this book is available from the British Library

First published 2001 by BirdLife International

Designed and produced by the **Nature**Bureau, 36 Kingfisher Court, Hambridge Road, Newbury, Berkshire RG14 5SJ, United Kingdom

Available from the Natural History Book Service Ltd, 2–3 Wills Road, Totnes, Devon TQ9 5XN, UK. Tel: +44 1803 865913 Fax: +44 1803 865280 Email nhbs@nhbs.co.uk
Internet: www.nhbs.com/services/birdlife.html

GREATER ADJUTANT
Leptoptilos dubius

Critical ☐ —
Endangered ■ A2c,d,e; C1
Vulnerable ☐ C2a; D1

This stork qualifies as Endangered as it has a very small, declining population. This decline is projected to increase in the future based on current levels of exploitation, the effects of pollutants and continuing reductions in the availability of nesting and quality of feeding sites.

DISTRIBUTION At the beginning of the twentieth century, the Greater Adjutant occurred, often in huge numbers, in much of South and South-East Asia from Pakistan through northern India, Nepal and Bangladesh to Myanmar, Thailand, Laos, Vietnam and Cambodia. A massive decline over the following hundred years has, however, left only two very small and highly disjunct breeding populations of the species, one in Assam (Rahmani 1989c, Saikia and Bhattacharjee 1990a,b) and the other in Cambodia (Mundkur *et al*. 1995b). Outside these areas it has dwindled to a fraction of its former abundance, although it still occurs as a vagrant to Vietnam, Thailand and Myanmar. Its global range was thought to have more than halved since 1800 (Saikia 1995); however, given that wandering individuals turn up over a wide region and that the breeding range was always quite local, it is the decline in numbers rather than range that is far more alarming.

In the following account, provisional records (e.g. unspecified *Leptoptilos* storks) and the less site-specific records have largely been excluded. However, many site-specific and species-specific records, both published and unpublished, involve sight observations with little supporting evidence (albeit such evidence might have been forthcoming if time had permitted further communication with observers); in these cases the underestimated identification difficulties (see Remarks 1) have generally resulted in the omission here of unsubstantiated extralimital records, especially in areas where confusion with Lesser Adjutant *L. javanicus* appeared likely. Early reports that Greater Adjutant occurred on the Sundaic islands of Sumatra, Java and Borneo (Baker 1922–1930, Peters 1931–1987) were the result of misidentifications (Hancock *et al.* 1992), as are several recent reports from the Thai-Malay peninsula and southern Laos (see Remarks 2 and 3). In Sumatra, it was provisionally recorded at Pantaipercut, Deli, Utara, March 1979 (van Marle and Voous 1988), but this is generally not accepted.

■ ***PAKISTAN*** Having once appeared regularly in the nineteenth century, and then erratically up to the mid-twentieth century during the wet season, there have been no confirmed records since. Because of the decline in overall numbers, seasonal influxes across India have become almost non-existent, and the species is now very unlikely to occur in the country. Records were from: ■ ***Sind*** recorded in nineteenth century (Inverarity 1886–1888), at sites including near **Sukkur**, three individuals on a sandbar in the Indus river, December 1930 (Roberts 1991–1992); **Eastern Narra**, "common", undated (Butler 1878); regular around **Rohri**, November, around 1870 (Hume 1872–1873); **Manchar lake**, one individual caught and subsequently exhibited at Karachi Zoo, around 1915–1920 (Ticehurst 1922–1924); **Jhimpir** (Jempeer), one, November 1877 (Murray 1878); ■ ***Punjab*** **Shahdara**, on the Ravi river, one individual captured and later kept in Lahore Zoo, late 1950s (Roberts 1991–1992); near the Chenab–Sutlej junction, near **Alipur**, one, December 1871 (Hume 1872–1873).

■ ***INDIA*** Records come from the Brahmaputra and Gangetic plains, Gujarat, and central India, with no confirmed records from southern India (Ali and Ripley 1968–1998, A. R.

Rahmani *in litt*. 1998); Tamil Nadu is mentioned as the southernmost limit of the historical range of the species (Rahmani *et al*. 1990, Hancock *et al*. 1992), but the record in question is not accepted here (see below). It has now disappeared from much of this range, with the main breeding and non-breeding population restricted to Assam (Rahmani *et al.* 1990), where, however, the species recently appeared to be expanding its breeding range (Singha *et al*. in press).

■ ***Haryana*** There is only one record: Parwali lake, close to **Sirsa**, one, March 1933 (Koelz 1940).

■ ***Delhi*** Repeated records stem from the vicinity of the capital: **Delhi**, September 1875 (male in BMNH), singletons at refuse tips in April, 1931–1945 (Frome 1947–1948), August 1967 (Kahl 1971), three flying over, January 1987 (Rahmani *et al*. 1990), previously regular at Delhi Zoo (Bhatia and Desai 1971, Urfi 1995), including nine, January 1982 (E. Mølgaard *in litt.* 1998), 16, 1994 (Saikia 1995), and near the airport, two, January or February 1989 (Linderstrom 1989).

■ ***Rajasthan*** Reports of "vast numbers" feeding on locusts in Sri Ganganagar district, August 1956 (Singh and Singh 1959) probably involved misidentifications. The only other reports are from: **Keoladeo National Park**, Bharatpur, where it was previously regular but is now very infrequently recorded, with small flocks, August 1966 (Kahl 1971), several, April 1973 (Panday 1974), several records of 7–10 (amongst 150–200 Lesser Adjutants) and up to 30 individuals reported, March–June 1983 (V. J. Rajan *in litt*. 1988, V. Prakash verbally 1997), one, February 1987 (Turin *et al.* 1987), one (amongst 3–4 *L. javanicus*), 1989 (Rahmani *et al*. 1990), and one reported (identification details not supplied), January 1995 (R. Skeen *in litt*. 1999); **Sambhar** (Sambhur) **lake**, two pairs seen over a two-year period, c.1870 (Adam 1873); **Jodhpur**, nineteenth century (A. O. Hume, footnote to Butler 1875–1877).

■ ***Gujarat*** Records (none recent) are from: Ahmedabad (not mapped), undated (Dharmakumarsinhji 1955); **Deesa** (Disa), three, August, undated (Butler 1875–1877); **Bhuj**, Kutch, winter of 1944–1945 (Ali 1954–1955); Burnath river (untraced; possibly Banas river), parties of 6–8 frequently observed, post-August, unspecified years (Butler 1875–1877).

■ ***Uttar Pradesh*** A nest reported at Mansur Ghat, north Gorakhpur district, December 1861 (Beavan 1865–1868), is perhaps more likely to have involved Lesser Adjutant and is thus omitted. The only acceptable records traced are from: **Loni**, four, October 1944 (Benthall 1949); **Agra**, 1893 (specimen in NHMW); and **Lucknow**, pre-1881 (Reid 1887).

■ ***Madhya Pradesh*** The only records are historical: **Sehore**, May–August, 1908–1910 (Whitehead 1911); **Surguja**, occasional individuals, undated (Ball 1874); and Somnapur, **Balaghat district**, January 1912 (D'Abreu 1912).

■ ***Maharashtra*** An undated historical record from "Konkan-Ghat-Mata" (Konkan = a long coastal strip between Daman and Goa) (Anon. 1886) is not mapped. Other old records are from: **Melghat forest**, south of the Tapti river, one, undated (Burton 1921); **Dhule** (Dhulia taluka), one, January 1881 (Davidson 1882), one, July 1886, and less than a dozen during the rains in the preceding six years (Davidson 1886). "The Adjutant" (a term usually indicating Greater rather than Lesser) is listed as an uncommon migrant at Mansingh Deo Wildlife Sanctuary (Bhamburkar and Desai 1993) without further comment; the record is treated here as unconfirmed.

■ ***Karnataka*** A site is mapped by Grimmett *et al*. (1998) in northern Karnataka, but this is an unlikely locality for the species and the record has not been traced. Two recent records from Chitradurga-Hassan, January 1990, and Bijapur-Badrami, March 1994 (S. Howe *in litt*. 1999), are treated as provisional given the lack of other sightings in the region.

■ ***Tamil Nadu*** A report is mentioned by Rahmani (1989d) and Rahmani *et al*. (1990; mapped by Grimmett *et al*. 1998) of eight birds together near Mahabalipuram (specifically at 12°37′N 80°14′E). As this sighting comes from so far outside the usual range of the species, it is treated as unconfirmed in the absence of corroborative detail.

■ ***Andhra Pradesh*** Apart from an undated historical report from **Hyderabad** (Jerdon 1862–1864, E. A. Butler 1881), there is no other record of the bird's occurrence in this state (Rahmani *et al*. 1990).

■ ***Bihar*** The species was clearly a regular wet-season immigrant a century ago, but recent records have been few: **Darbhanga**, July 1901 (female in AMNH), annual during the rains (Inglis 1901–1904), undated (Dalgleish 1902); **Purnea**, one, April 1988 (Rahmani *et al*. 1990); between a bridge over the Ganges and **Kishanganj**, eight, March 1981 (N. Krabbe verbally 1985); by the Kursi river near **Kursela** (Kurseala), six, April 1988 (Rahmani *et al*. 1990); **Lohardaga**, undated (Ball 1878); **Singhbhum** (Dhalbum), occasional individuals, undated (Ball 1874, 1878); Haziribagh (not mapped), probable record, undated (Baillie 1946).

■ ***Orissa*** Although there are reports of the species from the state, none is both acceptably documented and from a named locality. Records are from: unspecified localities, 1929 (Baker 1922–1930), January 1990 (AWC 1990 count data *per* T. Mundkur *in litt*. 1998); "some" apparently breeding at Chilka lake, undated ("Vagrant" 1868).

■ ***West Bengal*** The species was once locally common in the Calcutta area, but is now only an occasional visitor from Assam (Rahmani 1989a). Records are from: **Jaldapara Wildlife Sanctuary**, one, January 1987 (Turin *et al.* 1987; also Rahmani *et al*. 1990); **Jalpaiguri district**, undated (Inglis *et al.* 1920), and possible breeding records ("may have been *javanicus*") at "Dhoopgooree" (although these were perhaps Lesser Adjutants), undated (Cripps 1878); **Puruliya** (Manbhum), occasional individuals, undated (Ball 1874, 1878); **Bankura district**, by the road to Jamshedpur, one, July 1970 (Gauntlett 1986); **Calcutta**, undated (Beavan 1866a), February and September 1873, plus another pre-1895 (specimens in BMNH), 1879 (Baker 1922–1930), c.1920 (Dover and Basil-Edwardes 1921), apparently in 1940s (Hancock 1989); **Fort William**, May 1865 (Beavan 1865–1868; see Remarks 4); **Salt lakes**, year-round, undated (Munn 1894);

■ ***Assam*** A breeding population survives in Assam; indeed a plethora of reports has stemmed from the state in the last decade, in part owing to the mobility and conspicuousness of this species and the new awareness of the threat status of the species. One result of this glut of data (and its use of modern versions of the names of tiny villages) is that many sites have not been traceable, but are listed by district where possible. Records are from: **Amarpur**, near Dibru-Saikhowa National Park, Tinsukia district, four, September 1993 (Choudhury 1995, 1997d), and two, March 1998 (Allen 1998a); **Dibru-Saikhowa National Park**, Tinsukia district, December 1995 (Datta 1996), specifically at Saikhowaghat, one, September 1992 (Choudhury 1995), and Baluchar, four, February 1993 (Choudhury 1995); **Chaulkhoa** (Chaulkhowa) river, Barpeta district, 2–7, 1989–1994 (Saikia 1995), one, April 1997 (J.-C. Kovacs *in litt*. 1998); **Panidihing Sanctuary**, Sibsagar district, 4–38, 1989–1994 (Saikia 1995), nine, January 1995 (Singha 1995); **Laluka** (Laluka Goan), Dibrugarh district, 13, April 1989 (Rahmani *et al*. 1990), 16–18, 1989–1991 (Saikia 1995), and Laluka graveyard, resident, 23, June 1993 (Choudhury 1995); **Sibsagar**, Sibsagar district, 16 at the "waste dump", April 1989 (Rahmani *et al*. 1990), nine nests, October 1990 (Baruah 1991), at least eight active nests, January 1991 (Choudhury 1993c), at Dichial, north of Ranghar, 8–25 nests, 1989–1994 (Changkakati and Das 1991, Saikia 1995); **Majuli island**, Jorhat district, at Kamalabari, 4–5, 1991–1994 (Saikia 1995), "sizeable numbers", 1990s (Choudhury 2000c); **Misamari**, Sonitpur district, 15–18, 1990–1994 (Saikia 1995), and elsewhere in this district at Burhachapori Wildlife Sanctuary, 1990s (Choudhury 2000c); in Jorhat district between **Jorhat** and Moranhat, west of Rajmai tea estate, March 1998 (Hornbuckle *et al*. 1998a); **Manas National Park**, Barpeta district, listed without details (Scott 1989, Anon. 1993a); **Nalbari**, Darrang district, 1–2, August 1988 and April 1989 (Rahmani *et al*. 1990), three, 1994 (Saikia 1995); **Tezpur**, Sonitpur district, eight, January 1986 (Rao and Murulidharan 1989), 57 in May 1989 (Rahmani *et al*. 1990), 16–60, 1989–1994 (Saikia 1995), and at Kabarsthan, 56 in 1989 (Saikia and Bhattacharjee 1989a); **Orang National Park**, Darrang district, one, April

1988 (Rahmani *et al*. 1990), 12, 1991 (Changkakati and Das 1991); **Kaziranga National Park**, one nest, November–December 1967 (Kahl 1971), 10 individuals, January 1971 (Inskipp 1971), four pairs nesting in 1983 (Scott 1989), flocks in non-breeding season of 34 at Sohala, and 44 at Burhapahar, early 1990s (Bhattacharjee *et al.* 1996), 12–40 counted throughout the park, 1989–1994 (Saikia 1995), one nest, 1991 (Changkakati and Das 1991), three nesting at Gotonga and 1–2 nesting at Kerasin, 1989–1994 (Saikia 1995, Barua and Sharma 1999), 3–4 almost daily, February 1994 (Alström *et al*. 1994c), also apparently 43 at Dunga beel, February 1996 (Singha *et al*. in press) and 45 there in March 1998 (Barua and Sharma 1999); Baihata Charali, near **Rangia**, Kamrup district, one in May 1989 (Rahmani *et al*. 1990), and at Rangia, 8–76, 1989–1994 (Saikia 1995), one, February 1995 (Singha *et al.* in press); **Ranganadi**, Dhubri district, 11, 1990 (Saikia 1995); **Fakiragram**, Kokrajhar district, one in breeding plumage and thus possibly breeding nearby, March 1997 (Singha *et al.* in press); **Sareswar bheel**, Dhubri district, regular in winter, including 13 in January 1987 (Scott 1989); Dhubri district, at Diplai beel, three, 1994 (Saikia 1995), and nearby at **Chakrashila Wildlife Sanctuary**, December 1997–November 1998 (*Oriental Bird Club Bull*. 32: 12); **Barpeta**, Barpeta district, 3–23, 1989–1994 (Saikia 1995), and Dangorkuchi, 3–8 with 2–5 nests, 1989–1994 (Changkakati and Das 1991, Saikia 1995), and at Kolomy beel, near Barpeta, 15, November 1995 (Choudhury 2000c); **Raha**, Nagaon (Nowgong, Nawgang) district, 4–6, 1993–1994 (Saikia 1995); **Kampur**, Nagaon district, six, 1991 (Saikia 1995); **Gauhati** (Guwahati), Kamrup district, March 1957 (male in ZMH), 117, 1991 (Changkakati and Das 1991), and in the vicinity of Gauhati at Bamuni maidan (maximum count: 12), Baralumukh (maximum count: 17), Bhangagarh (maximum count: 13), Narengi Army campus (maximum count: 18), Ulubari (maximum count: 26), Udalbakra (maximum count: 193), Kahilipara (maximum count: 3) (Saikia 1995), with 200 individuals counted around Gauhati in the 1996 non-breeding season (Singha *et al*. in press) and, at North Gauhati, 2–10 nests, 1997–1998 (P. K. Saikia *in litt*. 1999), 50–60 birds in total, March 1998 (H. Hendriks *in litt*. 1999), 46, April 1998 (Holt 1998), 30, mostly adults, April 1999 (B. Carrick *in litt*. 1999); **Pobitora** (Pabitora) **Wildlife Sanctuary**, Nalbari district, listed (Talukdar 1996, Choudhury 2000c); **Deepor beel**, Kamrup district, 56, January 1987 (Saikia and Bhattacharjee 1989c), three, winter 1990–1991 (Barman *et al*. 1995), 5–7, 1994 (Alström *et al*. 1994c, Saikia 1995); **Sonapur**, Nagaon district, one, 1991–1993 (Saikia 1995); **Palasbari**, Kamrup district, March 1957 (male in ZMH); **Dew-Mornai**, Darrang district, up to five nests, 1990–1994 (Saikia 1995); **Hojai** (Nilbagan), Karbi Anglong district, two, 1994 (Saikia 1995); **North Cachar Hills district**, undated (Baker 1894–1901).

Unmapped localities (see Remarks 5) are: (*Bongaigaon district*) unspecified localities, sporadic records, 1990s (Choudhury 2000c); (*Kamrup district*) Hengrabari beel, Sasal, Dispur, April 1988 and May 1989 (Rahmani *et al*. 1990); (*Kokrajhar district*) Ultapani area of Chirang Reserve Forest, five, November 1998 (Choudhury 2000c); (*Lakhimpur district*) Bordoibam-Bilmukh Sanctuary, undated (Choudhury 2000c); (*Nagaon district*) Laokhowa Wildlife Sanctuary, one, April 1988 (Rahmani *et al*. 1990; Choudhury 2000c).

Untraced localities: (*Barpeta district*) Keutkuchi, 8–35, 1989–1994 (Saikia 1995); Senga, 4–5, 1989–1991 (Saikia 1995); (*Darrang district*) Dumnichoki, December 1995 (Choudhury 2000c); Mongoldoi, three, May 1989 (Rahmani *et al*. 1990), 3–7 with 4–5 nests, 1989–1993 (Saikia 1995); Na-Hawly, 10 with nine nests, 1990–1991 (Saikia 1995); (*Dibrugarh district*) Amulapatty Noiapara, 12–18, 1991–1994 (Saikia 1995); Japara, one, 1993–1994 (Saikia 1995); Kutuha, two, 1993 (Saikia 1995); Phulbagan, two, 1993–1994 (Saikia 1995); (*Jorhat district*) Bhugdoi river, 3–9, 1989–1994 (Saikia 1995); Gormur, 2–17, 1989–1994 (Saikia 1995); Janjimukh (Hatipara beel), three, 1994 (Saikia 1995); (*Kamrup district*) Alikask, 7–19 nests, 1989–1994 (Saikia 1995); Dadara, 5–28 nests, 1992–1994 (Saikia 1995), increasing to 40 nests, 1997–1998 (P. K. Saikia *in litt*. 1999); Satgaon (Satgwon), eight nests, October 1996 (Singha *et al*. in press); Singimari, 9–18 nests, 1989–1994 (Saikia 1995); (*Lakhimpur district*) Gohain beel and Singia, Dhakuakhana subdivision, December 1990 (Choudhury 2000c); Koling beel,

four, November 1994 (Choudhury 2000c); (*Morigaon district*) (between Kamrup and Nagaon districts) Dondua-Tiniali, 15, 1991 (Saikia 1995); Fakir Salkata, 7–11, 1989–1994 (Saikia 1995); Jagi road, one, May 1989 (Rahmani *et al*. 1990), 1–4, 1991–1993 (Saikia 1995); Jalikguti, 16–50, 1989–1994 (Saikia 1995); Narikol beel, 1–7, 1990–1994 (Saikia 1995); Manaha, breeding in 1990s (Singha *et al*. in press); (*Nalbari district*) Adabari, 3–10, 1989–1994 (Saikia 1995); Daulasala, 2–18, 1989–1994 (Saikia 1995), and breeding (see Population); Ghograpara, eight, 1994 (Saikia 1995); (*Nagaon district*) Barpujia (Bhorbugia), 51, 1991 (Changkakati and Das 1991), Bota (Lowkhowa road), 2–5, 1990–1991 (Saikia 1995); Chapormukh, one, 1993 (Saikia 1995); Chinapatty, 1–15, 1989–1994 (Saikia 1995); Daurabeel, 7–20, 1989–1991 (Saikia 1995); Haibargoan (North Hoibargaon), 2–12 in non-breeding season, 56 at a colony, March 1991 (Changkakati and Das 1991), 13–28 occupied nests in the breeding season, 1989–1994 (Saikia 1995); Islampur, two nesting trees recorded, one with three nests, one with nine nests, February 1986, January 1990 and subsequent years (Choudhury 1993c), 1–3, 1989–1991 (Saikia 1995), six, November 1995 (Farrow 1995); Kharampatty, three nests, 1990 (Saikia 1995), presumably same as Khorompatty, 3–11, 1989–1992 (Saikia 1995), two nests reported, 1991 (Changkakati and Das 1991); Khutikatia, 11–19 nests, 1991–1994 (Changkakati and Das 1991, Saikia 1995); Koliabor, five, December 1990 (Choudhury 2000c); Sialmari, 16–98, 1989–1994 (Saikia 1995); (*Sibsagar district*) Bagharchuk, breeding in 1990s (Singha *et al*. in press); Dhuliapar, four, 1993 (Saikia 1995); Kuwarpur, eight, 1994 (Saikia 1995); Maganapara, two, March 1997 (Singha *et al*. in press); Mothadang–Nadipar, 14, 1994 (Saikia 1995), Mothadang, 9–12, 1992–1994 (Saikia 1995); Na-Pukhuri, 1–2, 1993–1994 (Saikia 1995); Oltoli, 21–33, 1993–1994 (Saikia 1995); Ranghar Chariali, 1–2, 1990–1994 (Saikia 1995); and near Sat Sang Bihar, 16–31, 1989–1992 (Saikia 1995); (*Sonitpur district*) between Balipara and Jamuguri, February 1991 (Choudhury 2000c); (*district unknown*) Bamanigaon, December 1949 (one in UMMZ).

■ ***Meghalaya*** There is only one record from the Assam border: near **Baridua** (Bardua), one, May 1992 (Choudhury 1996a).

■ ***Manipur*** Records (neither recent) are from: "between Koombee and Kokshin Koonoo", presumably near **Kakching**, on the banks of the Koga river, c.40 perching in a *Bombax*, pre-1881 (Hume 1888); on the **Toyang river**, close to its confluence with the Chakpee river, pre-1881 (Hume 1888).

■ ***NEPAL*** The species is a rare wet season ("summer") visitor to the few localities at which it still occurs. Records are from: between Somnath and **Narayanghat**, north of Royal Chitwan National Park, one, January 1988 (Ellen 1988); **Kathmandu valley**, two, July and September, year unspecified (Hodgson 1829a, 1838, 1844); **Royal Chitwan National Park**, at Sauraha, 250 m, one, December 1983 (Wothan and Bond 1984), and near Machan, one, April 1988 (Heathcote and Heathcote 1988); **Chainpur**, 1,500 m, two, June 1954 (Biswas 1974); **Siraha district**, one, February 1992 (Mackenzie 1994, *Nepal Birdwatching Club Newsletter* 3, 2 [1994]: 2–3); **Kosi Tappu Wildlife Reserve**, unspecified numbers, 1976 (Dahmer 1976), one, September–November 1986 (Heinen 1990), one, March 1989 (Dodman and Guinan 1989), specifically at Prakashpur, two, January–February 1995 (Wheeldon 1995), and nearby at Itahari, two, March 1992 (Bräunlich and Oehlschaeger 1993); **Kosi barrage**, regularly recorded, including one, February 1979 (Redman and Murphy 1979), one, February–March 1981 (Porter *et al.* 1981, Inskipp and Inskipp 1981a), 1–3, March–May 1982 (Turton and Speight 1982, Robson 1982, Grimmett 1982), 1–2, March–April 1986 (Heath 1986, Mayer 1986), two, February–March 1987 (Heegard *et al*. 1987, Stones 1987), one, March 1989 (Bose *et al*. 1989), one, April 1990 (Buckton and Morris 1990); between **Biratnagar** and Dharan, undated (Fleming *et al.* 1984).

■ ***BANGLADESH*** The species was found "in many parts" of the country until the early twentieth century (Baker 1922–1930). More recently, Rashid (1967) listed it as a widespread visitor during the monsoon, and a resident in the north-east and central portions. This overview is based on historical records and inference (see Remarks 2 under Manipur Bush-

quail *Perdicula manipurensis*), and is clearly obsolete: there are very few recent sight records (Husain 1985, P. M. Thompson *in litt*. 1997) and this stork is probably extinct in the country except as a sporadic visitor in very small numbers (Husain 1989). Records from Madanipur, Munshiganj and the Chittagong Hill Tracts are mentioned without details (Husain 1979, Khan 1987) and are treated here as unconfirmed. There were apparently authentic records of more than one individual wandering in the north-west of the country during the late 1990s (P. M. Thompson *in litt*. 1999), but further details are not known. Records are from: **Hakaluki**, four, December 1967 (Mountfort and Poore 1968); **Sylhet**, large flocks, pre-1881 (Hume 1888) and a 1901 specimen (in AMNH) labelled "Rema Jeluokepore Te, S. Silhet, Assam", is presumably from Rema tea estate, southern Sylhet; **Dhaka** (Dacca), occasional visitor, c.1850 (Tytler 1854); **Faridpur** (Furreedpore), seasonally common, mid-1870s (Cripps 1878); **Sundarbans**, breeding alongside Lesser Adjutant in the south-east part and at Morellgunj, undated (Hume and Oates 1889–1890), c.50 pairs, January 1883 (Baker 1922–1930), 1–8 reported daily, November 1967 (Mountfort and Poore 1968; but see Remarks 6), and one with c.25 Lesser Adjutants in a three-day excursion, December 1988 (W. G. Harvey *in litt*. 1989).

■ ***MYANMAR*** The Greater Adjutant was formerly distributed over almost the entire country (Oates 1883, Smythies 1986), being found in Shwebo district (Roseveare 1949), Myingyin district (Macdonald 1906), Minbu district (Roseveare 1952), Arakan state (Hopwood 1912b, Christison *et al.* 1946) and Tenasserim (Taninthayi) (Mason 1850, Hume and Davison 1878), but apparently not in the Thoungyin (Thoungyeen) valley (Bingham 1880a). The greatest concentrations, however, were to be found in Pegu (Bago) state, where huge numbers bred in the nineteenth century (Oates 1875, 1878, 1882, 1883, Wardlaw Ramsay 1877). It appears that there is no longer a resident or breeding population in the country (Luthin 1987, Hancock *et al.* 1992), although a juvenile captured at an unknown site in Myanmar in 1991 was brought to Yangon Zoo, dying shortly afterwards (U Aye Hlaing verbally 1997), suggesting that small numbers may breed. Records are from: **Tasang**, July, year unspecified (Stanford and

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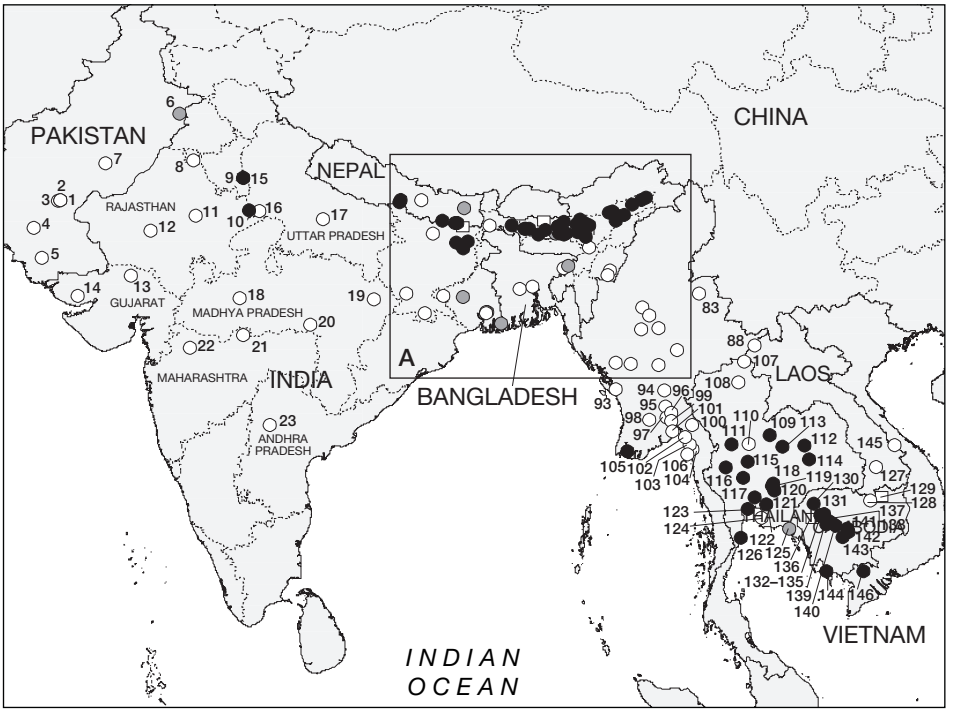
The distribution of Greater Adjutant *Leptoptilos dubius*: (1) Sukkur; (2) Eastern Nara; (3) Rohri; (4) Manchar lake; (5) Jhimpir; (6) Shahdara; (7) Alipur; (8) Sirsa; (9) Delhi; (10) Keoladeo National Park; (11) Sambhar lake; (12) Jodhpur; (13) Deesa; (14) Bhuj; (15) Loni; (16) Agra; (17) Lucknow; (18) Sehore; (19) Surguja; (20) Balaghat district; (21) Melghat forest; (22) Dhule; (23) Hyderabad; (24) Darbhanga; (25) Purnea; (26) Kishanganj; (27) Kursela; (28) Lohardaga; (29) Singhbhum; (30) Jaldapara Wildlife Sanctuary; (31) Jalpaiguri district; (32) Puruliya; (33) Bankura district; (34) Calcutta; (35) Fort William; (36) Salt lakes; (37) Amarpur; (38) Dibru-Saikhowa National Park; (39) Chaulkhoa; (40) Panidihing Sanctuary; (41) Laluka; (42) Sibsagar; (43) Majuli island; (44) Misamari; (45) Jorhat; (46) Manas National Park; (47) Nalbari; (48) Tezpur; (49) Orang National Park; (50) Kaziranga National Park; (51) Rangia; (52) Ranganadi; (53) Fakiragram; (54) Sareswar bheel; (55) Chakrashila Wildlife Sanctuary; (56) Barpeta; (57) Raha; (58) Kampur; (59) Gauhati; (60) Pobitora Wildlife Sanctuary; (61) Deepor beel; (62) Sonapur; (63) Palasbari; (64) Dew-Mornai; (65) Hojai; (66) North Cachar Hills district; (67) Baridua; (68) Kakching; (69) Toyang river; (70) Narayanghat; (71) Kathmandu valley; (72) Royal Chitwan National Park; (73) Chainpur; (74) Siraha district; (75) Kosi Tappu Wildlife Reserve; (76) Kosi barrage; (77) Biratnagar; (78) Hakaluki; (79) Sylhet; (80) Dhaka; (81) Faridpur; (82) Sundarbans; (83) Tasang; (84) Mu river; (85) Wetlet; (86) Mandalay canal; (87) Sameikkon; (88) Mekong valley; (89) Taunggyi; (90) Minbu district; (91) Magwe; (92) Tatkon; (93) Arakan; (94) Toungoo; (95) Penwegon; (96) Shwegyin; (97) Paungdawthi; (98) Tharrawaddy district; (99) Myitkyo; (100) Kaukarit; (101) Sittang estuary; (102) Wimpong rocks; (103) Moulmein; (104) Needong hills; (105) Labutta; (106) Kyaikkami; (107) Chiang Saen; (108) Mae Chai; (109) Lom Kao district; (110) Tha Law; (111) Kamphaeng Phet; (112) Khon Kaen; (113) Khon San; (114) Na Chuak; (115) Bung Boraphet; (116) Huai Kha Khaeng Wildlife Sanctuary; (117) Chavak lake; (118) Pak Chong-Lumtakong; (119) Khao Peng Ma; (120) Khao Yai National Park; (121) Sam Khok; (122) Chachoengsao; (123) Samut Sakhon; (124) Sriracha; (125) Chanthaburi; (126) Khao Sam Roi Yot National Park; (127) Xe Don plains; (128) Khone; (129) Siem Pang; (130) Ang Trapeang Thmor Reserve; (131) Phnum Kraom; (132) Prek Da; (133) Prek Toal; (134) Stoeng Sangke; (135) Prek Spot; (136) Battambang; (137) Tonle Sap lake; (138) Moat Khla; (139) Prek Kal; (140) Boeng Chhma; (141) Kruos Kraoum; (142) Baray district; (143) Kampong Chhnang; (144) Stoeng Kampong Smach; (145) Quang Tri; (146) Tram Chim Nature Reserve.

○ Historical (pre-1950) ◍ Fairly recent (1950–1979) ● Recent (1980–present) □ Undated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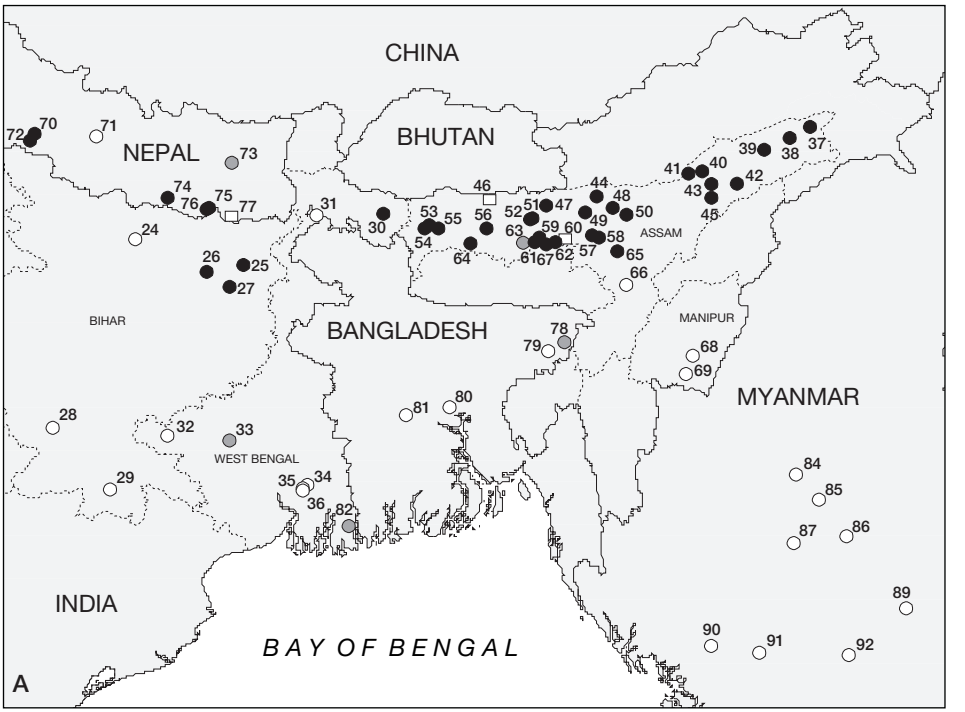
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Ticehurst 1938–1939); **Mu river**, Shwebo district, visited by non-breeders between April and September, 1930–1934 (Roseveare 1949); **Wetlet**, Shwebo district, "several birds" on the Myindaw *in* (an *in* is a small marsh), September 1932 (Smith 1942); **Mandalay canal** area, Shwebo district, 15, August 1930–1934 (Roseveare 1949); **Sameikkon**, Myingyan district, undated (Macdonald 1906); **Mekong valley**, "Southern Shan States", 1889–1900 (Bingham and Thompson 1900a), and at unspecified locality in Southern Shan States (Harington 1909a); **Taunggyi**, one record, 1889–1900 (Bingham and Thompson 1900a); **Minbu district**, up to nine, June to November, 1934–1937 (Roseveare 1952); **Magwe**, October 1905 (three eggs in NMS; see Remarks 7); plains north of **Tatkon**, Yamethin district, seven, November 1940 (Smith 1942); **Arakan**, 1909–1910 (Hopwood 1912b), 1943–1945 (Christison *et al.* 1946); **Toungoo**, October, vast numbers flying over, 1870s (Wardlaw Ramsay 1877); **Penwegon**, Pegu plains, one on the Tonkan chaung, August 1938 (Smith 1942); **Shwegyin** (Shwaygheen), Pegu, eggs collected, November 1878 (BMNH egg data), and Kadat, "incredible numbers", November 1877 (Oates 1877a), fewer in 1910 (Baker 1932–1935), rare in 1935 (Stanford and Ticehurst 1935a); **Paungdawthi**, Pegu, breeding, December 1910 (BMNH egg data); Ngapigo, on the Myitmaka, **Tharrawaddy district**, August 1923 (Smith 1942); **Myitkyo**, Pegu, August 1923 (Smith 1942), and at unspecified localities in the Pegu lowlands (Pegu plains), January 1874 (Wardlaw Ramsay 1877), undated (Oates 1875); **Kaukarit**, nearby in 1879–1880 (Bingham 1880a); **Sittang estuary**, at Theinchaung, six in July 1939, and 20 in October 1939 (Smith 1942); **Wimpong rocks**, Thaton, breeding, November 1877 and 1878 (BMNH egg data); between **Moulmein** and Ye, Tenasserim, 1874 (Hume 1874b) and at the Kharong hills, 8 km east of Moulmein, breeding, December 1848 (Hume and Oates 1889–1890); **Needong hills**, south-east of Moulmein, 40 km upstream of Ataran river (at the junction of the Zamee and Winyeo streams), breeding, January 1877, November 1878 (Bingham 1878, Harington 1909a); **Labutta**, one juvenile, 1991 (U Aye Hlaing *per* Khin Ma Ma Thwin *in litt*. 1997); **Kyaikkami** (Amherst), Tenasserim, common, undated (Mason 1850); Kyantan (untraced), January 1906 (BMNH egg data); Teygawbil (untraced), breeding, October 1907 (BMNH egg data); Naungtalaw (untraced), July, year unspecified (Stanford and Ticehurst 1938–1939); Meinmahla Kyun (unconfirmed), one, November–December 1982 (Salter 1982; also Scott 1989), although this is perhaps more likely to be a Lesser Adjutant, as it was feeding on exposed mud on a mangrove island; Yangon (Rangoon), one reported, February 1995 (S. Howe *in litt*. 1999).

■ ***THAILAND*** Gyldenstolpe (1920) stated that the species was "found throughout the whole country, though it apparently becomes more rare in the southern districts". Robinson and Kloss (1921–1924), however, believed it probably did not range south of Ratburi and their judgement appears to be the more accurate, as there are no confirmed records from the Thai-Malay peninsula (Wells 1999; see Remarks 2). It has been observed in the north (Chiang Rai and Phayao provinces), the south-east (Chon Buri), the Central Plains (Deignan 1963), the western hills adjoining Tenasserim, Myanmar, and as far south as Khao Sam Roi Yot National Park in Prachuap Khirikhan. It now occurs as a vagrant, usually to the north-east; but there were almost annual records in the 1980s–1990s of wandering individuals (probably from Cambodia) shot, supplied to zoos or otherwise exhibited by villagers, usually in the early part of the monsoon season (May–July) (P. D. Round *in litt*. 1999). Records are as follows: **Chiang Saen**, Chiang Rai, one, August 1914 (Deignan 1945, male in NRM); **Mae Chai** marsh, Phayao, a pair, May 1936 (Deignan 1945); **Lom Kao district**, Petchabun, one shot, June 1990 (*Bird Conserv. Soc. Thailand Bull*. 7[8]: 11–12), probably part of influxes from Cambodia; **Tha Law**, c.30 birds daily, 1912 (Gyldenstolpe 1913); **Kamphaeng Phet**, two flying south, November 1987 (*Oriental Bird Club Bull.* 7 [1988]: 34–40); **Khon Kaen**, 1990s (P. D. Round *in litt*. 1998); **Khon San**, Chaiyaphum, up to eight locally reported, June 1990 (*Bird Conserv. Soc. Thailand Bull*. 7[9]: 11–12); **Na Chuak**, 1990s (P. D. Round *in litt*. 1998); **Bung Boraphet**, one shot and winged somewhere in the vicinity of the lake, late 1980s

(P. D. Round *in litt*. 1998); **Huai Kha Khaeng Wildlife Sanctuary**, Uthai Thani, one perched in deciduous dipterocarp woodland of plains on the eastern border of the sanctuary, March 1984 (P. D. Round *in litt*. 1998); Suphanburi, at **Chavak lake** (Bung Chawak), mid-June 1995 (*Bird Conserv. Soc. Thailand Bull*. 12[8]: 14–15); **Pak Chong-Lumtakong**, Nakhon Ratchasima, three, October 1993 (*Bird Conserv. Soc. Thailand Bull*. 10[12]: 10–11); **Khao Peng Ma**, Prachinburi, one in flight, November 1998 (*Bird Conserv. Soc. Thailand Bull*. 16[1]: 13); **Khao Yai National Park**, two flying over, December 1987 (*Bird Conserv. Soc. Thailand Bull*. 5, 1 [1988]: 10, *Oriental Bird Club Bull.* 8 [1988]: 32–36); **Sam Khok**, one, January 1986 (P. D. Round *in litt*. 1998); **Chachoengsao**, one captured, November 1984 (B. Amget verbally 1985); **Samut Sakhon** (Inner Gulf of Thailand), two flying over, December 1993 (N. Bell, I. Crowther and B. Hall *per* P. D. Round *in litt*. 1998); **Sriracha** (Si Racha), c.12, April 1912 (Gyldenstolpe 1913); over **Chanthaburi**, three passing north to south, January 1971 (Ogle 1974); **Khao Sam Roi Yot National Park**, Prachuap Khirikhan, one, December 1983 (P. Kennerley, G. Speight and J. M. Turton *per* P. D. Round *in litt*. 1998), to at least January 1984 (*Oriental Bird Club Bull.* 3 [1986]: 33–36).

■ ***LAOS*** Early reports of this species are scarce and confined to southern provinces. While there are no reliable records from north Laos, the sighting on the Mekong in eastern Myanmar (Bingham and Thompson 1900a) must have been very close to present-day Laos, and reference to flocks of "marabous" along the Mekong between Pakxan and Vientiane (Bassene 1912) involved either this or Lesser Adjutant. Despite several recent reports, however, none has been confirmed (see Remarks 3), leaving just two confirmed localities for the species: **Xe Don plains**, one, 1920s or 1930s (Engelbach 1932); "below **Khone**" (Khon), Champasak, on the Mekong river, Engelbach (1932).

■ ***CAMBODIA*** The species was first recorded in the country in 1905 (Delacour 1929b). A small breeding population survives around Tonle Sap lake, tending to disperse widely in the country, including to coastal regions, during the wet season. Tonle Kong (Sekong river), 40–80 km north-east of Stung Treng town, and thus in the region of **Siem Pang**, apparently once common in the dry season, undated (Thomas 1964), now "rare" (Sun Hean *in litt*. 1997); **Ang Trapeang Thmor Reserve**, Banteay Meanchay province, 42 reported, June 1999 (C. M. Poole *in litt*. 1999), and elsewhere in this province at Veal Stung Kambot, one, October 1999 (*Cambodia Bird News* 3: 41–43); **Phnum Kraom**, one, March 1994 (Mundkur *et al.* 1995a); **Prek Da**, fledglings collected and reared at Phum Prek Toal by locals in 1994 (Mundkur *et al.* 1995a), three individuals, February 1996, five, March 1996, and locals reporting 30–50 nests at the river's source (Parr *et al.* 1996); **Prek Toal**, 40 km east of Battambang town, five seen overhead at a nearby village (Phum Prek Toal), March 1994 (Mundkur *et al.* 1995a), reported on most waterways in the vicinity and a minimum of 40 pairs reported breeding (Parr *et al.* 1996, Sun Hean *in litt*. 1997), with at least 60 and probably over 100 individuals, April 2000 (P. Davidson *in litt*. 2000, *Oriental Bird Club Bull.* 32 [2000]: 66–76); **Stoeng Sangke**, two, December 1997 (F. Goes verbally 1999); **Prek Spot**, six, May 1998 and one, June 1998 (Goes *et al.* 1998b); **Battambang**, one in the company of vultures at carrion near the town, undated (Thomas 1964); **Tonle Sap lake**, a few feeding on carcasses with vultures, 1920s (Delacour 1929b), up to 11 recorded near the lake, 1992 and 1993 (Scott 1992, Carr 1993, AWC 1993 count data *per* T. Mundkur *in litt*. 1998), and (specifically at 12°55′N 104°12′E), three adults observed resting and feeding on a stream through flooded forest, April 1994 (Mundkur *et al.* 1995a); **Moat Khla**, Siem Reap province, locally reported to breed nearby with perhaps 10–20 pairs in flooded forest near Stoeng Viel Tong (Parr *et al.* 1996); **Prek Kal**, Pursat, 15–20 with Lesser Adjutants, apparently attending nests in 3–4 trees in flooded forest, April 1994 (Mundkur *et al.* 1995a); **Boeng Chhma**, Kampong Thom province, a lake linked to Tonle Sap, 60 km west of Kompong Thom town, four adults, April 1994 (Mundkur *et al.* 1995a), apparently 70–80 with Lesser Adjutants, June 1998 (Goes *et al.* 1998b), a further

population by local report at Prey Kandal along a stream 20 km to the east, but aerial surveys detected no colony (Mundkur *et al.* 1995a); **Kruos Kraoum**, 84 birds, June 2000 (*Oriental Bird Club Bull.* 32 [2000]: 66–76); Veal Anh Chan, in or near **Baray district**, 34 in a group of large waterbirds, probably from Boeng Chhma, May 1999 (Veasna 1999); **Kampong Chhnang**, at Chhunuk Tru, one, May 1993 (Carr 1993), one, March 1994 (Mundkur *et al.* 1995a); **Stoeng Kampong Smach**, near Kompong Som (= Sihanoukville), 22 flew from coastal mudflats beyond mangroves, April 1994 (Mundkur *et al.* 1995a); Preah Vihear province (not mapped), including Chhep district, up to seven, January 2001 (P. Davidson *in litt*. 2001).

■ ***VIETNAM*** A few historical records come from central and southern regions but the species now appears only very infrequently. Unconfirmed or unspecific records include an adult in Hanoi Botanical Garden in 1958, which apparently came from near Hue, Thua Thien Hue province (Fischer 1961), and a specimen (in BMNH) from "Cochinchina" (Southern Region), pre-1878. Confirmed records are from: **Quang Tri**, three trapped at unspecified localities (possibly Vinh Linh), 1924 (Delacour and Jabouille 1925); **Tram Chim Nature Reseve**, Dong Thap, apparently common until 1960s (Luthin 1987), one, December 1992 (*Oriental Bird Club Bull.* 17 [1993]: 49–53).

POPULATION In the late nineteenth century, phenomenal numbers bred in Myanmar and dispersed widely throughout South Asia. It seems reasonable to assume that the global population consisted of (at least) many hundreds of thousands at that time. During the twentieth century this population plummeted. By mid-century the species had almost disappeared from its former stronghold of Myanmar, and by the early 1990s only around 400 individuals were thought to survive in the world (Perennou *et al.* 1994). Given recent information from Cambodia and Assam, this was revised upward to 500–600 (Mundkur *et al.* 1995a), then to under 700 (Rose and Scott 1997) and possibly to 750–800 individuals (Goes *et al.* 1998b); based on the evidence accumulated in this account, the actual figure perhaps approaches or slightly exceeds 1,000 individuals. During the course of a century, therefore, this large stork has experienced a decline commensurate with at least 1% a year, resulting in a population of at best 1%, and conceivably 0.1%, of the numbers that saw the start of the twentieth century: thus it has descended from being one of the commonest storks in the world to perhaps (with the possible exception of Storm's Stork *Ciconia stormi*: see relevant account) the rarest. The encounters of Oates (1878) and Wardlaw Ramsay (1877) with flocks many thousand strong now possess an almost mythical status and are clearly never to be repeated. The largest single flock seen anywhere in recent years was a group of 87 in March 1994 on the banks of the Brahmaputra near Gauhati (Choudhury 2000c).

Pakistan In the nineteenth century it was apparently common along the Eastern Narra, and "not uncommon during the rainy season in other parts of Lower Sind" (Butler 1878), specifically in the Rohri region, where it was considered "common enough" wherever there was water (Hume 1872–1873). Barnes (1885), however, stated that "in Sind it is seldom met with", and it was certainly usually scarce in northern Sind (Hume 1872–1873). Ticehurst (1922–1924) never found it in the province, concluding it was "but a straggler" that was reported occasionally "after the inundations subside"; indeed he suspected that it was already "a much rarer bird than formerly". Three years of fieldwork in Sind in the 1960s produced no records (Holmes and Wright 1968–1969). As rainy season influxes across India from Myanmar no longer occur, it is very unlikely to reappear in Pakistan.

India Early accounts described the species as a rainy-season visitor to India, probably from the breeding population in Myanmar (Hume and Oates 1889–1890). While the species was perhaps once a resident, spreading out from unknown Indian breeding areas in the wet season (A. R. Rahmani *in litt.* 1999), there is no evidence to prove or even suggest this. It was once common in "Lower Bengal" (southern West Bengal and Bangladesh) and especially in

the city of Calcutta, where "over a hundred" could be seen on Government House in the rains (Beavan 1865–1868). Individuals gathered on "almost every house" in the city (Baker 1922–1930) and "in great numbers" at Park Street cemetery (Lyell 1872), although they were "rare at some miles distance from the town" (Sundevall 1837). It was noted towards the end of the nineteenth century that they were "annually becoming rarer visitors" to the city of Calcutta (Munn 1894). In North Cachar Hills district, Assam, it was "by no means uncommon", occurring in some years "in very large numbers" (Baker 1894–1901).

Further east and in peninsular India the species also occurred exclusively during the wet season, but was less common. Ali and Ripley (1968–1998) stated that it bred "only sporadically in Assam, Orissa and the Sundarbans", being "not uncommon" throughout northern India during the rains. In Darbhanga district, Bihar, it was thought to be "rather scarce" (Inglis 1901–1904), and only "seen occasionally" (Dalgliesh 1902). In the Lucknow region, Uttar Pradesh, it was "not uncommon in small parties" of 2–8 (Reid 1887), although Jesse (1902–1903) later described it as "scarce". Barnes (1885) considered it "not uncommon" in central India and Gujarat, while A. O. Hume (footnote to Butler 1875–1877) mentioned that it occurred "somewhat sparingly" in Gujarat, Rajasthan and Maharashtra, and even more rarely in arid areas such as Jodhpur. It was not recorded at all in the latter area in the 1920s–1930s (Whistler 1938), nor in 1985–1989 (Rahmani *et al*. 1990). Around 1873 it appeared in very small numbers (two pairs seen in three years) around the lake at Sambhar, Rajasthan, during the rains (Adam 1873). In Dhule, Maharashtra, it was certainly a "rare" visitor, Davidson (1882) only encountering one individual. In Madhya Pradesh, Jerdon (1862–1864) described it as "not rare about Hyderabad in the Deccan", while Whitehead (1911) considered it to be "common from May till August at least" at Sehore. However, it was generally "very rare" in the Deccan (Davidson and Wenden 1878, Barnes 1885) and had apparently declined by the twentieth century, as Ali and Whistler (1933–1934) did not record it in their survey of Hyderabad.

In the 1920s Baker (1922–1930) stated that "it no longer occurs in the vast numbers of fifty years ago", this presumably relating to the imminent collapse of the Myanmar colonies. Until the 1950s it was still, nevertheless, "not an uncommon bird in the north and north-east", but its numbers continued to drop dramatically (A. R. Rahmani *in litt*. 1998). Several years of recent fieldwork in Gujarat have yielded no records (T. Mundkur verbally 1989, A. R. Rahmani *in litt*. 1998). The species has appeared sporadically in small but decreasing numbers around Delhi during the non-breeding season (see Distribution). Until the 1980s, individuals were regularly reported at Keoladeo National Park, Rajasthan, but since then there have been no confirmed records at this site or elsewhere in the state (A. R. Rahmani *in litt*. 1998). Despite widespread recent surveys in Uttar Pradesh and Madhya Pradesh (including around Dudwa National Park and Karera Bustard Sanctuary) the species has not been encountered and it is clearly extremely rare (Rahmani *et al*. 1990, A. R. Rahmani *in litt*. 1998). While the wet-season influx of the species once spread all across northern India to Pakistan, by the 1990s it involved no more than an irregular pulse of a very few birds into northern West Bengal and Bihar (Rahmani 1989a, A. R. Rahmani *in litt*. 1998).

Although breeding has been reported in Uttar Pradesh (Beavan 1865–1868), Assam and Orissa (Hume and Oates 1889–1890, Baker 1922–1930, Ali and Ripley 1968–1998, Kahl 1971), the only breeding records accepted here come from Assam (Saikia 1995). Around 300 individuals with 75 active nests were counted in the Brahmaputra valley in 1989 (Saikia and Bhattacharjee 1990a,b), and 99 nests were recorded in the whole of Assam in 1991, prompting the estimation that 500 individuals were present in the state (Changkakati and Das 1991). A few years later, this rose to 900 individuals and 163 active nests (Saikia 1995), primarily in unprotected areas (see Saikia and Battacharjee 1990d). The figures (active nests in parentheses) given by P. K. Saikia *in litt*. (1998) are slightly different: 370 (107) in 1989, 497 (131) in 1990, 563 (114) in 1991, 470 (135) in 1992, 725 (163) in 1993 and 649 (157) in 1994. Flocks of up to

44 have been recorded in Kaziranga National Park in the non-breeding season (Bhattacharjee *et al.* 1996), and flocks of 84 have been seen near Gauhati (Choudhury 2000c). Of 17 districts in the Brahmaputra valley surveyed in 1995, Greater Adjutants were found in seven, with a total of 573 counted, at an adult:juvenile ratio of 3:1 (Singha 1999). In the 1994–1995 breeding season, 573 Greater Adjutants were counted in the Brahmaputra valley, while in the 1996 non-breeding season 440 were counted; the largest concentration of nesting birds was in Nagaon district (Singha *et al*. in press). Only 11 known breeding colonies exist in the Brahmaputra valley, these being at (with number of nests in 1994–1997 in parentheses): Daulasal, Nalbari district (3), Singimari, Kamrup district (9), Dadara, Kamrup district (8), Satgwon, Kamrup district (7–8), Manaha, Morigaon district (9–19), Haibargaon, Nagaon district (18), Khutikatia, Nagaon district (5), Barpujia, Nagaon district (5–14), Dichial, Sibsagar district (1–6), Bagharchuk, Sibsagar district (8–11), and Maganapara, Sibsagar district (2) (Singha *et al*. in press). Estimations of the Assamese (and therefore Indian) population currently vary from 650–700 individuals (P. K. Saikia *in litt*. 1999) to over 800 (Choudhury 2000c).

The disappearance of the Myanmar colonies might have removed the primary source of the Indian population, the breeding portion of which was never thought to be large (A. R. Rahmani *in litt*. 1998). Oates (1878) believed that "certainly almost all" India's Greater Adjutants bred in Pegu state, Myanmar. The possibility should not be discounted that the species is only a fairly recent breeding colonist in Assam after the its colonies in Myanmar became untenable, or at least that the Assam population has grown as a result. Local people report, however, that some village colonies are very old (P. K. Saikia *in litt*. 1999).

Nepal Ripley (1950b) stated that in 1947–1949 this species occurred throughout the terai in all areas where water was found in open country, but that it was uncommon. He made no mention of Lesser Adjutant, however, a species he may have overlooked, as it is generally much the commoner of the duo in Nepal. In and around Koshi Tappu Wildlife Reserve the Greater Adjutant was thought to be an uncommon resident (Dahmer 1976) but has more recently proved a rare non-breeding visitor (Heinen 1990, Wheeldon 1995). The numbers involved are very small (Baral 1993) but there is no direct evidence of recent declines (C. Inskipp and T. P. Inskipp *in litt*. 1998).

Bangladesh In the 1870s it was seen in flocks of up to 300 on migration in around Faridpur (Cripps 1878). Although J. R. Cripps (in Hume 1888) mentioned "large flocks" in Sylhet, A. O. Hume himself made no observations in that portion of current Bangladesh. Early in the twentieth century, Baker (1922–1930) described the species as "still common in many parts" of the country, but mentioned no records. It has often been reported to breed in the Sundarbans (Baker 1922–1930, Ali and Ripley 1968–1998), and, judging by the descriptions provided (in Hume and Oates 1889–1890) of the "large or pouched species" with "pale wing-band complete", mid-nineteenth-century breeding records are certainly accurate. Baker (1922–1930) estimated 50 pairs in the Sundarbans and, more recently, Mountfort and Poore (1968) identified several each day of their visit (but see Remarks 6). By the 1980s it was "rare" (Khan 1982), and in the 1990s only one or two wandering individuals could be found (P. M. Thompson *in litt*. 1999).

Myanmar The species was once abundant on the large plains of southern Pegu state, being seasonally much more common than the resident Lesser Adjutant (Oates 1875, 1883, Wardlaw Ramsay 1877). "Literally hundreds of thousands" gathered there before breeding in nearby forests (Hume and Oates 1889–1890). At the end of October and the beginning of November, the species flew over the town of Toungoo in enormous flocks, one of which was audible nearly 15 minutes before it arrived owing to the noise made by the birds' wings, and took about 20 minutes to pass overhead (Wardlaw Ramsay 1877). These "vast armies" settled on the Pegu lowlands for "about two days" before moving to their breeding colonies (Oates 1878). "Incredible" numbers of Greater Adjutants were seen during this time "huddled

together" on the plains, with countless groups of c.50 birds separated by gaps of c.30 m visible in all directions for 3 km, and the whole area "literally covered with them" (Oates 1878). Flocks of up to 200 adjutants of both species and a much larger number of pelicans (probably Spot-billed Pelican *Pelecanus philippensis*) were observed in a 1 ha southern Pegu fishery (Oates 1875). At the remarkable colony itself, in forests west of Shwegyin, "millions of birds" (chiefly the two adjutants and Spot-billed Pelicans) nested in an area c.19 km long and c.8 km broad (Oates 1878), later given as about 160 km^2 (Oates 1883). The nesting colonies at the Needong Hills also contained "immense numbers" of both adjutants (Bingham 1878, Baker 1922–1930). Elsewhere, the species was not quite as abundant, but it still generally occurred in large numbers, possibly mainly on migration. It was common in Arakan in the west (Hopwood 1912b), around Kyaikkami (=Amherst) in the south (Mason 1850), and "very common in the cold weather in the plains between the Salween and Sittang rivers" (this presumably referring to southern Pegu state and southward) (Hume and Davison 1878), but less common in Myingyan district (Macdonald 1906). Although "fair numbers" were observed each rainy season in Shan state ("Southern Shan States") by Rippon (1901), it was described as "rare" in the same region by Bingham and Thompson (1900a). In general it was considered "uncommon" in northern Myanmar (Stanford and Ticehurst 1938–1939).

By the mid-twentieth century the forests of the Sittang valley had been felled and replaced with rice cultivation, the stork colony had collapsed (see equivalent section under Spot-billed Pelican) and numbers of Greater Adjutants had declined drastically. The huge influxes recorded 70 years earlier no longer occurred; the species remained widespread but uncommon in the wet season and was thought to migrate to some unknown breeding locality during the cold season (Smythies 1986). It was still a "common or very common" visitor to Minbu district between June and November, 1934–1937 (Roseveare 1952), although in Shwebo district it was usually seen singly or in small flocks of up to 15 birds, but never common (Roseveare 1949). Christison *et al.* (1946) found it scarce in Arakan, with stragglers recorded in the cold season. Since a sighting in the 1940s in the plains of northern Myanmar (Hancock 1989) there have been very few recent records in the country (Luthin 1987, Khin Ma Ma Thwin *in litt*. 1997): in less than 100 years the species toppled from spectacular abundance to almost total absence. The capture of a lone juvenile in 1991 (Khin Ma Ma Thwin *in litt*. 1997) suggests recent breeding by small numbers in a remote region.

Thailand Although there are no confirmed breeding records for Thailand it is likely that it once bred; areas of floodplain forest dominated by *Dipterocarpus alatus* and other tall trees (similar habitat to the early nesting colonies in Myanmar) once occurred widely in the country but were cleared for agriculture before twentieth-century ornithological record-keeping commenced (P. D. Round *in litt*. 1998). Indeed, Gyldenstolpe (1916) concluded that birds "probably breed" in Thailand after he saw two copulating on top of a large tree near the Mae Ping in October 1914. It was apparently still a common visitor in Chiang Rai around 1940 (Deignan 1945). By the close of the twentieth century, however, no more than a handful of individuals occurred annually, with diminishing frequency year by year (P. D. Round *in litt*. 1998), and it has essentially disappeared from the country (Bain and Humphrey 1982, Luthin 1987).

Laos Early in the twentieth century the species was common along the lower reaches of the Mekong river in southern Laos, generally below the falls at Khone (Khon) (Engelbach 1932), and it may have been seasonally quite widespread along the Mekong (see Distribution). There are no confirmed recent records (see Remarks 3) and it is doubtless now a very rare visitor if it occurs at all (Thewlis *et al*. 1998, Duckworth *et al*. 1999).

Cambodia It was encountered "occasionally" in the late 1920s (Delacour 1929b), and considered locally common in the 1960s (Thomas 1964). By the end of the twentieth century numbers were thought to lie between 100 and 150 birds (Mundkur *et al.* 1995a). However, high counts around Prek Toal, with c.80 estimated near the local waterbird colonies (Parr *et*

al. 1996), and up to 100 there in 2000 (P. Davidson *in litt*. 2000), suggest that total numbers may be higher. A breeding colony was finally found near Prek Toal in 2000 when "53 adults and chicks" were found in a stretch of forest between Prek Spot and Prek Preah Dam Cheu (Goes 2000c, P. Davidson *in litt*. 2000), the only known breeding site in South-East Asia. The colony is part of a large waterbird nesting area (termed "Prek Dai Krey Kreng") which extends 2.5 by 3 km (Briggs 2000). Given the difficulties posed by counting nesting storks in broad tracts of virtually impenetrable flooded forest, totals from the Tonle Sap colonies are thought to be absolute minima, with the actual population of this species possibly being "much higher" (R. J. Timmins *in litt*. 2001). Away from this key breeding locality, a small breeding population might also survive in coastal districts: one chick being raised in captivity in the coastal city of Kompong Som (=Sihanoukville), around January 1994, was reported to come from a colony near the coast in the north of the same province (Mundkur *et al.* 1995a). In addition, locals reported a colony in the Kamchai mountains, Kampot, in 1978–1979 (Mundkur *et al.* 1995a). Around 70–80 birds were noted at Boeng Chhma in 1998 (Goes *et al.* 1998b) and a flock of 34 was found elsewhere in Kompong Thom in 1999 (Veasna 1999), perhaps (indeed probably) both involving foraging birds from the Prek Toal colony. Recent searches for the species in Stung Treng and Ratanakiri provinces, where the species might be expected to persist, were unsuccessful (Timmins and Soriyun 1998).

Vietnam The species apparently outnumbered the Lesser Adjutant in Quang Tri province in the early 1920s, with the situation reversed in southern regions (Delacour and Jabouille 1925). All other reference to the species in Vietnam clearly depicts it as much the rarer adjutant (e.g. Wildash 1968). Recently there have been very few confirmed records and it appears only as an irregular visitor.

ECOLOGY ***Habitat*** This "prodigy of ugliness" (Sundevall 1837) frequents various wetland habitats, particularly those drying out and where fish are concentrated, including shallow or deep lakes, swamps and marshes, river and canal beds, stagnant pools, damp grassy plains and paddyfields (Oates 1875, 1883, Roseveare 1949, Ali and Ripley 1968–1998, Saikia 1995, 1998), usually in the lowlands but occasionally up to c.1,500 m in the Himalayan foothills of Nepal (Biswas 1960–1966, 1974). It also visits non-wetland habitats such as fallow agricultural land and (especially in South-East Asia) drier country with small ponds and waterholes scattered in open deciduous woodland (Delacour 1929b, Saikia 1995). In Dibru-Saikhowa National Park, Assam, the two species of adjutant occur side-by-side, but apparently the Lesser tends to frequent the marshes, wet paddyfields and edge of wetlands whilst the Greater is found mainly on the dry sandy riverside "chapories" (seasonally flooded grassy sandbanks and river islands) (Choudhury 1995). An association with forests has occasionally been noted; in Assam, for example, J. R. Cripps (in Hume 1888) mentioned its preference for "quiet but damp pathars well hemmed-in with forest", and in southern Laos it has been recorded in open marshy habitat amongst dense forest (Engelbach 1932). In Cambodia it is found in seasonally flooded riverine grassland and pools in dry dipterocarp forest (Sun Hean *in litt*. 1997). It occurs in riverine forests, flooded forests and the inland fringes of mangrove forests (Mundkur *et al*. 1995b) but, unlike the Lesser Adjutant, it generally avoids peat-swamp forest and the tidal mangrove foreshore (Hancock *et al*. 1992, P. D. Round *in litt*. 1998). It nests (see Breeding) and often roosts on trees. In Assam, roost trees are most commonly *Bombax ceiba* (41%), *Anthocephalus cadamba* (17%), *Alstonia scholaris* (14%) and *Ficus religiosa* (12%) (Saikia 1995).

The Greater Adjutant has long been known in India for making frequent use of rubbish dumps (municipal, grocery and meat), abattoirs and burial grounds, and these man-modified environments are important for its survival (Ali and Ripley 1968–1998, Hancock 1989, Saikia and Bhattacharjee 1990a, Saikia 1995). Birds are therefore often observed in urban settings, where they perch freely on the roofs of buildings (see, e.g., Beavan 1865–1868). During the non-breeding season in Assam, they disperse to dumps in various major towns to feed on

rubbish alongside vultures, kites and feral dogs (Saikia 1995). After fledging, juvenile birds move directly to these areas (Saikia 1995). Although the species has been described as shy and residing in remote wetlands (Hodgson 1829a), at urban rubbish dumps it is often extremely confiding (Cripps 1878, Saikia 1995).

In Assam, wetlands are used most intensively by Greater Adjutants between October and February (the breeding season), when fish stocks are apparently at their highest; around 12% of birds used wetlands in September, rising to 55% in October, 64% in November and 70% in December (Saikia 1995). During the non-breeding season, more than 90% of birds concentrate in urban disposal sites (Saikia 1995). Where small wetlands lie adjacent to disposal sites, groups of non-breeding adjutants can remain throughout the year (Saikia 1995).

Food This species often associates with other birds attracted to wetlands or refuse disposal sites while foraging, and has been recorded feeding alongside other storks (e.g. Lesser Adjutant, Woolly-necked Stork *Ciconia episcopus*), pelicans, cormorants, egrets, terns, cranes (e.g. Sarus *Grus antigone*), vultures (e.g. White-backed Vulture *Gyps bengalensis*), kites (e.g. Black Kite *Milvus migrans* and Brahminy Kite *Haliastur indus*) (Oates 1875, Wardlaw Ramsay 1877, Roseveare 1949, Hancock *et al.* 1992, Saikia 1995). It tends to forage in tight flocks at wetlands, carcasses and rubbish dumps; in wetlands it feeds by touch, sweeping its large bill under the water's surface or by probing and groping in muddy areas, while in dumps it dominates other scavenging animals, often stealing food from vultures (Saikia 1995).

The species is principally a carnivore and consumes many vertebrates, particularly to meet the considerable calcium requirements of fast-growing young (Hancock *et al.* 1992). Its diet includes carrion, fish, frogs, reptiles (Russell's viper *Vipera russelli* and spiny-tailed lizard *Uromastix hardwickii* being reported; six of the latter were found in the crop of one bird in Sind: Murray 1878), crustaceans (such as freshwater crabs), large insects, even maimed or young ducks and other birds (Macdonald 1906, Panday 1974, Sridharan 1986, Baruah 1991, Roberts 1991–1992). In Assam, Saikia (1995) enumerated 36 species of fish, four amphibians, two reptiles and one mollusc plus small mammals and birds in the winter diet, but found that chicks were fed for the first six weeks almost exclusively on small fish; these included the families Cobitidae, Mustacembilidae and Cyprinidae, and the species *Botia dario*, *B. rostrata*, *Balitora brucei*, *Mastacembellus armetus*, *M. punctatus*, *Puntius puntius*. After six weeks young were given larger fish and eels such as *Wallgo attu*, *Channa striatus*, *C. marualia*, *Anguila benghalensis* and *Heteropneustes fossilis* (Saikia 1995). Adults have been reported feeding on the bones and flesh of dead cattle (including a shot gaur *Bos gaurus*), other livestock, domestic animals, the disposed refuse of fish and meat markets and exposed human bodies at burial grounds (Burton 1921, Delacour 1929b, Ali and Ripley 1968–1998, Hancock *et al.* 1992, Saikia 1995). They have also been observed capturing and devouring live animals from rubbish dumps, such as rats, snakes and even an unfortunate House Crow *Corvus splendens*, while in paddyfields they regularly snatch domestic ducks and ducklings, especially during July and August (Sridharan 1986, Saikia 1995). An individual at Panidihing in Assam was watched capturing and, after ten minutes, swallowing a wild duck in January 1995 (Singha 1995). Around Calcutta, the species once lived "chiefly on the putrid bodies which are cast up on the river banks" after Hindu burials, and its bill is reportedly strong enough to "cut off the arm from a corpse" (Sundevall 1837). Rao and Murlidharan (1989) watched an individual swallow a 30 cm section of vertebral column from a buffalo calf, a process which took five minutes. It is this behaviour which gives rise to the Hindi name "Hargila" or bone-swallower. Baker (1922–1930) stated that "there are few things an Adjutant will not swallow" and mentioned their "curious habit of picking up bright unusual objects, from small pieces of metal to articles the size of a soda-water bottle", while Gurney (1871) noted that "in the way of food nothing comes amiss"; he had even seen one "gulp down a shoe of substantial native make" in the streets of Calcutta. Likewise, Akhtar (1974) watched a captive individual swallow "a shoe well shod with iron". Unidentified adjutants have been noted eating gravel on riverine

sandbanks, possibly to aid digestion (Schomburgk 1864), although no more recent observation has corroborated this sighting. A report of a large flock feasting on locusts in Rajasthan (Singh and Singh 1960; and repeated by Hancock *et al*. 1992) is considered to be erroneous (A. R. Rahmani *in litt*. 1998).

***Breeding** Season* In Assam (as in the defunct Sundarbans colony) the species breeds in the dry season; birds congregate at the nesting areas from October onwards and lay eggs between November and January; some chicks are still being fed at the nest in April (Hume and Oates 1889–1890, Saikia 1995, Saikia and Bhattacharjee 1996). The breeding season in Myanmar is or was also between September and January, with eggs laid in October or December and activity continuing until February or March (Bingham 1878, Oates 1878, 1882, 1883, Hume and Oates 1889–1890, Baker 1922–1930). Around Tonle Sap, Cambodia, the timing of breeding is similar: October–March (Goes *et al.* 1998b).

Nest site The species breeds singly, semi-colonially or colonially in traditional arboreal sites which are sometimes used for many years, often in colonies mixed with other waterbirds, including Lesser Adjutant (Bingham 1878, Hancock *et al.* 1992, Saikia 1995, Mundkur *et al.* 1995a). It has also been recorded nesting alongside Spot-billed Pelican (Oates 1877a, 1883) and Asian Openbill *Anastomus oscitans* (Baruah 1991). Characteristically, adjutants of both species tend to place their nest on very tall trees; Hancock *et al.* (1992) mention trees 30 m tall, but they can be even higher—the trees ("wood-oil", *Dipterocarpus*) selected for nesting in the Pegu colony were of "stupendous" size, up to 45 m in height (Oates 1878). The birds found nesting in the Sittang valley occupied nearly 160 km^2 of tall, undisturbed, swampy *Dipterocarpus* forest (Oates 1883). While this colony must have contained tens (or probably hundreds) of thousands of pairs of this species, it has disappeared entirely and the largest colony reported in the twentieth century was of 40 nests in Assam (Saikia 1995). An apparent colony near Tonle Sap, Cambodia, was in flooded forest not far from the edge of a lake, in an area with a few densely packed *Barringtonia* or *Xanthophyllum* trees (Mundkur *et al.* 1995a). The current breeding site in this area is in flooded forest with a 2–3 m tall shrub layer and nests in almost all emergent (4–10 m) trees, these being relatively low (R. J. Timmins *in litt*. 2001). At the Needong Hills, Myanmar, the species nested at the top of precipitous limestone cliffs rising steeply out of a level plain and overhanging the Ataran river (Bingham 1878, Harington 1909a). There are 4–5 isolated limestone pinnacles in this area and nests were built on stunted trees growing high up on them (Bingham 1878).

All details regarding nest sites in Assam presented in the following paragraph were reported by Saikia and Bhattacharjee (1990a), Saikia (1995) and P. K. Saikia *in litt*. (1998). Nests were usually located within 3–50 (or 3–200) m of human habitation in densely populated urban or suburban areas and tended to be within 500–5,000 m of rubbish dumping centres. The main vegetational characteristics of nest sites were clumped trees, often with high foliage density in the upper canopy, and thick bamboo undergrowth often "as high as the nesting trees"; around 64% (sample size not given) of nests were located in areas dominated by bamboos. They are constructed in the top branches of trees (including *Bombax ceiba*, *Anthocephalus cadamba* and *Ficus religiosa*) that grow in lowlands; nests were found in eleven different tree species, principally *B. ceiba* (54.81 %) and *A. cadamba* (33.13 %) (sample size not given); nests are constructed at a height of around 16 m in residential and non-residential areas, and slightly lower (c.8.5 m) in protected areas. Greater Adjutants tended to be more colonial than Lesser Adjutants and yet their colonies were more camouflaged, their nests apparently visible from relatively close range. The most common items used in nest construction were branches or stems of *Bombax ceiba* (19%), bamboo spp. (15%) and *Albizia procer* (15%). Nests were usually constructed in the middle of the topmost canopy of large tree species such as *Bombax ceiba* (34.5% of nests), *A. cadamba* (33.8%) and *Alstonia scholaris* (11.5%).

Other tree species in which nests have been recorded in India include *Albizia lebbek*, *Garcinia cawa*, *Artocarpus lakoocha*, *Streblus aspera*, *Ficus glomerata*, *Syzygium cuminii*,

Mangifera indica (Saikia and Bhattacharjee 1990a) and *Albizia lucida* (Changkakati and Das 1991). Of seven nest trees identified in Sibsagar town, January 1991, six were *Alstonia scholaris* and one was *Bischofia javanica* (Choudhury 1993c).

Nest structure The nests observed by Oates (1878) in the Sittang valley were enormous structures placed on horizontal branches up to 15 m from the trunk of very large trees. These nests were made of "coarse sticks" and invariably placed in the fork of a branch towards the periphery of the tree canopy (Oates 1878). Nests (n=39) in Assam were a mean of 158 cm long, 80 cm wide and 14 cm deep, consisting of a large platform of sticks of different sizes surrounded by an outer layer of bamboo stems and lined with fresh leaves of nearby trees (Saikia 1995).

Clutch size, incubation and parental care Of 278 clutches encountered in Assam, all contained 2–3 white eggs (mean of 2.61) (Saikia 1995). Similarly, at the Sittang valley colony most clutches contained three eggs (Oates 1878), while those at the Needong Hills comprised 3–4 eggs (Bingham 1878). The incubation period is 28–30 days (Hancock *et al.* 1992, Saikia 1995). In Assam, 61.3% of eggs in 278 clutches produced fledglings (Saikia 1995). Both sexes share nest building, incubation and feeding of the nestlings (Baker 1922–1930, Ali and Ripley 1968–1998, Saikia 1995). A. R. Rahmani (*in litt*. 1999) has observed adults bringing water to juveniles on the nest, either to cool them down or for them to drink.

Migration During the period of its former abundance, the species visited northern India mainly during the wet season (roughly June–October) and then returned to Myanmar for breeding during the cold season (Oates 1878, Inglis 1901–1904, Hancock *et al.* 1992). Indeed Hume and Oates (1890) believed that the entire Indian population of the species consisted of non-breeding wet season visitors. In north Gujarat, Butler's (1875–1877) earliest sighting of Greater Adjutant was on 15 July, his latest on 29 February. In Faridpur, Bangladesh (between the former breeding and non-breeding ranges), large flocks were seen on migration, usually in April, and again in October (Cripps 1878), by which time they were presumably on their way south to Pegu. While Cripps's dates square admirably with the timing of arrival and departure from southern Myanmar (see Breeding and next paragraph), the dates from Calcutta are slightly less straightforward. When the species used to visit the city they apparently did so in large numbers late in the year with "very few" after 1 January (Lyell 1872), although the situation was perhaps confused by late-staying non-breeders or birds from the nearby Sundarbans colony (see Beavan 1866a). Sundevall (1837) stated that birds "remain near Calcutta all the year" and Irby (1861) thought that they were "common throughout the year" in Uttar Pradesh, but all other accounts indicate that the species was migratory.

At the end of October and the beginning of November (having presumably travelled directly from Bangladesh without lingering much in central Myanmar), adjutants passed over Toungoo, flying southwards in huge flocks (Wardlaw Ramsay 1877). "Immense numbers" of adjutants arrived in the Pegu lowlands virtually simultaneously in October, flying shortly afterwards to their breeding grounds in the Sittang valley (Oates 1877a, 1882, 1883). They decamped from these colonies in February or March, with only a few stragglers remaining throughout the year (Oates 1882). Oates (1875) had previously stated that the species was present "all the year round" in lowland Pegu, associating in large flocks after the rains when the wetlands dried up and provided rich sources of food, but he might have been mistaken. It was a seasonal visitor during autumn and winter in Tenasserim (Hume and Davison 1878). Roseveare (1949) saw it in Shwebo district between 22 April and 24 November (apart from one wandering bird in February), and believed that it still bred in southern Myanmar and moved to central Myanmar and possibly further north for the rest of the year. The available evidence suggests that a certain portion of the Myanmar population was resident, while large numbers of migrants travelled north in stages after breeding, eventually filtering into India as the year progressed, then returning *en masse* to breed.

The known Thai records are scattered throughout the year (January, March, April, May, June, August, October, November, December), and show no seasonal bias (P. D. Round *in*

litt. 1999). Likewise the Cambodian population appears to undertake no major annual migration, although there is too little evidence to be sure that it did not once do so. Most waterbirds breeding near Tonle Sap disperse away from the lake during the wet season, visiting wetlands across Cambodia (Mundkur *et al*. 1995b). The Greater Adjutant appears less inclined to undertake this movement, but is nevertheless regularly recorded away from the lake during the non-breeding season (C. M. Poole *in litt*. 1998). Furthermore, no storks of any species were recorded at Boeng Chhma in January 1996, strongly suggesting that all had moved away from the area during the high water period (Goes 1999a).

THREATS Underlying the phenomenal decline of this formerly abundant species are the excessive pressures imposed by Asia's unsparing development: breeding sites and feeding habitats have been cleared, drained, polluted and disturbed (Khan 1984, Luthin 1987, Hancock 1989, Rahmani *et al*. 1990). Hunting of adults and collection of eggs and chicks have also caused problems in certain parts of the species's range (Luthin 1987, Mundkur *et al.* 1995b). On the basis of this rate of decline, Hancock *et al*. (1992) suspected that this is the "most endangered of all the Asian storks". Certainly, if these threats are allowed to continue unchecked in India and Cambodia, populations of the species will dwindle towards non-viable levels, with potentially disastrous effects.

Habitat loss and modification Being at least seasonally dependent on wetlands for foraging and tall trees for nesting, the species suffers from the ongoing destruction of the former (through drainage, encroachment, overfishing etc.) and the latter (through logging, fire, exploitation, etc.). In South-East Asia in particular all large waterbirds are "suffering reduction in available breeding sites through felling of trees providing nest sites and loss of foraging areas to urban and industrial development" (Kushlan and Hafner 2000). *India* The large trees used as nesting and roosting sites have mostly been felled throughout its Indian breeding range (i.e. Assam); the majority of remaining nest trees are sited on private land, and these are regularly cut down to provide building materials, furniture or fuel (Saikia and Bhattacharjee 1990a). They are also deliberately removed to eliminate the unpleasant noise and aroma of stork colonies from the vicinity of human settlements (Saikia and Bhattacharjee 1990a). The loss of even one tree can have devastating effects, as witnessed in Assam when a tree containing six active nests was felled, causing the destruction of 13 nestlings and three eggs (Saikia and Bhattacharjee 1990a). The owner of a grove of trees at Nagaon, Assam, intended to clear the area for a housing project, despite the 24 nesting pairs of this species in 1996 (*Oriental Bird Club Bull*. 25: 14–18). In the breeding season the species relies on wetlands for food and this habitat has also declined alarmingly in extent throughout the north-eastern states of India. The decline in wetland productivity through pollution and over-exploitation also affects the success of the species (Saikia and Bhattacharjee 1990a). Populations of waterbirds in the Brahmaputra valley in general are declining because of "habitat alteration, extensive fishing, weed growth, siltation and biotic interference in the wetlands" (Saikia and Bhattacharjee 1990b). At Deepor beel, for example, encroaching rice cultivation around the fringes of the lake is "creating fundamental problems" (Saikia and Bhattacharjee 1989c). Other factors potentially responsible for reducing the Greater Adjutant population are pesticide poisoning, wetland drainage, industrialisation and water hyacinth infestation (Rahmani 1989a, Hancock *et al*. 1992). Changes in agricultural and municipal practices are also probably responsible for a decline in the quantity of carrion available (A. R. Rahmani *in litt*. 1998): reduced usage of open rubbish dumps for disposal of carcasses and foodstuffs has adversely affected numbers of the species (Saikia 1995), which at one stage was thought to be faring poorly against rising population of vultures in India as the latter were apparently dominant (at least in numbers) at carcasses and left little to the adjutants (Rahmani 1989a); given the reversal in fortunes for vultures (see relevant accounts), however, perhaps the food supply for this carrion-eating stork will increase. *Nepal* H. S. Baral (*in litt*. 1998) described

loss of habitat as one of the main threats to the species. *Bangladesh* The Sundarbans colony was apparently eliminated by long-term logging operations (Hancock *et al.* 1992). Khan (1984) reported that "the loss of tall nesting trees from the countryside, bad practices of clear-felling the natural forests and improving the same area with commercially desired tree species, virtually wiped out several species [of stork] while depriving several others of nesting opportunities". The widespread destruction of nesting trees (see equivalent section under Pallas's Fish-eagle *Haliaeetus leucoryphus*) is perhaps the major factor underlying the disappearance of the Greater Adjutant from the country. *Thailand* The loss of lowland swamps, forests and undisturbed wetlands has adversely affected populations of all large waterbirds (Round *et al.* 1988, P. D. Round *in litt.* 1998). *Laos* Wetlands have been largely 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). However, ample habitat is believed to remain in the country if the issue of persecution could be addressed (J. W. Duckworth *in litt.* 1999). *Cambodia* The felling of large trees continues to reduce the availability of nest sites (Sun Hean *in litt.* 1997).

Disturbance Details of disturbance at waterbird nesting and foraging sites appear in the equivalent sections under Sarus Crane and White-shouldered Ibis *Pseudibis davisoni*. *India* This species does not seem especially intolerant of human disturbance in Assam, where it can be seen "moving between houses in crowded localities and markets or perching on human dwellings" (A. R. Rahmani *in litt.* 1998). Nevertheless, some feeding sites may be rendered unattractive by the intensity of human usage; Deepor beel for example is heavily hunted and fished both day and night (Scott 1989). *Nepal* H. S. Baral (*in litt.* 1998) described disturbance of wetlands as one of the main threats to the species in Nepal. *Cambodia* 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; these areas tended to be avoided by feeding large waterbirds, a situation that looks likely to deteriorate as the number of settlers is increasing (Veasna 1999).

Persecution *India* There is apparently a long history in Bihar of the Greater Adjutant being snared by local people and eaten (Inglis 1901–1904). It was also apparently sometimes killed because of a superstitious belief in its medicinal properties (see Remarks 8). In general, however, it is relatively little threatened by persecution in India, and even valued by local people on the grounds that it effectively disposes of waste and carrion (A. R. Rahmani *in litt.* 1998). Because it eats meat it is generally seen as "unclean" by Indian Hindus and therefore left alone (Rahmani 1989a, Rahmani *et al.* 1990, Saikia and Bhattacharjee 1990a); elsewhere this viewpoint does not apply and it is persecuted accordingly (see, e.g., Round *et al.* 1988). This disparity explains why it does not visit urban areas outside India. Nevertheless, hunting remains a tangible threat in Assam. Saikia and Bhattacharjee (1990a,b) considered the primary pressure in the Brahmaputra valley to be the netting, trapping and shooting of adults (especially vulnerable incubating birds), the collection of nestlings and poisoning of fish. The species is unpopular with fishermen and fishpond owners because of the perceived damage it does to fish stocks, and individuals are regularly found shot or poisoned as a result (P. K. Saikia *in litt.* 1998, 1999). Large-scale killing of birds with firearms and nets occurred at Panidihing Sanctuary in Assam until 1989, followed by insecticide poisoning (Baruah 1991). Local people reportedly deliberately poison storks with Furadon and Malathion at this site, and in one case an adjutant was apparently burned alive as "punishment" for taking fish from the wetland (Baruah 1997), suggesting that negative attitudes towards adjutants may be increasing in the region. Saikia and Bhattacharjee (1990a) also mention the Santhal tribe from Bihar whose members spread in small groups throughout the Brahmaputra valley of Assam during winter primarily to hunt

and capture birds and mammals for consumption and sale in markets; they apparently frequently target the Greater Adjutant in their hunts. However, no nomadic stork-hunters were observed during prolonged surveys in 1994–1997 (Singha *et al*. in press). Meanwhile, long-running political turmoil in the region has undermined protective measures in some areas and might yet play a role in reducing the species's most important surviving population (del Hoyo *et al*. 1992). *Nepal* Hunting is a major threat to the species in Nepal (H. S. Baral *in litt*. 1998; see Threats under Sarus Crane). *Bangladesh* "Over-hunting, trapping, destruction of nests and eggs" in the country has "virtually wiped out several species" of stork (Khan 1984). The shooting of adult birds is thought have accelerated the disappearance of the Greater Adjutant from the country (Khan 1984). *Myanmar* It was eaten by local people in Myingyan district around 1900 (Macdonald 1906). Oates (1875) noted that, being voracious eaters, the birds were "a special object of aversion" to the many fishermen of Pegu, who paid large rents for the right to catch fish but lost much of their catch to the bold and gluttonous storks; he added that "no ordinary amount of frightening will drive them away". Indeed, even until the 1920s few people carried guns in Myanmar such that most birds were "tame as tame" (Stanford 1954). Shortly afterwards firearms became widely available and the fate of many Greater Adjutants, those "objects of aversion", is easily imagined. Little is known about current hunting practices in the country but it is thought that levels of persecution and poaching are very high (U Tun Yin 1954; see Threats under White-winged Duck *Cairina scutulata*). *Thailand* As with all other large birds, the Greater Adjutant is routinely shot by villagers if encountered, the casualties being offered for sale to zoos (P. D. Round *in litt*. 1999; see equivalent section under Spot-billed Pelican). It is unlikely that it could ever become re-established given the current high level of persecution (P. D. Round *in litt*. 1999). *Laos* Hunting is the major problem for this species in Laos, as it is integral to local traditions for a variety of cultural and economic reasons (see Thewlis *et al.* 1998) and populations of large, conspicuous species are particularly susceptible. Given the previous co-existence of large waterbirds and people in the region, there is still ample habitat in the country if the issue of persecution can be addressed (J. W. Duckworth *in litt*. 1999). *Cambodia* Adults are trapped for sale as pets or food, often by stalking roosting birds at night and dazzling them with a torch, by which method they can be "caught easily"; at Veal Anh Chanh, for example, "many people" were observed looking for roosting waterbirds with flashlights at night (Veasna 1999). This threat, along with the ubiquity of guns and the resultant hunting pressure, has led to clear declines in large waterbird populations in the country (Veasna 1999). However, the most pressing threats are experienced at colonies where eggs and chicks are collected by locals for food (Mundkur *et al*. 1995a, Parr *et al.* 1996, Carr 1998). Four chicks were being raised for food in March 1994 (Carr 1998) and no fewer than 220 eggs (see Remarks 9) were reportedly collected by villagers at the Prek Toal colony in the 1995–1996 breeding season (Parr *et al.* 1996). When it is considered that perhaps fewer than 1,000 individuals of this species survive in the world, the potential magnitude of this harvest is apparent. Eggs are apparently favoured targets as the chicks are considered too heavy to carry by some waterbird collectors (Parr *et al.* 1996). Middlemen travel from Battambang and Siem Reap towns to the Prek Toal area, often providing advance finances for waterbird chicks months before the breeding season (Ear-Dupuy *et al.* 1998). As in much of South-East Asia, wildlife is seen as a delicacy much sought after by city dwellers: stork chicks are usually consumed at Khmer New Year feasts in the area as the meat is preferred and the price is low (Ear-Dupuy *et al.* 1998). These demands are driving much of the exploitation at Tonle Sap colonies. While surveillance by Wildlife Protection Office staff was said to have improved the situation, recent news indicates that the colonies are still plundered from their unguarded landward side (*Cambodia Bird News* 3 [1999]: 64–65, see Measures Proposed).

Pollution *India* The use of synthetic organic pesticides is largely uncontrolled in India and might build up in the flesh of livestock that are eaten by the adjutants, perhaps interfering with their reproductive biology (A. R. Rahmani *in litt*. 1998). Similarly, in Dibru-Saikhowa

National Park Thiodan, Dieldrin and other pesticides are used in winter to kill fish, presumably with detrimental effects on wetland ecosystems (Choudhury 1995, 1997d). This practice is presumably widespread in the Brahmaputra lowlands. Peripheral agriculture also exerts pressure on aquatic systems, as at Deepor beel where rice cultivation around the fringes of the lake causes pesticide and fertiliser run-off, the latter of which has accelerated eutrophication and resulted in an infestation of water hyacinth *Eichhornia crassipes* (Saikia and Bhattacharjee 1989c, Scott 1989). In addition, a plan to route a sewage canal from Gauhati city to the lake would undoubtedly flood the aquatic system with toxins if it goes (or has gone) ahead (Saikia and Bhattacharjee 1989c). Apparently pollution sometimes results from direct attempts to kill waterbirds (see under Persecution). In 1995 an ailing bird in Assam was infested by poultry lice *Menopon gallinae*, but recovered after it was treated with insecticides (Singha *et al*. 1999). Many individuals apparently died in an unspecified year around Gauhati dump apparently owing to "contaminated food" (Singha *et al*. in press). *Cambodia* Local waterbird collectors in the Prek Toal and Prek Da areas of Tonle Sap reported to Sun Hean (*in litt*. 1997) that the species had declined recently and might be affected by the use of poisons.

Lack of awareness *India* The lack of awareness of legislation protecting the species is cause for further concern. Although most villagers do not actively harm it, they are unaware of protective legislation and are thus less likely to "take an active stand protecting the birds" (Saikia and Bhattacharjee 1990a). There is a problem with awareness (including many forestry officials): only 30% of people questioned in Assam in the 1990s were aware that the species was endangered (Singha *et al*. in press).

Disease The disease that appears to lie behind the catastrophic loss of vultures in the Indian subcontinent in the period since around 1995 (see Threats under White-backed Vulture) may be capable of affecting other scavenging birds, and close attention is needed to detect the first signs of pathological condition in the relict population of Greater Adjutant in north-east India.

Miscellaneous Adults have also been found electrocuted in Gauhati city, presumably after collision with power-lines (Choudhury 2000c, Singha *et al*. in press).

MEASURES TAKEN The species receives legal protection in India, Bangladesh, Myanmar, Thailand, Cambodia and Laos, although for the latter the listing is ambiguous (J. W. Duckworth *in litt*. 1999). Legal protection in India lies in the listing of "storks" under Schedule IV of the Wildlife Act 1972, although this apparently gives it no legal protected status (Singha *et al*. in press).

Protected areas and habitat management Occurrence within protected areas is no guarantee of survival, partly because Asian reserves vary dramatically in the level of security and management imposed, and also because this species wanders widely and its inclusion on park or reserve lists is often the result of occasional visits. Small protected areas are of little importance to the species, as home ranges of individual birds are very large and extensive rural areas with low human population density are often of greater value. Protected colonies are, however, of utmost importance. *India* The species survives in Kaziranga (where it breeds), Dibru-Saikhowa and Manas National Parks. There are also records from Bordoibam-Bilmukh Sanctuary, Burhachapori Wildlife Sanctuary, Deepor Beel Sanctuary, Laokhowa National Park, Orang National Park, Panidihing Sanctuary and Pobitora Wildlife Sanctuary. At selected sites, suitable trees have been planted to provide future nest sites (P. K. Saikia *in litt*. 1999). *Nepal* The species has occurred at Royal Chitwan National Park and Kosi Tappu Wildlife Sanctuary. *Bangladesh* An account of conservation measures taken in the Sundarbans (albeit too late for this species) appears under Lesser Adjutant. *Cambodia* All sites around Tonle Sap are included in the Tonle Sap Biosphere Reserve (designated in June 1998), in which the Prek Toal and Moat Khla/Boeng Chhma waterbird colonies are core areas (Parr

et al. 1996, J. W. K. Parr *in litt*. 1999, C. M. Poole *in litt*. 1999). The Moat Khla/Boeng Chhma area comprises 200 km^2 open water and 130 km^2 swamp (C. M. Poole *in litt*. 2000); unfortunately, this designation is neither secure nor effective (see Measures Proposed). *Vietnam* The species has occurred at Tram Chim National Park.

Control of persecution In 1997, around 80% of egg and chick collection was estimated to have been prevented by the presence of Wildlife Protection Office staff near Prek Toal, Cambodia (Sun Hean *in litt*. 1997, Ear-Dupuy *et al.* 1998). Numbers of most waterbird species apparently increased in the following year (Sun Hean *in litt*. 1997, C. M. Poole *in litt*. 1999), but it is not clear whether these facts are linked. Evidence from 1999 suggests that exploitation remains much reduced as a result of Wildlife Protection Office activity (Hong Chamnan verbally 1999), but it has certainly not ceased, with outsiders using oxcart tracks to access the colonies from their unguarded landward side (*Cambodia Bird News* 3 [1999]: 64–65). The Tonle Sap Technical Coordination Unit in the Ministry of the Environment is now monitoring the status of forest in the Prek Toal area and working with the WPO to continue enforcing laws preventing egg and chick collection (C. M. Poole *in litt*. 1999).

Education *India* In the Brahmaputra valley several conservation programmes have been launched; awareness meetings were held in breeding areas in 1991 to advise protection of the storks and their nesting trees (Changkakati and Das 1991). Posters and leaflets have been produced and distributed with a view to spreading awareness of the species's plight and the legislation that exists to protect it (P. K. Saikia *in litt*. 1998). *Laos* Posters highlighting the plight of large waterbirds and an appeal to stop hunting have been distributed in southern provinces by the WCS Lao programme, and these feature illustrations of a *Leptoptilos* stork (W. G. Robichaud verbally 1997). *Cambodia* The species is included in awareness material (books and posters) produced and distributed by the 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).

Research *India* A detailed study has been conducted in the Brahmaputra valley to clarify the status, biology and ecology of the species along with relevant conservation issues (Saikia 1995). *Cambodia* Considerable research has been conducted at Tonle Sap to determine the size of large waterbird colonies and assess the impact of waterbird harvesting (see, e.g., Mundkur *et al*. 1995b, Parr *et al*. 1996, Ear-Dupuy *et al*. 1998).

MEASURES PROPOSED The most urgent conservation measures involve rigorous protection of remaining colonies, intensive local education programmes and the control of hunting and habitat loss. The major stronghold of the species is in the Brahmaputra valley of Assam, India, which probably holds more than 80% of the world population; this area should be a priority for conservation action (Singha 1999). The other area of focus must be Tonle Sap in Cambodia where the entire South-East Asian population is now thought to breed.

Legislation *India* Protective legislation should be strengthened in India; the species should be listed on Schedule I of the Wildlife Act (Choudhury 2000c). *Cambodia* It has been proposed that new national laws defining specific offences against wildlife, together with relevant punishments, should be first passed and then publicised widely (Ear-Dupuy *et al.* 1998; J. W. K. Parr *in litt*. 2001).

Protected areas: establishment *India* A conservation project is needed specifically for the Greater Adjutant drawing together the expertise of specialists and generating action in the form of habitat and colony protection in Assam. A difficulty exists in that most Assamese nesting sites are on private land, and many could therefore disappear at the whim of their owners. All nesting sites outside protected areas should thus be protected, either through a "mini-reserve" programme (Saikia and Bhattacharjee 1989a,b) or by planting trees (with or

without purchasing land) as close as possible to existing colonies to supply future nest sites (P. K. Saikia *in litt*. 1998, 1999). Feeding sites also require protection: Panidihing Sanctuary should therefore include Phokolai and Dorou beels as well as the adjoining chaporis on the Brahmaputra (Choudhury 1991). Rupshi Reserve Forest should be extended to include Sareswar bheel and the latter declared a bird sanctuary (Scott 1989). *Myanmar* A system of wetland reserves needs to be incorporated into the national framework of protected areas (Lwin 1995). If any breeding populations are rediscovered, they should receive immediate site-based conservation action. *Cambodia* It has been proposed that the Prek Toal area should be declared a national park, with Boeng Chhma and Moat Khla as additional habitat management areas; their management structure (e.g. the responsibilities of different ministries) would need careful design (J. W. K. Parr *in litt*. 2000; but see below). Protection is required in suitable wetland areas of Kompong Thom province such as around Trapeang Rompeak (Veasna 1999; see equivalent section under White-shouldered Ibis). *Laos* The establishment of Dong Khantung proposed NBCA (see under Sarus Crane) is an urgent requirement. Although no confirmed sightings of this species derive from the site, its protection might well be of importance to the species in the longer term as considerable suitable habitat exists (Round 1998).

Protected areas: management *India* Choudhury (1995) made several recommendations for the protection of Dibru-Saikhowa National Park; these include the designation of a 190 km^2 core area where no human disturbance is allowed, translocation of enclave villagers "on a priority basis", increased patrolling and manning of camps throughout the reserve by Forest Department staff, which should be increased in number to at least 100 guards; in addition, ecotourism should be encouraged and an awareness campaign conducted in fringe villages. Both within and outside protected areas the cutting of trees suitable for nesting should be prohibited and further trees planted in appropriate locations (i.e. near wetlands and waste disposal sites) wherever possible. The gradual modernisation and improved hygiene of waste disposal will reduce the food supply of this species, and traditional management of some key rubbish dumps (e.g. those at Tezpur and Gauhati) should be considered. Alternatively, the provision of waste at designated rural sites might prove effective.

Bangladesh A ban on the felling of any trees providing potential habitat for nesting waterbirds has been called for (Khan 1984) along with direct protection of any colonies that are discovered (Khan 1987). Conservation issues pertinent to the Sundarbans, where a colony of this species once existed, are outlined in the equivalent section under Lesser Adjutant.

Laos Recommendations for Dong Khanthung proposed NBCA and Xe Pian NBCA, which this species might occasionally visit (or possibly colonise), appear in the equivalent section under Sarus Crane.

Cambodia The conservation of the Tonle Sap wetlands, flooded forests and their associated waterbird colonies is a key component of the conservation programme for several threatened species, including the Greater Adjutant. In conservation terms, the uniqueness and importance of Tonle Sap and its environs cannot be too strongly emphasised. The Prek Toal area alone, for example, holds very significant numbers, not only of this stork but of breeding Spot-billed Pelicans and Lesser Adjutant, along with lesser numbers of Masked Finfoot *Heliopais personata* and Milky Stork *Mycteria cinerea* (see relevant accounts) and healthy populations of breeding Near Threatened species (e.g. hundreds or thousands of pairs of Oriental Darter *Anhinga melanogaster*, Asian Openbill, Painted Stork *Mycteria leucocephala*, Black-headed Ibis *Threskiornis melanocephalus* and several pairs of Grey-headed Fish-eagle *Ichthyophaga ichthyaetus*) (Parr *et al.* 1996; see relevant accounts). For several of these species, Tonle Sap is the last stronghold in South-East Asia, and their survival in this region hinges on its protection; history has all too vividly shown—the Greater Adjutant is a prime example—that huge populations of large waterbirds can be eliminated over the course of a few decades. The protection of Tonle Sap, however, involves a complex array of issues, not least of which

is the fact that the entire area is above all a private fishing concession leased piecemeal to fishing businesses and cooperatives; fuller treatment of these issues can be found in several recent publications (e.g. Mundkur *et al.* 1995a, Parr *et al.* 1996, Ear-Dupuy *et al.* 1998, *Cambodia Bird News* 1 [1999]: 11–18, Goes 1999b, *Cambodia Bird News* 3 [1999]: 64–65).

The protected status of Tonle Sap is not fully established, nor are the designations and implications of its core and peripheral areas well defined. A proposed royal decree to protect Tonle Sap totally was recently blocked, at least temporarily, by "ministerial wrangling" revolving around the claimed reductions in fishing revenue and potential oil exploration revenue that would ensue with full protection; this decree should be reconsidered, and finalised if possible, allowing the long-term preservation of fish stocks and increasing the lake's ecotourism potential (*Oriental Bird Club Bull.* 30 [1999]: 20–25). Moreover, the size of designated core areas has apparently been reduced (F. Goes *in litt.* 2000). Protected-area boundaries and zone classifications of the breeding colonies need urgently to be specified with a view to protecting the feeding and breeding habitats of threatened waterbirds (Ear-Dupuy *et al.* 1998). Important sites (specifically Prek Toal and Boeng Chhma) should be strictly protected using a variety of methods (Parr *et al.* 1996, Goes *et al.* 1998b, Ear-Dupuy *et al.* 1998, J. W. K. Parr *in litt.* 2000). Concealed observatory posts should be built at each site for the purposes of studying breeding biology and success, serving as a deterrent to waterbird harvesters and forming an ecotourism and education focus. A team of personnel is required to man these posts in the breeding season and monitor the colonies; this approach could offer alternative livelihoods to former bird harvesters, as could development of tourism.

Given the proximity of Prek Toal to Siem Reap and the famous (and much visited) Angkor Wat, the potential to develop tourism (both for wildlife and for recreational and cultural interests) is high (J. W. K. Parr *in litt.* 2000); a sensitive balance is required whereby the needs of general interest tourists are met and strictly controlled access is available (for ecotourists, at a price) to the sensitive waterbird colonies. The potential of constructing a tourist centre at Prek Toal should be considered. It should be noted that annual profits from fishing in "Lot 2" alone (the area that contains the bulk of the waterbird colonies) run into the hundreds of thousands of dollars, and that tourism will never be able to compete with this as a source of revenue; moreover, fishing bosses perceive tourism as a threat to their business (partly because they want to conceal their illegal fishing methods) and, like the politicians who pocket a portion of the fishermens' profits, are willing to obstruct its development (F. Goes *in litt.* 2000). Friction between powerless local communities and the fishing industry is mounting (resulting in recent deaths). These facts suggest that establishment of a standard protected area is out of the question for the time being, and that tourism might not work in the area (its potential value should certainly be investigated very cautiously) (Goes 1999b, F. Goes *in litt.* 2000). Alternatively, the unique opportunity exists for a cooperative endeavour involving fisheries, conservation bodies and tourism agencies, and perhaps through this route the spectacular colonies of storks and pelicans around Tonle Sap can be conserved.

Control of persecution *Cambodia* A suite of measures designed to maintain waterbird numbers around Prek Toal (Mundkur *et al.* 1995a, Parr *et al.* 1996) includes the suggestions that local waterbird collectors be registered to help control exploitation, that the Fisheries Department consider disallowing collection of waterbird eggs and nests inside, and their transport through, concessions, and that a moratorium be placed on the collection of eggs and nestlings of colonial waterbirds. A short-term relief programme would be needed to cater for locals who collect wildlife to survive; alternative livelihoods such as duck or crocodile rearing and bee-keeping should be provided as well as education in husbandry practices and financial management (Ear-Dupuy *et al.* 1998). Support for the existing floating research and guard station is needed (the only current management presence), as is an increase in the number and capacity of the staff employed there (J. W. K. Parr *in litt.* 2000). The landward access routes to colonies must be guarded and controlled at critical times.

Research As with most large waterbirds, the priority should now firmly fall on direct action at known strongholds, in this case the Brahmaputra lowlands of Assam and Tonle Sap in Cambodia. Nevertheless, research is still warranted. *Bangladesh* Further surveys have been called for in Bangladesh (Khan 1987); details of distribution and conservation needs of all wetland birds in the country were deemed urgently required by the Forest Department (1974), but little action has since been taken and the species is almost certainly extinct there. (*Myanmar*) Surveys are required throughout for a possible remnant breeding population (Khin Ma Ma Thwin *in litt.* 1997). *Cambodia* Waterbird survey work in the Tonle Sap area is recommended to determine further key sites and the most appropriate conservation measures (Mundkur *et al.* 1995a; see Remarks 3), and a detailed ecological survey of the Tonle Sap basin should be undertaken before any major development activities are permitted (Scott 1992). A suite of measures targeted at maintaining waterbird numbers at Prek Toal (Mundkur *et al.* 1995a, Parr *et al.* 1996, Ear-Dupuy *et al.* 1998, Goes *et al.* 1998b) includes the following research elements: (1) the evaluation and monitoring of threats (such as the conversion of forest to farmland and the exploitation of waterbirds) from nearby communities; (2) annual monitoring of waterbird numbers and their exploitation at strategic localities between January and April, with efforts to assess the impact on stork populations and to evaluate the potential for sustainable management; (3) continued aerial surveys of the Prek Toal area to ascertain precise details of colony locations and population estimates of waterbirds; (4) research into the viability of alternative livelihoods and ecotourism. As conservation issues are currently so intractable in the area, intensive research and lobbying should be directed at seeking solutions. The existing floating research centre at Prek Toal should be supported and expanded. Away from Tonle Sap, a regional wildlife research and conservation team should be established in northern Cambodia (i.e. in the area of habitat in Kompong Thom that is important for foraging large waterbirds and Bengal Florican *Houbaropsis bengalensis*: see relevant account), including a training centre to increase the capacity of local officials and to coordinate research, conservation and education (Veasna 1999).

Education *India* In Assam, local people and government staff need to be told about the endangerment and protected status of this species. *Bangladesh* Rural education programmes have been proposed to help conserve waterbirds by reducing habitat alteration and hunting (Forest Department 1974) but it is not known whether these proposals have been acted on. Further awareness campaigns were designed and proposed by Sarker (1989). *Thailand* This species should be included in a publicity campaign aimed at increasing general awareness of the need to conserve all large waterbirds (P. D. Round *in litt.* 1998). 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). *Cambodia* Old and new laws relating to activities at waterbird colonies need to be distributed amongst officials and local people in this area, and awareness programmes should be implemented at the district level (Ear-Dupuy *et al.* 1998). A conservation programme should be incorporated in the school curriculum around Tonle Sap and the school system itself needs to be improved as those recently supplied by UNICEF and SIDA are insufficient to meet local demand (Ear-Dupuy *et al.* 1998). An environmental education campaign is needed in the Boeng Prabel, Trapeang Rompeak, Viel Anh Chanh and Kruos Kraom districts of Kompong Thom province (Veasna 1999).

Institutional strengthening The weak institutional capacity of the governmental departments responsible for habitat or wildlife protection in India and Cambodia (Choudhury 2000c, J. W. K. Parr *in litt.* 2000) is a serious obstruction to the proper conservation of the species, a threat that needs to be addressed with adequate financial support, lobbying and training (see equivalent section under White-winged Duck).

REMARKS (1) Distinguishing between the two Asian members of the genus *Leptoptilos* is a straightforward process given sufficient field experience or good views of the stork in question ("the two species could scarcely be confounded": Hume 1875a). However, these provisos are often not fulfilled, leaving the observer, who all too infrequently publicises sighting as "unconfirmed", with a 50% probability of making a successful identification (see Rahmani 1989d). Early and recent literature alike are littered with confusion between the two adjutants and in several cases it has been shown that the incorrect alternative was chosen (see Remarks 2 and 3). When soaring overhead, the two species are surprisingly difficult to separate, and identifications based on size alone are prone to error as Lesser Adjutants can be very large. This factor should be taken into account when judging historical or extralimital accounts. Extreme caution is appropriate when encountering *Leptoptilos* storks, especially in unexpected localities, as the confusion generated by past inaccuracies has only served to obfuscate this review of their status and distribution. (2) A bird assigned to this species at Thale Song Hong, interior of Trang province, in January 1910 (Robinson and Kloss 1910–1911), was later re-identified as a large Lesser Adjutant in breeding plumage (Robinson and Kloss 1918b). In addition, a single bird at Chalerm Prakiet Wildlife Sanctuary, Narathiwat province, June 1992, and apparently still present in April 1993, is best considered provisional, while records from between 1979 and 1980 at Thale Noi are thought to refer to Lesser Adjutant (P. D. Round *in litt*. 1998). (3) There were several provisional or retracted reports from Laos in the 1990s. A record from Bolaven Southwest proposed NBCA, at Nong Houay Soymong, March 1992, remains unconfirmed (Salter 1993, Thewlis *et al.* 1998). During aerial surveys in August 1996, at least 33 storks (groups of 1–18) were sighted, chiefly along the Cambodian border, in and around Dong Khanthung proposed NBCA; although first identified as Greater Adjutant on size and plumage details, subsequent study of captive individuals of both species led to the retraction of these records on the grounds that they might have been either Greater or Lesser Adjutant (Thewlis *et al*. 1998). Another bird found during ground-based surveys in August 1996, at a pool 10 km south-south-east of Ban Vin-Tai, was initially identified as Greater Adjutant (Thewlis *et al.* 1998), but may have been a Lesser (W. G. Robichaud *in litt*. 1998). (4) It is contestable whether Beavan (1865–1868) actually observed the species at Fort William or merely compiled his passage about the species there. However, this site is close to Calcutta and thus it seems likely that some of his observations were made there. (5) Information on several Assamese localities was received too late for inclusion in the mapping process. (6) During the same period of this trip only a single Lesser Adjutant, a species relatively common in this area, was observed, suggesting that an identification error may attend this record. (7) There is no other indication that the species bred in this part of Myanmar and it might be that eggs of the Lesser Adjutant are mislabelled. (8) Ali and Ripley (1968–1998) reported that the popular folk belief persisted, as recorded by the Mogul Emperor Baber in his memoirs and encountered by Ball (1874) in Bihar, that if you split the head of a Greater Adjutant you may extract from it the fabulous Zahar-mohra or "snake-stone", allegedly a potent antidote against snakes and all other kinds of poison. Ball (1874) was asked by a village chief for the stones contained in a specimen ("I need perhaps scarcely add that the skull only contained brains"). (9) These eggs are identified by local report and it is thus difficult to judge what proportion belong to the Lesser Adjutant.