

Threatened Birds of Asia:

The BirdLife International Red Data Book

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MILKY STORK

Mycteria cinerea

Critical —
Endangered —
Vulnerable A2c,d; C1



This stork has a small, declining population owing to loss of coastal habitat, hunting and trade. These factors are predicted to cause rapid declines in the near future. It therefore qualifies as Vulnerable.

DISTRIBUTION The Milky Stork is widely but very patchily distributed in South-East Asia. It is known from Thailand, Cambodia, Vietnam, Peninsular Malaysia and Indonesia, with an unconfirmed record from Singapore (see Remarks 1).

■ **THAILAND** The species is clearly at the edge of its range in Thailand and the very few records represent either vagrants or escaped birds; if it ever bred in the country it is now presumed no longer to do so (Treesucon and Round 1990). Records are from: north of **Laem Phak Bia**, Phetchaburi, 1–3 in a flock of c.100 Painted Storks *Mycteria leucocephala*, September and October 1998 (P. Charoenjai, J. Visetchinda and S. Supparativikorn per P. D. Round *in litt.* 1998, *Bird Cons. Soc. Thailand Bull.* 16, 10 [1999]: 18–19, *Oriental Bird Club Bull.* 30 [1999]: 52–56); **Satul**, one adult, August 1935 (Gibson-Hill 1949b, Medway and Wells 1976; also Morioka and Yang 1990).

A bird at Wat Asokaram, Bang Poo, Samut Prakan, January 1994 (seen by Suradech Wongsinlang) was said to have been present from October 1993 and was thought to be an escape owing to its tameness (P. D. Round *in litt.* 1999).

■ **CAMBODIA** Apart from one record in Banteay Meanchay province, this species is apparently restricted to the immediate vicinity of Tonle Sap lake and coastal Kompong Som (=Sihanoukville) province (Sun Hean *in litt.* 1997). Records are from: **Ang Trapeang Thmor Reserve**, one June 2000 (P. Davidson verbally 2000); between **Sisophon** and **Siem Reap**, 1960s (Thomas 1964); **Siem Reap**, December 1927 (two specimens in BMNH; also Thomas 1964); **Prek Da**, 15, April 1994 (Mundkur *et al.* 1995a, *Oriental Bird Club Bull.* 20 [1994]: 55–61), 20–60 pairs reported by locals in the last few years (Parr *et al.* 1996), including two singletons in May and June 1998 (Goes *et al.* 1998b); **Prek Toal**, Battambang, the only confirmed breeding site in Cambodia, 15, 1994 (Mundkur *et al.* 1995a), c.15 pairs, 1996 (Parr *et al.* 1996), up to six, February and March 1996, with presence of chicks in villages confirming local breeding (Parr *et al.* 1996), three, 1997 (Ear-Dupuy *et al.* 1998), four plus a distant group of 31, April 1999 (F. Goes and C. M. Poole *in litt.* 1999), three, April 2000 (P. Davidson *in litt.* 2000), and nearby at the Stoeng Sangke (Sangke river), one, July 1998 (Goes *et al.* 1998b) and Boeng Rohal, three, March–April 1997 (Ear-Dupuy *et al.* 1998); **Prek Peach Kantoeli** (Prek Peach Kantiel), one, July 1998 (Goes *et al.* 1998b); **Kampong Chhnang**, at Chhunuk Tru, one, May 1993 (Carr 1993); Tnal Krabei, Prek Kaoh Pao estuary, 5 km south of **Koh Kong** town, “some”, April 1944 (Engelbach 1952); **Stoeng Kampong Smach**, Kampong Som (=Sihanoukville), one, April 1994 (Mundkur *et al.* 1995a, *Oriental Bird Club Bull.* 20 [1994]: 55–61), and one near Prek Kampong Smach with 50 Painted Storks, December 1995 (J. C. Eames *in litt.* 2000); **Kampong Som** (=Sihanoukville), one, February 1999 (D. Judell verbally 1999), eight, including three immatures, April 1999 (J. Smith and C. M. Poole *in litt.* 1999); **Ream National Park**, seven, March 1996 (J. W. K. Parr *in litt.* 1998), eight (including three immatures), April 1999 (*Cambodia Bird News* 2 [1999]: 38–39, 3: 39–43).

■ **VIETNAM** Despite repeated recent reports (including intimations of breeding), none is acceptable (Eames and Tordoff in prep.; see Remarks 2). The only record is from: **Bac Lieu**, where two captive birds at Ho Chi Minh city (=Saigon) Zoo had apparently been captured (Delacour and Jabouille 1931), although there is no further report from the province (Scott 1989).

■ **MALAYSIA** An isolated resident population of this species survives on the north-east coast of Peninsular Malaysia (Perak); there have also been a few records from the south-west coast (Johor), possibly of wanderers from the nearby Sumatran population to the west rather than the more distant Perak population (Hawkins and Howes 1986, Wells 1999; but see Remarks 1). Confirmed records are from: **Kuala Kedah**, late November 1907 (Robinson and Kloss 1910–1911, Robinson and Chasen 1936); **Sungai Burong** (Sungai Burung), Kuala Kurau, Perak, October 1984 (Swennen and Martejn 1987, Wells 1990b); **Matang Mangrove Forest Reserve**, Perak, including Kuala Gula, 42 in 1975, 79 in August 1983 (Parish and Wells 1985), 31 in 1984 (Swennen and Martejn 1985), and many records until the present, also slightly further south at Pulau Kelumpang, Kuala Kurau, 74, August 1983 (Wells 1990a), maximum of 101 in October 1984 (Swennen and Martejn 1987, Wells 1990b), and 29 nests in 1989 (Siti Hawa Yatim 1990, Wells 1999), at Pulau Terong, 40, January–February 1986 (Hawkins and Silvius 1986), to the south of Kuala Larut, 36 at a pool in mangroves, August 1983 (Parish and Wells 1985, Wells 1990a), and at unspecified localities in the forest reserve, 57 adults, March 1989 (*Enggang* 2, 4 [1989]), and 42 in September 1995 (A. C. Sebastian *in litt.* 1999); **Pulau Ketam**, Kelang estuary, Selangor, “up to four pairs” breeding, 1933–1935 (Madoc ms, Madoc 1936 in Wells 1999), including two nests in August 1935 (Robinson and Chasen 1936), subsequently disappearing along with the heronry (DWNPPM 1987); **Sungai Kinchin**, Pahang, July 1989 (Wells 1990d); on the coast of **Melaka** (Malacca), mid-nineteenth century (Gibson-Hill 1949 in Wells 1999); **Benut Forest Reserve**, Johor, apparently in 1950s (Wells 1999), two at Kuala Sanglang, February 1985, one on the foreshore at Kuala Benut, March 1986 (Hawkins and Howes 1986, Wells 1990c).

■ **INDONESIA** Highest numbers are recorded from Sumatra and Java where the species breeds, with lesser numbers from Sulawesi (breeding likely), Buton and Sumbawa. The global stronghold of the species is Sumatra, where it is primarily distributed along the coasts in the coastal swamps of Aceh, North, Jambi and Lampung provinces, with breeding recorded in the latter two of these (van Marle and Voous 1988). Records for the country are from:

Sumatra ■ **Aceh** large numbers on a creek near **Banda Aceh**, February 1873 (Hume 1873b); **Lhokseumawe**, 1970, 1981–1982 and 1985 (Burton 1985 in van Marle and Voous 1988); ■ **North Sumatra Ramunia**, Serdang, June 1915 (male in ZMA, de Beaufort and de Bussy 1919); **Perbaungan**, December 1920 (male in RMNH); **Serbadjadi**, and elsewhere in Deli, 1913 and 1916 (specimens in ZMA, RMNH); between Bukittinggi and **Sipirok**, one, October 1993 (J. N. Dymond *in litt.* 1999); ■ **West Sumatra Bukittinggi** (=Fort de Kock), 900 m, undated (Kloss 1931); **Danau Singkarak**, 400 m, February 1977 (van Marle and Voous 1988); **Solok**, undated (specimen in AMNH); **Lunang**, West Sumatra, October 1990 (Holmes 1996); ■ **Riau Ollak Tanding**, **Sindang**, October 1881 (female in BMNH); **Pulau Halang**, March 1981 (van Marle and Voous 1988); **Bagansiapiapi** region, with strong evidence of breeding in the Kubu area, perhaps also on Bengkalis, August 1990 (Holmes 1996); **Kampar estuary**, six, February 1999 (S. J. M. Blaber *in litt.* 1999); concentrations of feeding birds at coastal promontories such as **Tanjung Datuk** and **Tanjung Bakung**, undated (Silvius 1988); **Kualacenako** (Kuala Cinaku), on the border with Jambi, November 1992 (Holmes 1996), Kateman (not mapped), 1930 (Morioka and Yang 1996); ■ **Jambi Kuala Betara**, Hutan Bakan Pantai Timor Nature Reserve (74 active nests in late July 1985), west side of Sungai Betara, mid-1980s (Danielsen and Skov 1985, 1987), but colony gone by 1989 (Danielsen *et al.* 1991b); **Tanjung Jabung**, undated (Silvius 1988); **Sungai Batang Hari**, c.50 km inland, 1980s (Verheugt

1987); **Berbak National Park** at Sungei Lokan, 126 in September 1986 (A. Elliott *per* T. P. Inskipp *in litt.* 1997), and at Sungei Simpang Gajah, one, September 1986 (A. Elliott *per* T. P. Inskipp *in litt.* 1997); ■ **South Sumatra** entire coastline, including **Banyuasin peninsula**, major colony, September 1988 (Danielsen *et al.* 1991a; see Population); **Tanjung Selokan**, major colony, September 1988 (Danielsen *et al.* 1991a; see Population); **Padang Sugihan Wildlife Reserve**, regularly August–October 1984 and May–June 1985 (but with no records between these dates), including a bird in breeding plumage, May (Nash and Nash 1985); **Tanjung Koyan**, major colony, September 1988 (Danielsen *et al.* 1991a; see Population); ■ **Lampung** near **Menggala**, 1993–1994 (Holmes and Noor 1995); **Way Kambas National Park**, resident (Wind *et al.* 1979), with an apparent breeding colony of 200–230 found 6 km south of Pos Pedemaran, June 1989, and many records from within the area (Parrott and Andrew 1996); **Telukbetung**, undated (specimen in RMNH); (untraced) estuaries of the Siput river and Jentolo river, large numbers in 1980s (Verheugt 1987);

Java ■ **West Java Ujung Kulon National Park**, 1940s (Hoogerwerf 1948a); **Pulau Dua**, where formerly breeding (Hoogerwerf 1947a, 1948a) and last recorded doing so in 1975, but now a regular visitor, often roosting there (Milton and Marhadi 1985); **Serang**, flock of 49 flying east, September 1984 (Allport and Wilson 1986); **Tangerang**, north coast, July 1935 (Hoogerwerf 1936a); **Pulau Rambut Wildlife Reserve**, Jakarta Bay, since 1974, and including January 1987 (Lambert and Erfemeijer 1989), 42 adults, five fledged young and five active nests, June 1989 (Wilkinson *et al.* 1991a); **Jakarta** (=Batavia) and environs, until 1930s (Hoogerwerf and Siccama 1937–1938, Hoogerwerf 1948a, specimen in MCZ), and more recently at Ancol beach, June 1989 (Wilkinson *et al.* 1991a), regular at Muara Angke, undated (Bartels 1915–1930), and occurring there recently including August 1993 (N. Bostock *in litt.* 1999), August 1994 (Tobias and Phelps 1994), and in roadside pools near Soekarno-Hatta airport, including several in September 1996 (JAT), but decreasing at this site as it becomes more disturbed and developed (B. F. King verbally 1998); **Muara Gembong**, September 1915 and April 1917 (two females in RMNH); **Muara Wetan**, August 1908 and April 1914 (two specimens in RMNH), October 1922 (two juveniles in RMNH); Citarum delta (this general area includes other sites such as Muara Gembong and Balubuk), seasonally very common and breeding, undated (Bartels 1915–1930), including at **Muara Bungin**, 1907–1923 (five specimens in RMNH); **Balubuk** (Muara Blubuk), July 1919 (one immature and one pullus in RMNH) and May 1922 (male in RMNH); **Rawa Gempol**, Krawang, October 1908 (van Oort 1910; also two females in AMNH); **Tanjung Sedari** (Sedari delta), seasonal in occurrence (usually in the “east monsoon”), undated (Bartels 1915–1930); **Indramayu**, April 1925 (male in RMNH), at the Bungko estuary, November 1990 (Indrawan *et al.* 1993b); **Cirebon** (Cheribon), October 1925 (male in RMNH); ■ **Central Java Segara Anakan**, east of Pangandaran, where recorded in early 1980s (Verheugt 1987), a non-breeding area for 160–180 birds, with up to 20, mid-1989 (Erfemeijer *et al.* 1988, Lewis *et al.* 1989), “small” numbers, July 1991 (Heath 1991); **Nusa Kambangan**, 25 birds foraging near Klacis, August 1998 (V. Nijman *in litt.* 2000); **Tegal**, February 1910 (male in RMNH); ■ **East Java Surabaya**, one immature shot on a nearby pond, undated (Bartels 1915–1930); **Baluran National Park**, “small” numbers, July 1991 (Heath 1991);

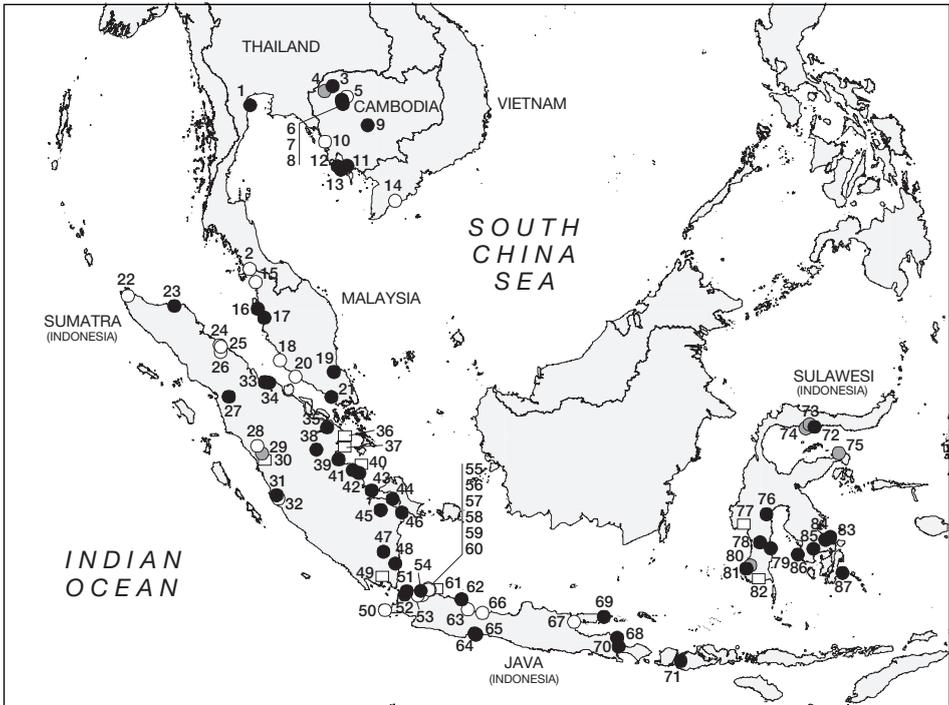
Madura Sumenep, 170, March 1996 (*Oriental Bird Club Bull.* 24 [1996]: 59–65);

Bali an “irregular visitor” (Verheugt 1987), including one passing east over **Gilimanuk**, October 1982 (Ash 1984, NJC; see Migration);

Sumbawa unspecified locality (Verheugt 1987), “west coast”, May 1988 (Silvius and Verheugt 1989) and **Taliwang**, December 1989 (Gibbs 1990), where apparently seen the previous year;

Sulawesi ■ **North Sulawesi** small lake c.10 km east of **Panua Reserve** (near Marisa), Kecamatan Paguat, Desa Sale Lama, flock of 51, all in adult, mostly non-breeding plumage, December 1997, but none in August 1999 (Bishop *in press*); **Marisa**, 10–15 birds, February

1979 (Watling 1983b); **Tanjung Panjang**, a group of c.15, December 1978 (J. R. MacKinnon in Escott and Holmes 1980; also White and Bruce 1986); **Central Sulawesi Kolombi**, Roraya district, August 1978 (Escott and Holmes 1980; also White and Bruce 1986); **South Sulawesi Palopo** and adjacent shoreline, undated (Holmes and Wood 1980 in White and Bruce 1986), March/April 1986 (Uttley 1987); near **Polewali**, undated (Escott and Holmes 1980); **Danau Tempe**, two adults and one juvenile, January 1990 (Baltzer 1990); **Palima** in the Cendrenai (Cenrana) delta, March 1986, at least 33 birds including four immatures, the first evidence of possible breeding on the island (Uttley 1987), late 1989 (Baltzer 1990); **Maros**, five, March 1977 (Escott and Holmes 1980); **Makassar** (= Ujung Pandang), undated records



The distribution of Milky Stork *Mycteria cinerea*: (1) Laem Phak Bia; (2) Satul; (3) Ang Trapeang Thmor Reserve; (4) Sisophon; (5) Siem Reap; (6) Prek Da; (7) Prek Toal; (8) Prek Peach Kantoeli; (9) Kampong Chhnang; (10) Koh Kong; (11) Stoeng Kampong Smach; (12) Kampong Som; (13) Ream National Park; (14) Bac Lieu; (15) Kuala Kedah; (16) Sungai Burong; (17) Matang Mangrove Forest Reserve; (18) Pulau Ketam; (19) Sungai Kinchin; (20) Melaka; (21) Benut Forest Reserve; (22) Banda Aceh; (23) Lhokseumawe; (24) Ramunia; (25) Perbaungan; (26) Serbajadi; (27) Sipirok; (28) Bukittinggi; (29) Danau Singkarak; (30) Solok; (31) Lunang; (32) Sindang; (33) Pulau Halang; (34) Bagansiapiapi; (35) Kampar estuary; (36) Tanjung Datuk; (37) Tanjung Bakung; (38) Kualacenako; (39) Kuala Betara; (40) Tanjung Jabung; (41) Sungai Batang Hari; (42) Berbak National Park; (43) Banyuasin peninsula; (44) Tanjung Selokan; (45) Padang Sugihan Wildlife Reserve; (46) Tanjung Koyan; (47) Menggala; (48) Way Kambas National Park; (49) Telukbetung; (50) Ujung Kulon National Park; (51) Pulau Dua; (52) Serang; (53) Tangerang; (54) Pulau Rambut Wildlife Reserve; (55) Jakarta; (56) Muara Gembong; (57) Muara Wetan; (58) Muara Bungin; (59) Balubuk; (60) Rawa Gempol; (61) Tanjung Sedari; (62) Indramayu; (63) Cirebon; (64) Segara Anakan; (65) Nusa Kambangan; (66) Tegal; (67) Surabaya; (68) Baluran National Park; (69) Sumenep; (70) Gilimanuk; (71) Taliwang; (72) Panua Reserve; (73) Marisa; (74) Tanjung Panjang; (75) Kolombi; (76) Palopo; (77) Polewali; (78) Danau Tempe; (79) Palima; (80) Maros; (81) Makassar; (82) Jeneponto; (83) Pulau Bokhari; (84) Ranomeeto; (85) Rawa Aopa Watumohai National Park; (86) Wolulu; (87) Danau Ambuau.

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

(Escott and Holmes 1980), between Makassar and Maros at Lanteboeng (5°05'S 119°28'E: Bishop in press), up to 30, March 1986 (Uttley 1987), 22 birds, February 1990 (Baltzer 1990), and c.3 km south-west of Ujung Pandang airport, three adults, January 1986 (Bishop in press); Mampie Game Reserve by strong report, recently (Baltzer 1990); **Jeneponto**, undated (Escott and Holmes 1980); ■ **South-East Sulawesi Pulau Bokhari**, Kota Kendari, 14, August 1998 (R. Gregory-Smith *in litt.* 1999); **Ranomeeto**, Kota Kendari, one, September 1998 (R. Gregory-Smith *in litt.* 1999); **Rawa Aopa Watumohai National Park**, up to c.137 (largest flock 88) seen at Savanna, Mangrove, Aopa swamp, Kendari, Anaaha and Kolaka, September–October 1995 (*Oriental Bird Club Bull.* 24 [1996]: 59–65, Wardill *et al.* 1995), seven, August 1998 (R. Gregory-Smith *in litt.* 1999); **Wolulu**, “Kab. Kolaka”, eight, August 1998 (R. Gregory-Smith *in litt.* 1999);

Buton Danau Ambuau, November 1996 (Catterall undated); “square 78”, November 1996 (Catterall undated); “square 74”, November 1996 (Catterall undated).

POPULATION The estimated world population is 6,100 (Perennou *et al.* 1994), or more precisely, 6,000 in Indonesia and 100–150 in Cambodia and Peninsular Malaysia combined (Rose and Scott 1997).

Thailand Although the scant evidence has been interpreted to suggest that the species might have occurred regularly in the south, possibly breeding along the coasts (Morioka and Yang 1990), it is perhaps more likely that it was always scarce in the country; it is now apparently locally extinct (Treesucon and Round 1990).

Cambodia Early reports give the impression that the species was always uncommon in Cambodia (e.g. Delacour 1929b); it was “rare” in the country by the 1960s (Thomas 1964) and has apparently undergone subsequent declines (Scott 1992). Numbers are now thought to be very low, with an estimated 30 breeding pairs at Prek Toal and Prek Da near Tonle Sap lake being the only resident population reported in Indochina (Parr *et al.* 1996, Sun Hean *in litt.* 1997); the largest group reported recently contained 31 individuals near Tonle Sap in April 1999 (F. Goes and C. M. Poole *in litt.* 1999). No breeding birds were found in an extensive survey of waterbird breeding colonies around Tonle Sap in 1998, although locals reported that small colonies still exist (Goes *et al.* 1998b).

Vietnam There is no unequivocal evidence that the species ever bred in the country and it is certainly now only a vagrant at best (Collar *et al.* 1994, Eames and Tordoff in prep.; see Remarks 2).

Peninsular Malaysia Although Robinson and Chasen (1936) were able to compile “few formal records”, they nevertheless considered it “not rare in suitable localities”; it was, for example, “not uncommon” on the Selangor coast. Over the next few decades, however, none was observed on the Selangor coast by Madoc (ms) between 1944 and 1957 despite “many trips around the outer islands and mudflats”, while Medway and Wells (1976) added that “on many visits to the Selangor mudflats during 1961–71 this stork was never seen”. The Pulau Ketam heronry had long been abandoned by 1957 (Madoc ms), presumably because it was “much-raided” (Wells 1999). At that time the species was only known in Krian district, Perak (Medway and Wells 1976). In 1984 an aerial survey between Kuala Lumpur and Langkawi yielded sightings of 115 individuals, a group of 36 south of the Larut estuary and 79 around the Kuala Gula area; this was thought to approximate to the entire population of Peninsular Malaysia (Parish and Wells 1985).

Indonesia W. Davison (in Hume 1873b) mentioned “an enormous flock” in a large creek in Aceh, northernmost Sumatra, suggesting that the species was previously very common on Sumatra. By the end of the 1980s the island was indeed recognised as the global stronghold of the species, with a population estimated to be around 5,000 individuals (Silvius and Verheugt 1989). In 1985, 116 were counted in Lampung province (Milton and Marhadi 1985). Counts in October–November 1984 were of 3,053 birds in the provinces of Riau (703), Jambi

(763) and South Sumatra (1,587); in July–August 1985 of 1,029 in Jambi (697) and South Sumatra (732); and again in March–April 1986 of 1,937 in Jambi (1,134), and South Sumatra (803); on the basis of these data these three provinces were judged to hold the majority of the world population (Danielsen and Skov 1985, Silvius 1988). In September 1988 at Tanjung Koyan 300–400 nests were estimated to be present, with a total of 500 birds including at least 50 juveniles; at Tanjung Selokan 300 nests were estimated to be present, with a total of 150 birds including several juveniles; and on the Banyuasin peninsula 280 nests were observed along with 250 adults and 100 juveniles (Danielsen *et al.* 1991a), with as many as 1,000 birds there subsequently (Verheugt *et al.* 1993). These welcome findings were in part offset by the subsequent discovery of the loss of the colony within Hutan Bakau Pantai Timor reserve, Jambi province (Danielsen *et al.* 1991b), which must be taken as reasonably likely to represent a real decline in overall numbers.

Early in the twentieth century the species was clearly seasonally very common in Java, with large colonies (“many nests”, or 75–100 nests) noted in the Citarum delta (Bartels 1915–1930, Hoogerwerf 1936a). By the mid-1980s, the breeding population was tiny but the island experienced influxes of other birds (Lambert and Erfteimeijer 1989); the total population of West Java was estimated at c.400 (356–408 individuals) (Allport and Wilson 1986; also Verheugt 1987). Over 1,000 individuals have been reported to visit the north-east coast of Java seasonally (Hancock *et al.* 1992), but this is possibly an overestimation. Surveys of the south coast of Central Java yielded a minimum of 164 birds, but without confirmation of breeding (Erfteimeijer *et al.* 1988), and surveys in East Java found only 38 birds (Erfteimeijer and Djuharsa 1988). Pulau Rambut may be the last breeding site on the north coast of Java, since the species is known to have ceased breeding on Pulau Dua in 1975 and at an unspecified date in the Brantas or Solo deltas of East Java, indicating a considerable decline; the maximum number of nests recently found was 10 in 1984 (14 given in Allport and Wilson [1986]). A recent record of 170 individuals on Madura (*Oriental Bird Club Bull.* 24 [1996]: 59–65) suggested that the island may support an important numbers of the species, at least seasonally.

The population on Sulawesi appears to have increased in recent years, although this is almost certainly a result of greater observer coverage and surveying of new areas, especially in South-east Sulawesi (Bishop *in press*). As many as 73 birds were discovered at a variety of coastal sites in South Sulawesi in 1986, suggesting a modest resident population in the province (Uttley 1987). South-east Sulawesi may hold a small but valuable population, with c.100 in Rawa Aopa Watumohai National Park in 1995 (Wardill *et al.* 1995). Breeding has not been proven on the island (Bishop *in press*), although sightings of juveniles suggests that it is very likely to occur. In 1996 the species was also noted at three localities on Buton, with 21 birds in one tree, and an immature also seen, suggesting local breeding (Catterall undated).

ECOLOGY Habitat Throughout much of its range, the Milky Stork is essentially a coastal species, favouring mangroves, mudflats and estuaries (Hancock *et al.* 1992). It also feeds on ricefields and fishponds (Verheugt 1987). This is certainly the case in its Sumatran heartland, although it occasionally visits “lebaks” (backswamps along river floodplains) up to 150 km from the coast; during spring tides, birds often roost in remnant trees in ricefields (Verheugt *et al.* 1993; also Danielsen and Skov 1985, 1987). Roost sites are sometimes in the crowns of tall mangrove trees (Hancock *et al.* 1992), although they also regularly roost on the ground out on mudflats or in marshes (Bartels 1915–1930), a factor that makes the species relatively easy to count, even from the air (e.g. Parish and Wells 1985). In Peninsular Malaysia, the species is “more exclusively marine” than its congener the Painted Stork (Robinson and Chasen 1936), the suggestion being that the two separate ecologically when they meet (Morioka and Yang 1990). However, they were reported to frequent the same marshy plains in Cambodia, often in the same flock (Delacour and Jabouille 1931), and recent reports from Cambodia again suggest that they use or used similar habitats (Mundkur *et al.* 1995a, C. M.

Poole *in litt.* 1997); moreover, local people report that they breed alongside each other in flooded forest around Tonle Sap (Goes *et al.* 1998b). In Cambodia, Milky Storks frequent flooded forest and mangrove in both freshwater and coastal habitats (Mundkur *et al.* 1995a, Sun Hean *in litt.* 1997). Concentrations have been recorded at fishponds in Sulawesi (Andrew and Holmes 1990). Although they are said to be generally shy and vulnerable to disturbance (Verheugt 1987), this applies to foraging individuals, as nesting birds can often be approached quite closely (Allport and Wilson 1986, Hancock *et al.* 1992).

Food At Sungai Burong, Malaysia, the bulk of the diet appeared to be large mudskippers *Periophthalmus* 10–23 cm in length; the estimated weight of fish eaten in one observation of 39 minutes was 225 g (Swennen and Marteijn 1987). In Indonesia the species has also been reported consuming snakes and frogs (Hoogerwerf and Siccama 1937–1938), fish (including a large “blanak”, presumably a kind of fish) (Bartels 1915–1930), and feeding eels, mudskippers and 20 cm fish to nestlings (Hoogerwerf 1936b).

Often feeding in aggregations with other wading birds, such as Lesser Adjutant *Leptoptilos javanicus* and egrets Ardeidae (Verheugt 1987, Hancock *et al.* 1992), the species generally employs a tactile foraging technique, involving standing still (sometimes for several minutes) or walking through mud and usually very shallow (but sometimes deeper) water, probing with a partly opened bill, or drawing it in an arc from side to side, until a prey item is located by touch (Bartels 1915–1930, Swennen and Marteijn 1987, Silvius 1988, Indrawan *et al.* 1993b); it has also been seen to seek food by foot-stirring (Hoogerwerf 1936b). Less frequently, individuals either detect prey by sight or root them from their burrows (Swennen and Marteijn 1987, Silvius 1988). On locating a mudskipper’s hole an individual will usually probe its bill in the immediate vicinity 10–15 times, sometimes immersing the whole bill and head into the mud and then hauling out the prey once it has been secured in the bill (del Hoyo *et al.* 1992). Birds have been observed feeding spaced 50–100 m apart (A. Elliott *per* T. P. Inskipp *in litt.* 1997), but sometimes they will move in a single tight flock, flushing fish in shallow water (Indrawan *et al.* 1993b). Where food is abundant, foraging bouts are of relatively short duration, and roosting or comfort behaviour is undertaken for protracted periods (Hancock *et al.* 1992). At the Pulau Dua colony, considerable nocturnal activity was noted, with birds both foraging and visiting nests during hours of darkness, at least under a full moon (Hancock *et al.* 1992).

Breeding Season At Tonle Sap, Cambodia, egg-laying apparently takes place during the dry season (as with all other waterbirds at the site) in January and February (Parr *et al.* 1996), while in Malaysia two nests contained three eggs on 18 August (Robinson and Chasen 1936) and the Kuala Gula colony was active in November (Hancock *et al.* 1992). In Indonesia, breeding occurs during the dry season that usually lasts until October (Hancock *et al.* 1992). Clutches taken on Java date from March, May and July (Hellebrekers and Hoogerwerf 1967), a Javan colony mostly contained fledged and almost full-grown young (with one clutch unhatched) in July (Hoogerwerf 1936a), and eggs are apparently sometimes laid in August (Hancock *et al.* 1992). On 19 July 1919, nests were active at the Citarum delta on Java, most containing three eggs, some with newly hatched chicks and a very few with chicks close to fledging (Bartels 1915–1930). In Sumatra a bird was seen in breeding plumage in May (Nash and Nash 1985) and egg-laying occurs in June–August (Hancock *et al.* 1992). Dry-season breeding probably coincides with maximum fish stocks, following the rainy season (Hancock *et al.* 1992), and presumably increased ease of prey capture as water levels drop (although this is presumably does not apply to birds feeding in tidal areas).

Nest site and structure Breeding is colonial, often occurring in multi-species aggregations, with Milky Stork nests often numbering only 10–20, but sometimes up to several hundred (Hancock *et al.* 1992). In Sumatra the species has been recorded nesting alongside Lesser Adjutant, Black-headed Ibis *Ibis melanocephala* and several species of heron Ardeidae (Danielsen *et al.* 1991a). Nesting around Tonle Sap presumably takes place in large colonies

containing Painted Stork, Lesser Adjutant and Spot-billed Pelicans *Pelecanus philippensis* (Mundkur *et al.* 1995a, Goes *et al.* 1998b).

The major breeding colonies found in Sumatra in September 1988 were all in mangrove back swamps; at Tanjung Koyan the colony was some 2 km from the coast, in dense *Acrostichum* fern vegetation, with nests built in 3–4 m high bushes around a small (900 m²) pool; at Tanjung Selokan it was 1–2 km from the coast, with nests 5–15 m up in 10–12 dead trees within a flooded area 15 ha in extent; on the Banyuasin peninsula it was 3–4 km inland, 2–6 m up in 10–15 small bushes near a 2,500 m² pool in dense *Acrostichum* fern vegetation (Danielsen *et al.* 1991a); and at Kuala Betara, it was situated in the outer mangrove fringe in nine trees (probably *Avicennia*, although some were later identified as “red mangrove” *Rhizophora apiculata*) 8–12 m high (Danielsen and Skov 1985, 1987; also Silvius 1988). Two other nesting colonies were also reported one and three hours inland by canoe (Danielsen and Skov 1985). On Java a colony of 75–100 nests was sited in a group of large “black mangrove” *Avicennia marina* covering c.4.5 ha; nest-trees generally held 5–7 nests, sometimes 10, rarely only 2–3 (Hoogerwerf 1936a). At the Citarum delta only very tall trees were used, one of these containing 22 nests (Bartels 1915–1930). In the same tree species, nests were placed at heights of 8–30 m (Verheugt 1987), usually 30 m up on Pulau Rambut, but originally (prior to disturbance) down to 4 m above the ground on Pulau Dua (Hancock *et al.* 1992). In Malaysia, a colony of 20 nests was situated 8–10 m up both live and dead trees, mostly the latter (Siti Hawa Yatim 1990); in another case two nests were placed in the tops of mangroves (Robinson and Chasen 1936). Nests are fairly bulky structures of sticks, lined with fresh leafy twigs, in general resembling the nests of Grey Herons *Ardea cinerea* but containing thicker branches (Hoogerwerf 1936a, Robinson and Chasen 1936). Twigs and fresh leaves are sometimes collected for the nest from some distance away (Bartels 1915–1930).

Clutch, incubation and fledging Nine clutches from Java consisted of three eggs (Hellebrekers and Hoogerwerf 1967), although nests in one large colony held mostly two young, one with one and a few with three (Hoogerwerf 1936a), and clutches of four eggs have been recorded (Hoogerwerf 1949). In 1984, nests at Pulau Rambut, Java, mostly contained two young (Verheugt 1987). Two nests in Malaysia both contained three young (Robinson and Chasen 1936). The incubation period is estimated at 27–30 days; by 6–7 weeks the young are able to leave the nest and fly poorly, and by eight weeks they fly well but are still fed in the nest by parents (Hoogerwerf 1936b). Small young are fed more frequently than large young; before they are four weeks old chicks may be fed twice per hour (presumably on small items), whereas older nestlings may only be fed once per afternoon (presumably on larger items) (Hoogerwerf 1936b). When temperatures are high, adults sometimes bring water to the nest and drool it from their bills to cool the nestlings or allow them to drink (Hancock *et al.* 1992).

Migration Most waterbirds breeding around Tonle Sap vacate the area during the wet season, visiting wetlands across Cambodia (C. M. Poole *in litt.* 1998, Goes 1999a). The recent sighting of birds in the Gulf of Thailand coincides with this annual wet-season exodus (C. M. Poole verbally 1999), and indeed the species may be an overlooked regular but rare visitor to the area (P. D. Round *in litt.* 1999).

In Peninsular Malaysia the Perak population is essentially resident (Wells 1999). The few sightings from Johor are probably occasional wanderers from the Riau and Jambi populations on Sumatra, only 70 km distant (Hawkins and Howes 1986; see Remarks 1). The record from north-west Bali in October 1982 was of a bird flying east during a raptor migration (Ash 1982, NJC), and other sightings to the east in Sumbawa suggest that individuals occasionally wander for great distances. In addition, two birds were observed crossing the Sunda Straits in September 1984 (Allport and Wilson 1986), a flock of presumed immigrants was seen flying east at Serang, West Java, again in September 1984, and spring migration was noted in April 1985 when two small groups were seen flying in a north-westerly direction, leaving mainland Java and travelling towards Sumatra (Verheugt 1987). Although such

movements have not been considered true migration (Silvius and Verheugt 1989), the likely provenance of all these birds is south-east Sumatra, suggesting a minor annual migration (Hancock *et al.* 1992).

THREATS The main threats to the survival of the species are human disturbance, hunting and habitat loss. A review of threats to the species is given by Verheugt (1987).

Persecution, disturbance and trade In all portions of its range the species is threatened by poaching and interference with colonies (Hancock *et al.* 1992). **Cambodia** The flooded forest at Prek Toal, near Tonle Sap lake, supports one of the most important waterbird colonies in South-East Asia (Parr *et al.* 1996; see Measures Proposed under Greater Adjutant *Leptoptilos dubius*). The exploitation of eggs and chicks was identified as the principal threat to the continued survival of these colonies (Parr *et al.* 1996, Sun Hean *in litt.* 1997; see Threats under Greater Adjutant). As in much of South-East Asia, wildlife is seen as a delicacy much sought after by city dwellers, and middlemen travel from Battambang and Siem Reap to the Prek Toal area, often providing advance monies for waterbird chicks months before the breeding season; stork chicks are also often consumed at Khmer New Year feasts in the area, as the meat is preferred and the price is low (Ear-Dupuy *et al.* 1998). It was thought that, along with Painted Stork, this species is one of the most favoured by local waterbird collectors at Prek Toal because of the taste and manageable weight of its chicks (Parr *et al.* 1996; see Remarks 3), but this conclusion has not been supported by later research (Ear-Dupuy *et al.* 1998). These demands cause much of the exploitation at Tonle Sap colonies, resulting in an extremely low ratio of offspring to adults for all large waterbirds, which implies poor breeding success and low recruitment (Parr *et al.* 1996). Other local methods of waterbird exploitation include the use of fishing hooks and monofilament nylon lines or hooks mounted on sticks to snare adult birds (Mundkur *et al.* 1995a, Parr *et al.* 1996), but this mostly targets small or medium-sized waterbirds. Spring-traps baited with decoy birds are a potentially serious threat (Parr *et al.* 1996). **Peninsular Malaysia** Given the vast mudflats along the western Malaysian Peninsula, the local decline of the species cannot easily be attributed to any shortage in foraging habitat or food supply (although see Pollution under Lesser Adjutant); persecution and disturbance at nesting colonies (along with destruction of nesting habitat) are almost certainly the cause of apparent declines (Swennen and Martejijn 1985, Wells 1999). The Pulau Ketam heronry, in which this species once nested, was thought to have been abandoned owing to high levels of hunting and disturbance (DWNPPM 1987). **Indonesia** The future of the species in South Sumatra remains uncertain partly owing to continuing local demand for food and trade (Silvius and Verheugt 1989). The breeding colony at Hutan Bakau Pantai Timor mangrove reserve had disappeared in 1989, along with much of the mangrove within the area; this was possibly caused by a pulse of illegal trade in the species, when 40–50 young birds were shipped to zoos within South-East Asia and western Europe at a time when the only other known (publicised) colony was the small one on Pulau Rambut, Java (Danielsen *et al.* 1991b). In the early 1990s, 70 Milky Storks were kept in captivity in nine zoos outside Indonesia (Hancock *et al.* 1992). D. A. Holmes (*in litt.* 1999) commented that “without urgent, strong, positive intervention it is likely that all the breeding colonies in Sumatra will be destroyed within a few years”, especially given the partial breakdown of law and order occurring in some regions. Bartels (1915–1930) reported that on Java no persecution of adult Milky Storks occurred and the birds were therefore very tame; they were often kept as pets, however, indicating that young ones were taken from colonies. The fact that the species no longer breeds on Java suggests that this pressure grew too intense or that disturbance of nesting colonies increased unsupportably. During the Japanese occupation of Indonesia (1942–1945) management of Pulau Dua was interrupted; severe damage to mangrove habitat was thereby incurred with a negative impact on numbers of the species (Hoogerwerf 1947a). The loss of this stork (in common with four other colonial

waterbirds) from the breeding avifauna of Pulau Dua in 1975 coincided with increased access to the island (it became joined to the mainland by a spit of accumulated silt in the mid-1970s, allowing pedestrian access to humans and other predators) and so is probably related to disturbance (Milton and Marhadi 1985, Verheugt 1987, Hancock *et al.* 1992).

Habitat loss and modification Throughout its range the species is threatened by habitat loss as a result of mangrove deforestation, tidal rice cultivation, fish- and prawn-farming and (in Indonesia at least) human resettlement (Luthin 1987, Verheugt 1987, Collar *et al.* 1994, Hancock *et al.* 1992). In South-East Asia 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). In particular, mangrove forests throughout the region are being cleared at a dramatic rate for development, for the commercial production of firewood and charcoal, and for fish-farming (Silvius *et al.* 1986, Verheugt 1987, Whitten *et al.* 1987b,c, Parr 1994b, Kushlan and Hafner 2000). *Cambodia* Large tracts of swamp forest around Tonle Sap have apparently already been logged and converted to agriculture; forest clearance is currently proceeding at a slow rate but as timber resources become depleted peripherally, the pressure to exploit the remaining habitat is set to intensify (Scott 1992, Parr *et al.* 1996). Intentional burning of the flooded forest at this site was noted in the dry season, but the extent of damage was not determined (Parr *et al.* 1996). Siltation may pose another threat. Although it has perhaps been exacerbated by widespread deforestation of the catchment area, and by a series of small dams constructed by the Khmer Rouge (Scott 1989), there is no evidence to support this and, in fact, some dam/irrigation schemes in Cambodia have produced excellent habitat for large waterbirds (e.g. Ang Trapeang Thmor Reserve) (C. M. Poole *in litt.* 1999). Ironically, the increasing prospect of peace in the region is perhaps one of the most serious threats to the waterbirds of Tonle Sap, as political and military stability will probably lead to a resumption of plans for flood control, drainage and irrigation as part of a regional development scheme (Scott 1992); on the other hand, of course, instability reduces the chances of establishing an effective protected-area network in Cambodia (Parr *et al.* 1996). *Vietnam* Hancock *et al.* (1992) stated that “this species was essentially eliminated from Vietnam by the widespread destruction of mangrove swamps during the Southeast Asian War”, going on to suggest that “extensive mangrove reforestation and protection by wardens may have resulted in some recolonization in recent years”. There is, in fact, little evidence to suggest that the species ever bred in Vietnam (see under Population) or that it was exterminated by habitat loss. Moreover, the mangrove reforestation programme is apparently ineffective, and wardening of suitable areas almost non-existent (S. T. Buckton verbally 2000). *Peninsular Malaysia* An account of threats to coastal wetlands and mangroves (including Kuala Gula) in the peninsula appears in Threats under Lesser Adjutant. *Indonesia* The future of the species in South Sumatra remains uncertain owing to plans to convert tidal forests into large-scale brackish-water fish-farms and to implement various logging and conversion schemes (Silvius and Verheugt 1989). Large areas of lowland forest in Sumatra, including swamp forest, have been severely adversely affected by widespread fires (see Threats under Hook-billed Bulbul *Setornis criniger*); for example, fire destroyed habitat in Berbak National Park in 1997 (Legg and Laumonier 1999). There are or were dangers associated with all three major breeding colonies on Sumatra in 1988, although positive opportunities existed (see Measures Taken and Measures Proposed). The disappearance of the breeding colony at Hutan Bakau Pantai Timor, along with much of the mangrove within the area, was possibly attributable to substantial incursions by farmers and loggers apparently unaware of the existence of the reserve (Danielsen *et al.* 1991b). Padang Sugihan reserve has been overrun by local settlers (Rudyanto verbally 2000). The important wetland of Segara Anakan in southern Central Java has been a source of concern through steady siltation and plans for its conversion to rice (Erftemeijer *et al.* 1988). In total, an estimated 1,000 km² of coastal wetland is lost in Indonesia per annum (Verheugt 1987). Rapid degradation of coastal

mangroves and swamps in Sulawesi was observed during December 1997 along the east and south coasts of the northern peninsula (Kasinbar to Tilamuta) and does not bode well for the local population of this species (Bishop in press). The degree of habitat loss in south and south-eastern Sulawesi is not known.

Pollution Industrial and agricultural pollution in Cambodia and Peninsular Malaysia is discussed in Threats under Lesser Adjutant.

MEASURES TAKEN The species has been listed on Appendix I of CITES since 1987. It is legally protected in Malaysia and Indonesia.

Protected areas *Cambodia* Prek Toal is a core area of Tonle Sap Biosphere Reserve (C. M. Poole *in litt.* 1999; but see Measures Taken and Measures Proposed under Greater Adjutant). Ream National Park might protect a breeding population (J. W. K. Parr *in litt.* 1998) and recent reports of immature birds in the area lend weight to this prospect (C. M. Poole *in litt.* 1999); extensive mangroves are located immediately east of the reserve. *Peninsular Malaysia* The species receives some protection at Kuala Gula in Matang Mangrove Forest Reserve. It also occurs in Benut Forest Reserve but it is unclear what level of protection this entails. *Indonesia* The large colony at Tanjung Koyan, South Sumatra, is within mangrove designated as protection forest, and although part of the area has been identified for agricultural settlement the site should not be affected if the status of the mangrove is maintained (Danielsen *et al.* 1991a). Other colonies are in the Berbak National Park and Way Kambas National Park (Sumatra), Pulau Rambut Strict Nature Reserve (Java) and Rawa Aopa Watumohai National Park (Sulawesi).

Reduction of persecution *Cambodia* An account of relevant measures at colonies near Tonle Sap appears under Greater Adjutant.

Education *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 the exploitation and hunting of large waterbirds (Veasna 1999, C. M. Poole *in litt.* 1999). Educational videos have also been shown to some villagers, emphasising the laws prohibiting hunting and the need to conserve large waterbirds (Veasna 1999).

Captive breeding *Malaysia* A captive breeding programme at Zoo Negara, Kuala Lumpur, resulted in four pairs producing 12 offspring up to 1990 (*ICBP/IWRB Storks, Ibises and Spoonbills Specialist Group Newsletter* 3, 1/2 [1990]: 5). Individuals were released from captivity at Kuala Selangor Nature Park, Selangor (*Enggang* 4, 3 [1996]), and by 2000 the zoo had 60 birds, but although some of these had been released into the park no breeding had occurred (*Suara Enggang* 4, July–August [2000]: 30–31).

MEASURES PROPOSED Accounts of all measures proposed in the Tonle Sap region, Cambodia, appear in equivalent sections under Greater Adjutant. Conservation action for this species also broadly overlaps that suggested for the Lesser Adjutant in Malaysia and Indonesia (see relevant account).

Protected areas *Malaysia* The level and area of protection at Matang Mangrove Forest Reserve and Benut Forest Reserve should be increased. Proposals relating to forestry practices in these areas appear under Lesser Adjutant. *Indonesia* The location of the inland colonies at Sungei Gapung and Sungei Siput, South Sumatra, the latter reputedly holding “hundreds of nests” (Danielsen and Skov 1985), is clearly important, and the protection of these and the colony in mangrove at Kuala Betara (Hutan Bakau Pantai Timor mangrove reserve), if still extant, is imperative. The breeding colony at Tanjung Selokan is or was within an area proposed for fishpond development, but a nature reserve of 100 km² has now been proposed (Danielsen and Verheugt 1990, Danielsen *et al.* 1991a). The colony on the Banyuasin peninsula is similarly within an area designated for fishpond development, in spite of being on acidic soils and falling within protection forest, but a major proposal to create the Sembilang Wildlife

Reserve, covering 3,875 km², has been formulated to protect not only the storks and another 34 globally threatened wildlife species but also a major migration stopover site and the natural spawning areas for 70% of the province's coastal fisheries (Danielsen and Verheugt 1990, Danielsen *et al.* 1991a). Silvius and Verheugt (1989) called for network of coastal nature or wildlife reserves to be established in Riau, Jambi and South Sumatra provinces, Sumatra. Repeated observations in Sulawesi come from an area of coastal mangroves, swamp forest and shallow lake(s) in and around the proposed Tanjung Panjang Reserve (FAO 1982), a site that clearly deserves protection.

Research and monitoring Further survey work is required, as is continued monitoring of all subpopulations at key sites (see Remarks 4). Commercial harvesting of swamp forest needs further study so that methods can be improved from the viewpoint of waterbird conservation. Research programmes are also required on the general ecology and seasonal movements of the species. In Indonesia, surveys of Sulawesi should seek to establish its status, distribution and management requirements. Key colonies need to be studied where possible so that reproductive success can be gauged, trends tracked and the source of significant threats identified.

Reduction of persecution Colonies need to be protected from disturbance and from egg or chick collection wherever possible. In some cases this will necessitate some form of breeding season surveillance, perhaps in conjunction with research or ecotourism, and certainly in conjunction with local education initiatives.

Education The success of conservation programmes and protected areas for the species in Malaysia "will depend much on actively interesting the local community" (Wells 1999); to address this need, community awareness projects should target relevant settlements. In Indonesia a public awareness campaign should inform the local communities, including fishermen who live semi-permanently offshore, of the conservation and protection status of the species (Silvius and Verheugt 1989).

REMARKS (1) Wells (1999) took the clustering of records into five nodes to be "suggestive of at least as many past colonies", rather than the result of wandering birds. Further unconfirmed records from the southern portion of the peninsula include a group seen at Kampung Telok Jawa, near Pasir Gidang, south Johor, Peninsular Malaysia, in June 1998, after a newspaper report of 14 in November 1997: these birds were suspiciously confiding and therefore probably escapees from Singapore Zoo (*Suara Enggang* July–August 1998). An earlier report of 14 flying north to south near Serangoon, Singapore, October 1997 (H. Jensen *in litt.* 1999), seems likely to refer to the same flock of birds. (2) Although rumours have circulated that "a former colony site in southern Vietnam has been recolonized in recent years" (Verheugt 1987) or that "some birds have apparently recolonized Vietnam since the war of 1963–75" (Hancock *et al.* 1992), there is no firm evidence of this. Ornithological surveys of wetlands throughout the Mekong delta in 1999 failed to find the species (Buckton *et al.* 1999), and there are no confirmed recent records from elsewhere in Vietnam (Nguyen Cu *in litt.* 1997, Eames and Tordoff *in prep.*). A possible record from Cat Tien National Park, Dong Nai, in December 1988 (Morris 1994), and other records from Ca Mau, Kien Giang and Minh Hai provinces (Le Dien Duc and Le Dinh Thuy 1987, Verheugt 1987, Le Dien Duc 1989, 1993a, Scott 1989) are all thought to be mistaken (J. C. Eames *in litt.* 2001). (3) The Milky Stork is often not differentiated from the Painted Stork by locals in Cambodia (Parr *et al.* 1996). Waterbird harvesters reportedly collected 6,570 eggs and 2,482 chicks of Painted Stork from the Prek Toal colony in the 1995–1996 breeding season, totals that might contain small numbers of Milky Stork eggs (Parr *et al.* 1996). (4) Care should be taken during survey work to distinguish between this species and Painted Stork. Their similarity (especially of juveniles) makes the Milky Stork easy to overlook, especially at sites such as Tonle Sap, Cambodia, where Painted Storks are much commoner (Goes *et al.* 1998b).