

BLACK-NECKED CRANE

Grus nigricollis

Critical —
Endangered —
Vulnerable C1

This species has a small, declining population as a result of loss and degradation of wetlands, changing agricultural practices and increased human activity in its breeding and wintering grounds. These factors qualify it as Vulnerable.



DISTRIBUTION The breeding range of the Black-necked Crane includes much of the Qinghai–Tibetan Plateau in south-central China, with small breeding populations in two adjacent parts of India. The main wintering grounds are in China, on the southern and eastern parts of the Qinghai–Tibetan Plateau and on the Yunnan–Guizhou Plateau, and in Bhutan. Very small numbers have wintered in Arunachal Pradesh in India, and in the lowlands of northern Vietnam (but see Vietnam below and Remarks 1), and there are single records from Nepal and Myanmar (where apparently suitable habitat exists to support a wintering population). A specimen collected on the upper Han River, Kyonggi province, South Korea, in February 1917 was originally identified as a Black-necked Crane (Mori 1917), but was probably either a melanistic Red-crowned Crane *Grus japonensis* or a hybrid Red-crowned × White-naped Crane *G. vipio* (Austin 1948).

■ **CHINA** The Black-necked Crane breeds at high elevations on the Qinghai–Tibetan Plateau, in south-eastern Xinjiang, Tibet, Qinghai, southern Gansu and north-western Sichuan; it winters at lower altitudes on the Qinghai–Tibetan and Yunnan–Guizhou Plateaus, in Tibet (especially along the middle reaches of the Yarlung Zangbo river), southern Sichuan, northern Yunnan and western Guizhou (and possibly also in Qinghai: see below) (Meine and Archibald 1996, Wang Qishan *in litt.* 1998, Li Fengshan and Bishop 1999). Its three most important known breeding grounds are Xainza (Shenzha) in central Tibet, Longbaotan in southern Qinghai and Zoigê in northern Sichuan (Meine and Archibald 1996, Wang Qishan *in litt.* 1998). In the following account there are occasionally both records from counties *and* records from within counties, although it is acknowledged that in some cases the areas intended may be the same; however, it was felt that, as these records are often from different time periods, it was better to present (and map) the information available rather than attempt its elision under one site. Records (by province) are as follows:

■ **Xinjiang Arjin Shan National Nature Reserve** (Altun Shan Reserve), Ruoqiang county, breeding, family parties with 1–2 chicks occurring annually at Yixiekepati lake (Yuan Guoying 1997);

■ **Tibet Rutog county**, August 1976 (specimen in ASCN), 17 birds at Guoba and two at Huilong, September 1987 (Feng Kemin 1989), reported to breed in this county, undated (Li Fengshan and Bishop 1999); **Ge'gyai county**, two birds in the western suburbs of Ge'gyai, two at Ziongba and three at Yanhu, October 1987 (Feng Kemin 1989), reported to breed in the county, undated (Li Fengshan and Bishop 1999); **Amdo county**, four birds at Conag and four at Zasa, June 1987 (Feng Kemin 1989), reported to breed in the county, undated (Li Fengshan and Bishop 1999); **Gerze county**, two birds at Cuonba, August 1987 and two at Charbo, October 1987 (Feng Kemin 1989), reported to breed in the county, undated (Li Fengshan and Bishop 1999); **Gar county**, two birds at Zozo, September 1987 (Feng Kemin 1989), reported to breed in the county, undated (Li Fengshan and Bishop 1999); **Baingoin**

county (Bange), two birds at Xiongqian, four at Deqing and two at Narlong, July 1987 (Feng Kemin 1989), three nests found at Duoba, May 1991 (Dwyer *et al.* 1992), with 40 adults and five chicks at Duoba, July 2000 (Tobgay and Sherub 2000, G. Archibald *per* M. A. Bishop *in litt.* 2000); **Nagqu county** (Nagchu), two chicks at Sang Xiong marsh, May 1991 (Dwyer *et al.* 1992); **Tsatang**, Nagqu county, 4,250 m, male collected, April 1890 (Oustalet 1893); marsh just below **Jerko La** (Jerbo La), Gar county, September 1932 (Ludlow ms); **Coqen county**, six birds in the eastern suburbs of Coqen, October 1987 (Feng Kemin 1989), two birds at Darja Cuo, October 1987 and July 1988 (Feng Kemin 1989), reported to breed in the county, undated (Li Fengshan and Bishop 1999); **Moincer**, Gar county, more than 20 birds, May 1999 (Lu Xin 1999); **Xainza county** (Shenza), 13 birds, including 10 breeders at the Luobo river, December 1982 (Lu Zongbao 1986), 22 birds at Xingou, July 1987 (Feng Kemin 1991), 28 birds at Luobo Cuo lake (4.5 km²) and four south-west of Xainza town, September 1988 (Feng Kemin 1991), 25 birds including five chicks at Luobo Cuo, three nests and seven chicks at Mujiu Cuo lake (70 km²), with nests also recorded at Shibu Cuo lake, Nari Cuo lake, Qiazhang and near Xainza town, May 1991 (Dwyer *et al.* 1992), four adults and one chick near Xainza town, 27 adults and 10 chicks at Luobo Cuo, and more than 105 adults and 11 chicks at Mujiu Cuo, July 2000 (Tobgay and Sherub 2000, G. Archibald *per* M. A. Bishop *in litt.* 2000); **Lejandak Tso**, near the source of the Sutlej river, southern edge of Barga (Barkha) plain, Burang county, c.4,570 m, June 1945 (Ali 1946), pairs seen on the margins of large riverine pools, July 1954, but no nests found (Lavkumar 1955, 1966); **Gyanyima Tso**, Kangrinboqê Feng-Mapam Yumco (Kailas–Manasarowar) region, Burang county, c.4,540 m, July 1945 (Ali 1946), pairs seen on a marsh, July 1954, but no nests found (Lavkumar 1955, 1966); **Ding Tso**, north-east of Mapam Yumco (Manasarowar lake), Burang county, c.4,630 m, June 1945 (Ali 1946); **Nam Co** lake, Damxung county, two adults and two young, September 1999 (Lu Xin 1999); **Mapam Yumco** lake, Burang county, flocks of 2–6 birds occasionally seen in marshes along the roads, May–September 1999, with a family of two adults and two young, September 1999 (Lu Xin 1999); **Rakas Tal**, reported to breed in large numbers, around 1932 (Ludlow ms); **Damxung county**, at Damxung marsh, three families with chicks and 198 birds on passage, May 1991 (Dwyer *et al.* 1992), in marshes in northern Damxung county, 21 birds in June 1996 and 11 adults and three young in September 1999 (Lu Xin 1999); **Burang county**, July 1976 (two specimens in ASCN), two birds at Barga, September 1987 (Feng Kemin 1989), reported to breed in the county, undated (Li Fengshan and Bishop 1999); **Lhunzhub county** (Linzhou), including Pengbo Nature Reserve, nine birds, November 1987 (Feng Kemin 1991), 449 birds, January 1992 (Bishop 1993), 500 birds roosting on Houtou and Kazi reservoirs (Bishop *et al.* 1998); **Yigrong Tso**, Bomi county, reported to occur “very occasionally”, winter 1946/1947 (Ludlow 1951); **Kyi Chu** valley, near Lhasa, “huge flocks”, winter 1942 (Ludlow 1950); **Gongbo’gyamda county**, Nyingchi prefecture, observed in winter (unspecified years) (Li Fengshan and Bishop 1999); **Maizhokunggar county**, 37 birds November 1987 (Feng Kemin 1991), 269 birds in the upper Lhasa river, undated (Yu Yuqun *et al.* 1993), 872 birds on the Lhasa river in Dagze and Maizhokunggar counties, January 1992 (Bishop 1993); east of **Gandaingoin** (Gandan), Dagze county, flock of at least 23, March 1986 (Robson 1986); marshes between **Sera Gompa** (Sera monastery) and Drepung monastery, near Lhasa, adults with young, summer 1942, although the species for the most part deserts Lhasa in the breeding season (Ludlow 1950); **Dagze county**, 872 birds on the Lhasa river in Dagze and Maizhokunggar counties, January 1992 (Bishop 1993); **Namling county**, 94 birds, December 1991 (Bishop 1993); **Zhongba county**, two birds at Qunjia, one at Kumjia, two at Pianji, two at Paryang and two at Youbuco, July 1988 (Feng Kemin 1989), two chicks at Zhuzhu Co, two chicks north of Ganjiu, one chick at the Maquan river valley and two chicks 6 km north-west of Paryang, May 1991 (Dwyer *et al.* 1992); **Lhasa**, 3,720 m, September 1904 (Walton 1906, specimen in BMNH), two or three groups totalling at least 57 birds c.8 km west of Lhasa, and flocks of c.41 and c.15 between Lhasa and Gandaingoin (Gandan), March 1986 (Robson 1986); **Doilungdeqen county**, 167 birds in Doilungdeqen and

Quxu counties, January 1992 (Bishop 1993); **Nyingchi county**, observed in winter (unspecified years), although the total number of wintering cranes in eastern Tibet is estimated to be not more than 20 birds (Li Fengshan and Bishop 1999); **Temo Gompa**, Nyingchi county, on the Yarlung Zangbo (Tsangpo) river, winter 1946/1947 (Ludlow 1951); **Saga county**, eight birds at Buza and two at Xiaru, June 1988 (Feng Keming 1989), one nest at Qangxiong, two chicks at Zhuzhu Co, two chicks north of Ganjiu, one chick at the Maquan river valley and two chicks 6 km north-west of Paryang, May–June 1991 (Dwyer *et al.* 1992); **Xaitongmoin county**, c.200 birds in the Xaitongmoin valley, winter 1991/1992 (Bishop 1993); **Quxu county**, 167 birds in Doilungdeqen and Quxu counties, January 1992 (Bishop 1993); **Shigatse county** (Xigaze), more than 600 birds, December 1991–January 1992 (Bishop 1993); **Gonggar county**, “many” between Kumba Padzi and Ghongar (Gonggar), March 1938 (Ludlow ms), 274 birds along the Yarlung Zangbo river between Gonggar and Nedong, January 1992 (Bishop 1993); **Chira** (Chera), on the Yarlung Zangbo (Tsangpo) river near Tsetang, flock of c.200 birds, March 1938 (Ludlow ms, Ludlow and Kinnear 1944); **Ngamring county**, August 1975 (specimen in ASCN), two birds at Sangsang and two at Comai, July 1988 (Feng Kemin 1989), reported to breed in the county, undated (Li Fengshan and Bishop 1999); **Zhanang county**, 274 birds along the Yarlung Zangbo river between Gonggar and Nedong, January 1992 (Bishop 1993); **Nedong county**, 274 birds along the Yarlung Zangbo river between Gonggar and Nedong, January 1992 (Bishop 1993); **Bainang county**, 78 birds, January 1992 (Bishop 1993); various places between **Lhagyari** and Gyangze (Gyantse), undated (Ludlow and Kinnear 1944); **Lhaze county**, c.200 birds in the Tashikang valley, south of the Xientongmoin valley, December 1991–January 1992, 641 birds between Lhaze and Pindzoling, January 1992 (Bishop 1993); **Gyirong county**, 10 birds at Helinco, June 1988 (Feng Kemin 1989), reported to breed in the county, undated (Li Fengshan and Bishop 1999); **Gyangze** (Gyantse), 17 collected, 1906–1909, common in winter (Bailey 1911), January 1914 (two females in NRM), four collected, December 1923–April 1924, and quite common in winter, either singly or in pairs, or in flocks of 20+ individuals, generally shy and difficult to approach but occasionally tame individuals encountered, leaving the Nyang Chu valley in spring and retiring to the lakes to breed (Ludlow 1927–1928, four specimens in BMNH), 1933 (Ludlow and Kinnear 1937), two pairs seen between Yatung and Gyangze (Gyantse), and a pair reported to nest “in Dochen Lake somewhere”, undated (Battye 1935), but with no birds found in Gyangze county in January 1992 (Bishop 1993); **Sa’gya county**, 314 birds in the Jiding valley, December 1991 (Bishop 1993); **Dongtse**, Gyangze county, female collected, December 1923 (Ludlow 1927–1928); **Yamdruk Tso**, Ngarze county, 1933 (Ludlow and Kinnear 1937), but with no birds found in Ngarze county in January 1992 (Bishop 1993); **Tingri county**, pair photographed on “Tinki plain”, 4,570 m, June 1922 (Hingston 1927), but with no birds found around Tingri town in December 1991 (Bishop 1993), although reported to breed in the county, undated (Li Fengshan and Bishop 1999); **Kalashar**, Kangmar county, collected in September (unspecified year) (Vaurie 1972); **Kala Tso**, c.50 km south of Gyangze (Gyantse), Kangmar county, September 1922 (two specimens in AMNH), pair seen east of the lake, 1946 (Maclaren 1947b, 1948); **Bam Tso** (Hram Tso, Rham Tso), c.50 km south of Gyangze (Gyantse), Yadong county, 1,750 m, 1905–1906 (R. Steen in Baker 1922–1930), eggs collected, June 1906–1909 (Bailey 1911), May 1923 (specimen in AMNH), pairs “scattered all over the marshes south and west of the lake”, 1946 (Maclaren 1947b, 1948); **Cona** (Tsona) marshes, Cona county, several pairs, July 1934 (Ludlow ms, Ludlow and Kinnear 1937); Tachucha (untraced), Mt Hishabanma, 4,000 m, male collected, March 1964 (Hsu Weishu 1980);

■ **Qinghai** Tulai He river, at **Tuole** (Tuolehe), Qilian county, seven birds, July 1979 (Yao Jianchu 1982), reported to breed, undated (Li Fengshan and Bishop 1999); **Huangzangsi**, Qilian county, an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Muri** (Muli), Qilian county, reported to breed, undated (Li Fengshan and Bishop 1999); **Reshui**, Qilian county, an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Hurleg Hu** (Kurlyk

Nor), Dulan county, collected in October, and to the south in August (unspecified years) (Vaurie 1972); **Bayan Gol** (Bayinguoluohe) river, Golmud county, collected in May (unspecified year) (Vaurie 1972); **Tianjun county**, an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Gobi** farm, Ulan county, four birds, August 1978 (Yao Jianchu 1982), an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Serh** (Saishike), Ulan county, reported to breed, undated (Li Fengshan and Bishop 1999); **Niao Dao Nature Reserve** (Qinghai Hu lake, Koko Nor), Gangcha county, 3,320 m, before 1893 (specimen in BMNH), September 1925 (Bangs and Peters 1928, male in MCZ), breeding at the Quanwan wetlands on Niao Dao (Bird Island), 10 birds, October 1978 (Guo Juting 1981), 20 summering birds (including at least one breeding pair) at Quanwan in May and June prior to 1988, with mid-June counts of 15 in 1994, 11 in 1995 and seven in 1996 (Li Laixing 1997c), known breeding sites at Qinghai Hu being Quanwan, the Ganzi He river mouth, Xiaopo Hu lake and the Daotang He river mouth (Li Laixing *et al.* 1999); **Ulan county**, adult collected, October 1964 (Wang Qishan *in litt.* 1998); **Senag** (Shinaihai), Gonghe county, an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Nomhon**, Dulan county, c.31 birds, September 1978 and October 1979 (Guo Juting 1981), one of the major breeding grounds of this species in Qinghai (Li Fengshan and Bishop 1999); **Golmud city**, one of the major breeding grounds of this species in Qinghai (Li Fengshan and Bishop 1999); **Sazhubxi** (Shazhuyu), Gonghe county, seven birds, March 1979 (Yao Jianchu 1982), reported to breed, undated (Li Fengshan and Bishop 1999); **Barun** (Baruun), Dulan county, collected in May (unspecified year) (Vaurie 1972); **Dulan county**, Balong is an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Guide county**, reported to breed at Niao by the Huang He (Yellow River), undated (Li Fengshan and Bishop 1999); **Zekog county** (Zeku), an unconfirmed breeding area (Li Fengshan and Bishop 1999); Heihe, **Madoi county**, one of the major current breeding grounds of this species in Qinghai (Li Fengshan and Bishop 1999); **Tshe Chu** (Tsechu) river, four days west of Labrang, Zekog county, male collected, May 1926 (Bangs and Peters 1928, male in MCZ); **Ngoring Hu** lake (Elinghu), Madoi county, one of the major breeding grounds of this species in Qinghai (Li Fengshan and Bishop 1999); **Gyaring Hu** lake (Zhalinghu), Madoi county, an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Jiang Cuo** lakes, Madoi county, pair seen, September 1995 (Allen and Thorpe 1995); **Yematan**, Madoi county, an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Qumarleb county**, an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Zhidoi county**, an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Qingshuihe**, Chindu county, reported to breed, undated (Li Fengshan and Bishop 1999), five pairs on the high plateau between Madoi and Qingshuihe, adjacent to small lakes and bogs, September 1995 (Allen and Thorpe 1995); **Jigzhi county** (Jiuzhi), adult collected, July 1971 (Wang Qishan *in litt.* 1998), an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Tongtian He** (Zhi Qu, Hi Chu), Chindu county, collected in August (unspecified year) (Vaurie 1972); **Tongchi Gompa** (Drechu Gompa), Chindu county, four females collected at “Camp 79” and at “Camp 23”, October 1934 (Schafer and Meyer de Schauensee 1938), collected in April (unspecified year) (Vaurie 1972); Amucuo, Zhenqin, **Chindu county**, an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Longbaotan Nature Reserve** (Longbaohu Nature Reserve), Yushu county, 47 birds, May 1978 (Guo Juting 1981), flock of 36 birds, April 1979, with a population density estimated at 0.78 birds per km² in June 1978 and 0.76 birds per km² in May–June 1979 (Lu Zongbao *et al.* 1980), 92 birds, July 1997 (Li Laixing 1997b), 108 birds, summer 1997 (Basanglamao 1998), one of the major breeding grounds of this species in Qinghai (Li Fengshan and Bishop 1999); **Zadoi county**, an unconfirmed breeding area (Li Fengshan and Bishop 1999); **Rkhombo-mtso**, collected in August (unspecified year) (Vaurie 1972); **Yushu county**, adult collected, August 1964 (Wang Qishan *in litt.* 1998), the Quma river in this county being an unconfirmed breeding area (Li Fengshan and Bishop 1999); between Yushu and **Nanqian**, pair with one juvenile on small lakes and bogs, September 1995 (Allen and Thorpe 1995);

■ **Gansu Ganhaizi Nature Reserve**, Yumen county, undated (Bishop 1996); **Xiao Sugan Hu Nature Reserve**, Akesai county, an important site, undated (Liu Donglai *et al.* 1996); **Da Sugan Hu Nature Reserve**, Akesai county, an important site, undated (Liu Donglai *et al.* 1996); **Luqu county** (Ma'ngce), part of Zoigê marsh, a breeding ground (unspecified years) (Li Fengshan and Bishop 1999); **Ga Hai Nature Reserve**, Luqu county, a breeding area, and also reported to be a wintering ground, unspecified years (Liu Donglai *et al.* 1996), with two collected at Ga Hai lake, undated (Wang Qishan *in litt.* 1998); **Maqu county** (Nyinma), part of Zoigê marsh, a breeding ground (unspecified years) (Li Fengshan and Bishop 1999);

■ **Sichuan Zoigê marsh** (Ruo'ergai, Ruoergai), including Qammê (Xiamen) Proposed Nature Reserve, Zoigê and Hongyuan counties, one collected at "Camp 5", near Zoigê, July 1931 (Stone 1933), 35 birds at Rar (Re'er) lake marsh, undated (Lu Zongbao 1986), 239 birds counted in an area of 1,198 km², and a total of 610 individuals estimated for the entire marsh, May–June 1991, with most records at Doima (Duoma), Tanggor (Tangke) and Lame in Zoigê county, and Waqen (Waqie, Wachie) and Longriba in Hongyuan county (Yang Xuyu *et al.* 1994, Li Fengshan and Bishop 1999), and with 240 birds and 24 active nests located in almost 800 km² of wetlands, and 600–900 cranes estimated to be present on the plateau, May–June 1991, making this the most important known breeding and summering area for the species (Scott 1993); Camp 13, west of **Songpan** (Sungpan), three females collected, August 1931 (Stone 1933), two pairs seen at nests at Wa Qie, near Songpan, May 1991 (Jihmanner 1991), four birds 4–5 km north of Wa Qie, June 1997 (R. M. Thewlis *in litt.* 1999); **Garzê prefecture** (Ganzi prefecture), present in all counties except Luding, Seda, Shiqu, Baiyu and Litang, undated (Dai Bo *et al.* 1994); c.80 km north-west of **Ya'an** (Yachow), immature male collected, October 1934 (Schafer and Meyer de Schauensee 1938); Waschan lake, presumably **Wa Shan**, "west of the Omei", male collected from a flock of seven, April (probably 1914), 30 birds presumably of the same species on the Kanzego plains at 3,500 m in November (presumably c.1914), and birds reported often to occur in Dawo (Stresemann 1923a); "Camp 23" (untraced), four females collected there and at "Camp 79", April 1934 (Schafer and Meyer de Schauensee 1938);

■ **Yunnan Yongshan county**, adult collected at Maolin, December 1982 (Wang Qishan *in litt.* 1998), 124 birds at Maolin and Wuzhai reservoirs, winter 1994/1995 (Li Chun 1996); **Napa Hai Nature Reserve**, Zhongdian county, wintering at Nagpag Co lake, 65 birds, November 1980 (Lu Zongbao 1986), 76 birds in 1988, 70 in 1992 (Li Laixing 1997a), 56 in February 1995 (Li Chun 1996); **Bita Hai Nature Reserve**, Zhongdian county, 25 km from Nagpag Co lake, a staging ground in October–November and an occasional refuge when cranes at Nagpag Co are disturbed (Li Fengshan and Bishop 1999; also MacKinnon *et al.* 1996); **Lugu Hu Nature Reserve**, Ninglang county, 20 birds, February 1995 (Li Chun 1996); **Zhongdian county**, eight, January 1995 (Hornskov 1995b), 45 birds, February 1995 (*Oriental Bird Club Bull.* 22 [1995]: 57–62); **Dashanbao Nature Reserve**, Zhaotong county, recently discovered as an important wintering ground, with c.450 birds, December 1988, c.350 birds, February 1990 (Qiu Guoxin 1990), 550 birds, October 1992 (Sun Dehui 1996), 389 birds, February 1995 (Li Chun 1996); **Zhaotong county**, Tiaodunhe and Dahaizi have been reported to be wintering grounds (unspecified years) (Li Fengshan and Bishop 1999); **Ninglang county**, at Yungning plain (near the Sichuan [Szechwan] border), 2,900 m, in December 1928 and January 1929 (Riley 1932) and two collected in March 1929 (Bangs 1921), 12 birds at Yongxuan and 30 at Niquigou (the former an untraced marsh, the latter 21 km from the north-west edge of Lugu Hu lake: M. A. Bishop *in litt.* 2000), 1994 (Li Chun 1996); **Ludian county**, 150–200 birds at Xinjie, March 1994 (He Xiaorue *per* M. A. Bishop *in litt.* 2000); Mashu, **Qiaojia county**, 76 birds, winter 1994/1995 (Li Chun 1996); **Lasihai** (Lashi Hai) lake, Lijiang county, a historical wintering area (Li Fengshan and Bishop 1999), none in winter 1994/1995 (Li Chun 1996), none in December 1997 (M. A. Bishop *in litt.* 2000), 78 birds, March 1997 (Yang Lan 1997a), May 1998 (Li Yun 1998); **Heqing county**, where Cao Hai and

Dali have been reported to be historical wintering grounds (Li Fengshan and Bishop 1999); **Huize county**, in Huize Nature Reserve, 120 birds at Daqiao reservoir and 167 birds at Changhaizi reservoir, December 1991 (*Oriental Bird Club Bull.* 17 [1993]: 17–18), 288 birds at Daqiao reservoir and 145 at Changhaizi reservoir, February 1995, 31 at Huohong reservoir and 121 at Guangtuo and 20 at Yema in the Jiache area (outside the nature reserve), winter 1994/1995 (Li Chun 1996), 92 birds at Daqiao reservoir in winter 1996/1997 and 69 there in winter 1997/1998 (Wang Gaoxiang 1998); **Banqiao**, Xundian county, 318 birds, February 1995 (Li Chun 1996); Hengheliangzi, Liuxiao township, **Xundian county**, the southernmost wintering ground in China, with birds present from November to late March or early April, and 43–58 birds, February 1995 (Han Lianxian and Zhou Wei 1998); **Qijing city**, 17 birds at Luanshipo Haizi (Dapuo) and 26 at Pianqiao reservoir, winter 1994/1995 (Li Chun 1996); Chen Yah Chow, near **Kunming** (Yunnan city), February 1899 (Ingram 1912, Rothschild 1926, specimen in BMNH); **Dian Chi** lake, Kunming, a historical wintering ground (Li Fengshan and Bishop 1999);

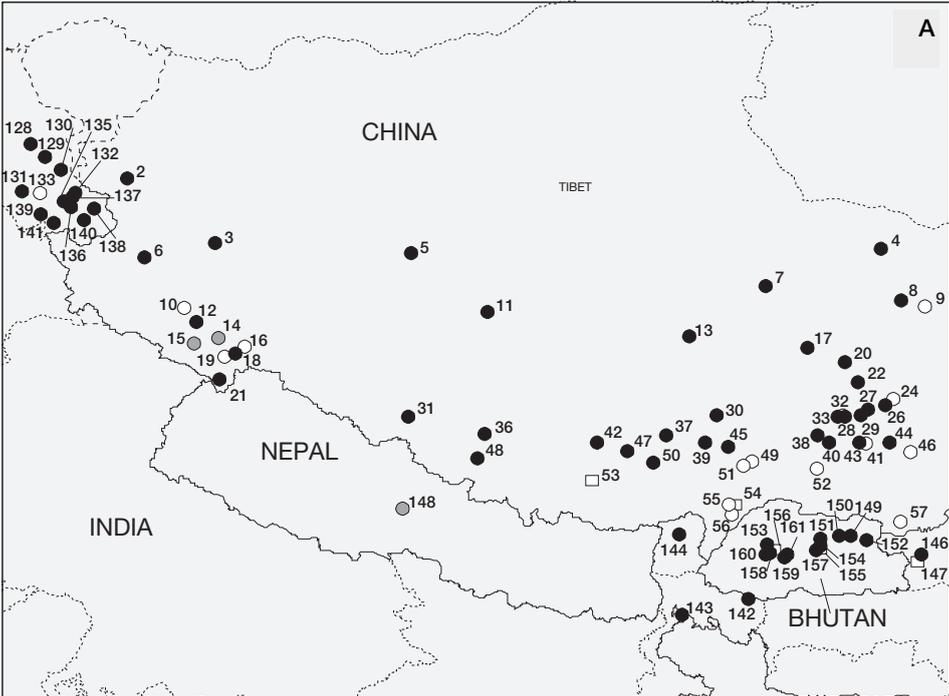
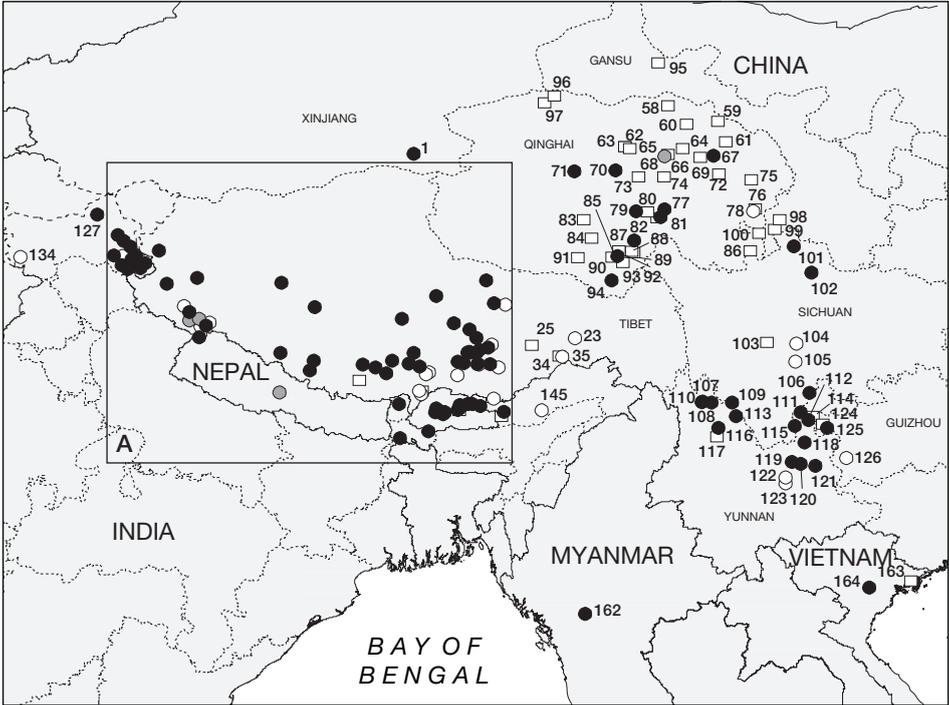
■ **Guizhou Tuoda** forest, Weining county, winter visitor to this area (unspecified years) (Wu Zhikang *et al.* 1992a); **Cao Hai Nature Reserve**, Weining county, an important wintering ground, with fewer than 100 birds in the 1970s (Wu Zhikang and Li Ruoxian 1985), four collected, including two in December 1978 and January 1979, the lake having been drained in 1972, but with a stable c.200–400 birds following the recovery of the lake after 1982 (Wang Qishan *in litt.* 1998); **Pu'an county**, two collected, December 1929 and January 1931, but no longer recorded (Zhu Jingyi *et al.* 1998).

■ **INDIA** Small numbers breed in the Ladakh district of Jammu and Kashmir, close to the border with Tibet (Pfister 1998), and breeding has also recently been reported from Sikkim (Ganguli-Lachungpa 1998). Small numbers of wintering birds have been found at two localities in Arunachal Pradesh (Betts 1954, Bishop 1993a, Gole 1995), and recently at unusually low altitudes in West Bengal (Sanyal 1995). Records (by state) are as follows:

■ **Jammu and Kashmir Nubra**, 3,200 m, up to five individuals observed on migration, 1987 and 1991 (Pfister 1998); **Harong**, 4,400 m, up to eight adults recorded, 1987–1997, breeding attempted in 1996 (Pfister 1998); **Lhungparma**, 4,650 m, up to two adults recorded since 1982, breeding since 1996 (Pfister 1998); **Chushul** (Shushal), 4,450 m, six birds, July 1923 (Osmaston 1925), two pairs, June 1926 (Meinertzhagen 1927), 2–14 adults, 1976–1997, breeding at Tsigul-Tso, Tso-Nyak and Jamarding in the 1990s (Pfister 1998); **Startsapuk-Tso** and Tso-Kar, 4,600 m, three birds, June 1919 (Ludlow 1920), three birds, June 1923 (Osmaston 1925), two pairs, June 1927 (Meinertzhagen 1927), breeding, June–July 1997 (Pfister 1998); **Dungti**, 4,250 m, several sightings since 1978 and four birds in 1997 (Pfister 1998); **Puga**, 4,400 m, a pair, June 1926 (Meinertzhagen 1927); **Chakar Talao**, 4,250 m, May 1926 (Meinertzhagen 1927); **Loma**, 4,200 m, four adults, October 1997 (Pfister 1998); **Staglung**, 4,200 m, 1986 (Hussain 1987), up to four adults, 1992–1997, but no breeding recorded (Pfister 1998); **Lalpari**, 4,300 m, pair breeding, at least 1978–1997 (Pfister 1998); **Fukche**, 4,250m, two adults, May and June 1926 (Meinertzhagen 1927), 2–4 adults summering, 1978–1997 (Pfister 1998); **Tso-Moriri lake**, 4,550 m, pair, June 1919 (Ludlow 1920), pair, June 1923 (Osmaston 1925), then with sporadic reports, including two birds, May 1997 (Pfister 1998) and Nuro Sumdo wetland, near Tsomoriri Lake, eastern Ladakh, three, July 1996 (Mishra and Humbert-Droz 1998); **Hanle**, 4,350 m, between one and nine adults reported on several occasions after 1976 (Pfister 1995, 1998), breeding at Shado-Bug, Raar and Jung Demo, June–July 1997 (Pfister 1998); **Lam-Tso**, breeding, 1995 (R. T. Chacko *in litt.* 1997), breeding, 1997 (Pfister 1998);

■ **West Bengal Buxa Sanctuary** (Tiger Reserve), 200 m, one pair, December 1992 (Sanyal 1995); Chapramari Sanctuary, **Jalpaiguri district**, early 1990s (Sanyal 1995).

■ **Sikkim Lhonak valley**, fewer than 10 individuals summering for many years, breeding reported in 1990s at Thepley Tso, near Muguthang, 4,500 m (Ganguli-Lachungpa 1998);



■ **Arunachal Pradesh Apa Tani valley**, Dafla hills, 20–40 birds most years until the 1940s, 27 birds, 1946 (Betts 1954), not present in 1978 (Khacher 1981) or subsequently (Pfister 1998); **Sangti valley**, Kemang district, pair in February 1990, six birds reported in November 1991, but none observed in 1992 (Bishop 1993a, Gole 1995); **Dirang**, small groups stopping over on migration (unspecified years) (R. Kaul verbally 1999).

■ **NEPAL** The species has been reported to visit the Kathmandu Valley, usually for a few days, approximately every 12 to 15 years in winters of particularly harsh weather (see Oesting and Archibald 1974), but this might refer to another species of crane. The only confirmed record is from: **Begnas Tal**, one bird photographed, July 1978 (Rosetti 1979).

■ **BHUTAN** Black-necked Cranes winter in several valleys in central and north-eastern Bhutan, with the largest concentrations around Phobjikha and Bumdeling, with records from: **Lhuntshi district**, 1990 (Bishop 1990); **Thangmachu**, 1,700–1,800 m, seven birds, March 1991 (Chacko 1991), 1991/1992 (Chacko 1993a), a staging area during autumn migration but not apparently during spring migration (Bishop 1993a); **Thangby-Kharsa**, Bumthang district, 13 birds (including five juveniles), 1991/1992 (Chacko 1993a), the Kurjey, Thangby and Kharsa area being a wintering ground of c.4 cranes (Bishop 1993a) and Kharsa-Khaktang, 2,870 m, a feeding area (Chacko 1993a,b); **Bumdeling** and Tashi Yangtse, 1,800–2,500 m, first reported in 1978 (Khacher 1981), over 300 birds in 1978–1985, 200–300 in 1985/1986 (Clements and Bradbear 1986, RSPN *per* R. Pradhan *in litt.* 1998), one of the two most important wintering grounds in Bhutan, 200+ in 1986/1987, 160+ in 1987/1988, 150+ in 1988/1989, 169+ (including 17 juveniles) in 1989/1990, 158 in 1990/1991, 160 (including 26 juveniles) in 1991/1992, 175 in 1992/1993, 203 in 1993/1994, 177 in 1994/1995, 144 in 1995/

The distribution of Black-necked Crane *Grus nigricollis* (maps opposite): (1) Arjin Shan National Nature Reserve; (2) Rutog county; (3) Ge'gyai county; (4) Amdo county; (5) Gerze county; (6) Gar county; (7) Baingoin county; (8) Nagqu county; (9) Tsatang; (10) Jerko La; (11) Coqen county; (12) Moincer; (13) Xainza county; (14) Lejandak Tso; (15) Gyanyima Tso; (16) Ding Tso; (17) Nam Co; (18) Mapam Yumco; (19) Rakas Tal; (20) Damxung county; (21) Burang county; (22) Lhunzhub county; (23) Yigrong Tso; (24) Kyi Chu; (25) Gongbo'gyamda county; (26) Maizhokunggar county; (27) Gandaingoin; (28) Sera Gompa; (29) Dagze county; (30) Namling county; (31) Zhongba county; (32) Lhasa; (33) Doilungdeqen county; (34) Nyingchi county; (35) Temo Gompa; (36) Saga county; (37) Xaitongmoin county; (38) Quxu county; (39) Shigatse county; (40) Gonggar county; (41) Chira; (42) Ngamring county; (43) Zhanang county; (44) Nedong county; (45) Bainang county; (46) Lhagyari; (47) Lhaze county; (48) Gyirong county; (49) Gyangze; (50) Sa'gya county; (51) Dongtse; (52) Yamdrok Tso; (53) Tingri county; (54) Kalashar; (55) Kala Tso; (56) Bam Tso; (57) Cona; (58) Tuole; (59) Huangzangsi; (60) Muri; (61) Reshui; (62) Hurlag Hu; (63) Bayan Gol; (64) Tianjun county; (65) Gobi; (66) Serh; (67) Niao Dao Nature Reserve; (68) Ulan county; (69) Senag; (70) Nomhon; (71) Golmud city; (72) Sazhubxi; (73) Barun; (74) Dulan county; (75) Guide county; (76) Zekog county; (77) Madoi county; (78) Tshu Chu; (79) Ngoring Hu; (80) Gyaring Hu; (81) Jiang Cuo; (82) Yematan; (83) Qumarleb county; (84) Zhidoi county; (85) Qingshuihe; (86) Jigzhi county; (87) Tongtian He; (88) Tongchi Gompa; (89) Chindu county; (90) Longbaotan Nature Reserve; (91) Zadoi county; (92) Rkhombo-mtso; (93) Yushu county; (94) Nanqian; (95) Ganhaizi Nature Reserve; (96) Xiao Sугan Hu Nature Reserve; (97) Da Sугan Hu Nature Reserve; (98) Luqu county; (99) Ga Hai Nature Reserve; (100) Maqu county; (101) Zoigè; (102) Songpan; (103) Garzè prefecture; (104) Ya'an; (105) Wa Shan; (106) Yongshan county; (107) Napa Hai Nature Reserve; (108) Bitu Hai Nature Reserve; (109) Lugu Hu Nature Reserve; (110) Zhongdian county; (111) Dashanbao Nature Reserve; (112) Zhaotong county; (113) Ninglang county; (114) Ludian county; (115) Qiaojia county; (116) Lasihai; (117) Heqing county; (118) Huize county; (119) Banqiao; (120) Xundian county; (121) Qijing city; (122) Kunming; (123) Dian Chi; (124) Tuoda; (125) Cao Hai Nature Reserve; (126) Pu'an county; (127) Nubra; (128) Harong; (129) Lungparma; (130) Chushul; (131) Startsapuk-Tso; (132) Dingt; (133) Puga; (134) Chakar Talao; (135) Loma; (136) Staglung; (137) Lalpai; (138) Fukche; (139) Tso-Moriri lake; (140) Hanle; (141) Lam-Tso; (142) Buxa Sanctuary; (143) Jalpaiguri district; (144) Lhonak valley; (145) Apa Tani valley; (146) Sangti valley; (147) Dirang; (148) Begnas Tal; (149) Lhuntshi district; (150) Thangmachu; (151) Thangby-Kharsa; (152) Bumdeling; (153) Punakha; (154) Bumthang valley; (155) Jakhar valley; (156) Samtengang; (157) Gyetsa valley; (158) Wangdi; (159) Phobjikha valley; (160) Khatekha valley; (161) Gogona; (162) Padu; (163) Quang Ninh province; (164) Ha Dong.

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

1996 (M. A. Bishop 1989a,b, 1993a, Chacko 1993a, Gole 1993a, RSPN *per* R. Pradhan *in litt.* 1998), 128 roosting at Bumdeling, February 1995 (J.-C. Kovacs *in litt.* 1998), 125 in January 1996 (Sherub and R. Pradhan verbally 1998), birds from this area often feeding at Chortenkhola (c.8 km away: M. Wangdi *in litt.* 2000), undated (Gole 1993a), presumably “Chhyothen Kora”, c.1,830 m, on the Kulong Chu, c.30 birds, December 1973 (Ali *et al.* 1996); Shegana, a small valley near **Punakha**, north east of Punakha Dzong, one bird, 1994/1995 (RSPN *per* R. Pradhan *in litt.* 1998); **Bumthang valley**, c.2,500–3,000 m, undated (Pemberton 1839; see Remarks 2), 14 birds, 1973 (Ali *et al.* 1996), 13 (including one immature), February 1981 (Gole 1981b), 20 in 1986/1987, 20 in 1987/1988, 20 in 1988/1989, 15 in 1989/1990, 12 in 1990/1991, eight in 1992/1993, 23 in 1994/1995, 17 in 1995/1996 (RSPN *per* R. Pradhan *in litt.* 1998); **Jakhar valley**, undated (Chacko 1993b); **Samtengang**, 2,400 m, undated (Chacko 1993a); **Gyetsa** (Gyetsa) **valley**, Bumthang district, pair, January 1978 (Ali *et al.* 1996), five birds, December 1980 (Gole 1981b), five near Donkar, 2,800 m, February 1981 (Gole 1981b, Chacko 1993a), February 1991 (Chacko 1991), 2,750 m, 22 birds in 1991, but only nine in 1992 (Bishop 1993a), one bird, December 1995 (R. Pradhan *in litt.* 1998), 13 birds in a swamp at Gyetsa-Thangby (between Aekho and Santena), and seen near Khewang, 1994 (Caron 1994); **Wangdi**, one bird, March 1993 (Johnson 1993); **Phobjikha valley** (Pobjika, Popshika, Phobjekha), Wangdiphodrang district, 2,600–2,900 m, 120 birds in 1986/1987, 122 in 1987/1988, 120 in 1988/1989, 102 in 1989/1990, 111 in 1990/1991, 139 in 1991/1992, 175 in 1992/1993, 195 in 1993/1994, 208 in 1994/1995, 212 in 1995/1996 (RSPN *per* R. Pradhan *in litt.* 1998), also 112 (including four juveniles) in January 1990 (Bishop 1990), 109 in February 1991 (Chacko 1991), this being one of the two most important wintering grounds in Bhutan, 133 in November 1991 (Bishop 1993a), 170 at Gangtey Gompa (a Buddhist monastery), November 1994 (Martins 1994), 174 (including eight juveniles) in November 1993, 183 in November 1995 (R. Pradhan *in litt.* 1998), and 170 roosting at Gangtey, February 1995 (J.-C. Kovacs *in litt.* 1998), also 210 there in November 2000 (B. Fletcher *per* C. Inskipp *in litt.* 2000); **Khatekha valley** (Khotokha), Wangdiphodrang district, 2,000–2,700 m, 30 birds in 1986/1987 and 1987/1988, 15 in 1988/1989, 11 in 1989/1990, 10 in 1990/1991, six in 1992/1993, 16 in 1994/1995, 13 in 1995/1996 (RSPN *per* R. Pradhan *in litt.* 1998; also Bishop 1993a); **Gogona**, 3,050 m, 1991–1992 (Chacko 1993a).

Unmapped localities include: Dungkhar (on the Kuri Chu river, near the border with China, as mapped in Chacko 1992b), 2,800 m, a staging area during autumn migration (unspecified years) but not apparently during spring migration (Bishop 1993a); Tscholing (just south of Dungkhar, as mapped in Chacko 1992b), March 1991 (Chacko 1991).

■ **MYANMAR** The species is known by a single recent record from: **Padu**, Sagaing state, five birds, December 1996 (Tin Niue Latt 1997), but this record should be regarded with some caution given that this locality is at only c.100 m altitude, and is a regular wintering site for Common Crane *Grus grus* (SC).

■ **VIETNAM** The small wintering population that has been reported to occur in the lowlands of northern Vietnam is something of an anomaly (Oesting and Archibald 1974). Given the potential confusion with Common Crane (see Remarks 1), the status of the species in the country remains unclear. Records are from: **Quang Ninh province**, undated (Do Ngoc Quang *per* Nguyen Cu *in litt.* 1997); the plain of **Ha Dong** and Hanoi, two captured alive, early 1924 (Delacour and Jabouille 1925), one seen near Hanoi, November 1925 (Delacour *et al.* 1928), with flocks of up to 300 reported in this and another area c.20 km north-north-east of Hanoi, winter (unspecified years) (Fischer 1974), and three adults reported flying southward over the Red River in Hanoi, February 1982 (Nadler 1993).

POPULATION The historical distribution and population of this species are poorly understood (Wang Qishan *in litt.* 1998). It was noted to be common in winter near Gyangze (Gyantse) and Lhasa in south-east Tibet in the early twentieth century (Walton 1906, Bailey

1911, Ludlow 1927–1928, 1950, Ludlow and Kinnear 1944), but little information was available from most of its breeding range. Declines took place in many wintering areas between 1920 and 1970, with its numbers becoming more stable after 1970 (Meine and Archibald 1996). In 1984, it was thought that only 100 birds survived in Tibet and Ladakh, and that the species would probably soon become extinct if conservation organisations failed to intervene (Matthiessen 1994). However, recent counts of wintering birds have shown that it is much more numerous than had been thought, and surveys have located many previously unknown breeding and wintering areas (see Distribution).

Coordinated counts at known wintering sites located 705 individuals in 1989 (M. A. Bishop 1989a,b), and it was thought that the entire population numbered fewer than 800 individuals (ICF web pages 1997). However, a total of 5,554 birds was counted in December 1991–January 1992 (Bishop 1993a). On the basis of these counts, the global population is estimated to be 5,600–6,000 birds (Meine and Archibald 1996, also Rose and Scott 1997), including wintering populations of 360 in Bhutan, no more than 10 in Arunachal Pradesh, India, 1,300–1,600 in north-east Yunnan and western Guizhou, China, no more than 100 in north-west Yunnan, 3,900 in south-central Tibet and no more than 20 in eastern Tibet (Meine and Archibald 1996, Li Fengshan and Bishop 1999; but see next paragraph). Very small numbers of wintering birds (perhaps only occasional visitors) have also been reported from Myanmar and Vietnam (see Distribution).

China Zoigê marshes in Sichuan and Gansu are the most important known breeding and summering area for the species, with an estimate of 600–900 birds based on a survey in May–June 1991 when 240 birds and 24 active nests were located in almost 800 km² of wetland (Scott 1993). The most important known breeding population in Tibet is around and including the Xainza Nature Reserve in Xainza county, where in July 2000 over 160 cranes were located including 20 chicks, primarily at Mijiu lake (116 birds) and Loubu lake (37 birds) (Tobgay and Sherub 2000, G. Archibald *per* M. A. Bishop *in litt.* 2000). In Qinghai province, the four major breeding grounds are Longbaotan Nature Reserve in Yushu county, Ngoring lake (Elinghu)/Heihe in Madoi county, Nomhon in Dulan county, and Bayan Gol (Bayinguoluohe) river in Golmud county (Li Fengshan and Bishop 1999).

However, most information on the population of this species comes from the wintering grounds. The number of wintering birds in southern Tibet was estimated at 3,910 in 1991–1992 (Bishop 1993a). This figure entirely supersedes the partial counts of 661 birds reported in winter 1987 from the valleys of the Yarlung Zangbo river and its tributaries (Li Dehao in Tong Yongchang *et al.* 1991), and 518 birds counted in March 1998 in south-central Tibet (Maizhokunggar, Dagze and Lhünzhub counties) (Zhou Jian 1998). The number of wintering birds in Yunnan in 1995 was estimated at 1,640 birds (Li Chun 1996) and 1,863 (Yang Lan 1997a). Zhaotong prefecture, including Ludian, Yongshan and Qiaojia counties and Zhaotong city, has the highest numbers in Yunnan: some 1,332 birds were counted there in January

Date	Number	Date	Number
November 1975	35	January 1988	254
October–December 1978	45	November 1988	250
December 1979	86	January 1989	345
December 1980	140	January 1990	174
December 1982	296	January 1991	214–245
January 1984	305	January 1992	215–265
December 1984	313–351	January 1993	285
February 1985	240	January 1994	c.400
January 1986	163	March 1995	394
1987	238		

Table 1. Numbers of wintering Black-necked Cranes at Cao Hai lake, Guizhou (Wang Qishan *in litt.* 1998, J. Harris *per* Wang Qishan *in litt.* 1998, Zhu Jingyi *et al.* 1998).

1998 (*China Crane News* 3, 1 [1999]: 18–20. However, Li Fengshan and Bishop (1999) considered that the total number of Black-necked Cranes wintering in northern Yunnan varies annually and that counts there are often unreliable; the wintering population there will remain a mystery until a coordinated roost count is conducted and observers are equipped with good binoculars and spotting scopes. Up to 400 birds winter at Cao Hai lake in Guizhou (Table 1), but their numbers there fluctuated greatly between 1972, when the lake was drained artificially, and 1982, when it was restored (Zhu Jingyi *et al.* 1998), since when its numbers seem to have been increasing (Li Laixing 1997a). The total wintering population of this species in China is estimated at c.6,000 birds; there may be some overlap between the counts at some sites, for example between those in north-eastern Yunnan and at nearby Cao Hai lake, but there are also likely to be some undiscovered wintering grounds (Wang Qishan *in litt.* 1998).

The trends in this species in China are difficult to determine given the limited information available, but the population appears to be stable (Wang Qishan *in litt.* 1998). Some localised declines have been noted, for example at Quanwan on Qinghai Lake, where the number of summering birds is decreasing (Li Laixing 1997c), probably because the water level has fallen and Niao Dao is no longer an island, leading to increased disturbance from tourists and predation by dogs and foxes (Wang Qishan *in litt.* 1998). The wintering population in Zhongdian county, Yunnan, has declined precipitously in the past few decades, from c.700–800 birds before the 1960s to c.300 in winter 1978–1979 and only 60–70 birds in winter 1981, as a result of the drainage of most of the wetlands for pastureland in 1968–1969 and hunting by local military and government agencies (Li Fengshan and Bishop 1999). The species was common at Gyangze (Gyantse), Tibet, in the early twentieth century (see above), but this wintering population no longer exists (Meine and Archibald 1996).

India Small numbers breed in Ladakh (Pfister 1998), and breeding also occurs in Sikkim (Ganguli-Lachungpa 1998). The breeding population in Ladakh was reported to be four pairs by Osmaston (1925) and five pairs by Meinertzhagen (1927). However, more comprehensive and coordinated counts in the 1980s and 1990s have located larger numbers, with a maximum population estimate of 38 individuals in 1997, including 12 breeding pairs (Pfister 1998). Of 14 well-defined wetland areas in Ladakh, four appear to have been recently abandoned by the cranes while only six are regularly used as breeding sites, suggesting that a small decline might be taking place (G. W. Archibald *in litt.* 1998). However, Pfister (1998) believed that a recent increase might have occurred after poaching by military personnel was controlled in the mid-1980s.

Small numbers of wintering birds were historically found at two localities in Arunachal Pradesh (Betts 1954, Bishop 1993a, Gole 1995). The small wintering population (20–40 individuals) in the Apa Tani valley of Arunachal Pradesh is thought to have disappeared by 1976 on account of new hunting practices by Apa Tanis who had recently acquired firearms (Khacher 1981). A pair reportedly visited the site in 1976, but was killed and eaten by tribespeople (Khacher 1981). Suggestions that further populations were likely to exist in other suitable valleys in Arunachal Pradesh (Khacher 1981) have not been substantiated. Indeed it appears that Apa Tani is topographically anomalous (Betts 1954) and that the species unlikely to be found in any other valleys in the state.

In Sikkim, a population of under 10 birds has been visiting the Lhonak valley “as far back as ...Tibetan graziers can remember” (Ganguli-Lachungpa 1998). When the Indian Army occupied the area in the 1980s, crane numbers dropped to under five individuals and the frequency of their arrival decreased (Ganguli-Lachungpa 1998). Breeding apparently took place on several occasions during the 1990s, although only three individuals were reported in 1996 and it appears that this population might be on the verge of extinction (Gole 1995). Surveys in the 1990s concluded that small numbers of wintering Black-necked Cranes also visit Sangti valley in Sikkim (Gole 1995). Curiously, a pair was observed in the lowlands of West Bengal in 1992, and local people reported them to be regular visitors (Sanyal 1995).

Bhutan Regular monitoring of the wintering populations at four localities indicated a steady decline in three localities and an increase at one; overall, the Bhutan population has declined from c.500 individuals in 1985/1986 to c.357 in 1995/1996 (RSPN *per* R. Pradhan *in litt.* 1998). As the crane population declined in the country, the birds disappeared from former wintering sites such as the Jakhar valley near Gyetsa and adjacent areas (Chacko 1993a). However, in recent years the wintering population in Bhutan appears to have increased. In January 1989, 297 individuals were counted in Bhutan (M. A. Bishop 1989a,b) and over 300 individuals were thought to winter in the country by 1994 (Caron 1994). In winter 1991/1992, 315 cranes were counted at the three sites (Phobjikha/Khotokha, Bumdeling and Bumthang), but by winter 1997/1998 the total had increased to 414 cranes (Li Fengshan and Bishop 1999). The c.200 individuals in the Bumdeling area appear to winter on only c.3 km² of paddyfields along c.10 km of a narrow valley, a seemingly “amazing” concentration of large birds in such a confined area (Gaston 1989). The most recent counts available are 230 in the Phobjikha area and 84 in the Bumdeling area in November 2000 (B. Fletcher and M. Wangdi *per* C. Inskipp *in litt.* 2000).

South-East Asia The species is apparently only a very rare visitor to Myanmar (Khin Ma Ma Thwin *in litt.* 1997). Earlier this century, it was reported that several individuals wintered near Hanoi in Vietnam (Delacour 1929c), and that even in 1982 it was not unusual to see the species flying in the vicinity of the city (Nadler 1993). The wintering population in the 1960s was in the order of 300 birds according to Fischer (1974). However, there are doubts about the identity of these large flocks (see Remarks 1), and a week-long survey of suitable agricultural areas in the Red River Delta in February 1989 produced no reports of cranes (M. A. Bishop 1989a,b). Apart from a possible (reported) sighting of a pair in northern Vietnam around 1997 (G. Archibald *per* M. A. Bishop *in litt.* 2000), there have been no more recent records and the species perhaps no longer winters in Vietnam.

ECOLOGY Habitat This species, the only alpine crane in the world (Oesting and Archibald 1974, Narayan *et al.* 1986) breeds at elevations between 2,950 and 4,900 m in high-altitude freshwater wetlands (Gole 1992, Meine and Archibald 1996). According to Guo Juting (1981) and Li Dehao (1986), its breeding habitats on the Qinghai–Tibetan Plateau fall into three main categories: (1) alpine bog meadows, ranging in elevation from 3,400 m (Zoigê marsh, Sichuan) to 4,900 m (Shenzha, Tibet), often in open valleys, basins and flatlands that are poorly drained and/or have a permafrost layer; (2) lacustrine marshes, at elevations from 2,600 m (Nomhon, Qinghai) to 4,900 m (Xianza, Tibet); and (3) riverine marshes. During a breeding survey in Tibet in summer 1991, Black-necked Cranes were found to nest in wetlands ranging from 0.02 km² ponds in alpine bog meadow to 70 km² lakes, often near flowing water, at altitudes of 4,360–4,860 m (mean of 4,646 m); 11 nests were located in four lacustrine wetland areas, and six nests were found at four palustrine sites, including alpine bog meadow typified by hummocks of *Kobresia*., with *Hippuris vulgaris* a dominant plant at seven nest sites (Dwyer *et al.* 1992).

The wintering grounds are also located at high altitude, in wetlands and on agricultural land. In south-central Tibet and Bhutan, the birds winter in river valleys, whereas in north-west Yunnan and north-east Yunnan–western Guizhou they winter mostly in wetlands around reservoirs that were mostly constructed in 1958 when the “Great Leap Forward” was initiated (Li Fengshan and Bishop 1999). In Bhutan, the wintering grounds are in large U-shaped valleys with wide valley bottoms consisting of undrained mires and agricultural land (Clements and Bradbear 1986, Caron 1994). In 1989 at Bumdeling, the birds were found feeding in ricefields on both the valley floor and lower hillsides, while the flooded ricefields and banks of Kulong Chu river were used as roosting habitats (M. A. Bishop 1989a,b). In Phobjikha valley, the birds also foraged mainly in agricultural fields, and roosted in small marshes (Caron 1994). In the Khotokha valley, a roosting area was located in a dense stand of dying

pinus at the southern end, and birds foraged freely throughout the area's fields and grasslands (Caron 1994). Observations on habitat preferences of cranes during winter indicated that croplands were used 55–80% of the time, followed in frequency of use by wetlands and riverine areas (Gole 1993a). In south-central Tibet, barley and spring wheat stubble were the main habitats used by the cranes during the day, particularly during the morning, and secondary river channels and reservoir shorelines were used for roosting (Bishop *et al.* 1998; also Yu Yuqun *et al.* 1995). At Cao Hai in Guizhou, the wintering cranes were seen foraging in all habitat types in the lake basin, and occasionally on upland farmland, but there was a great reliance on wetland habitats, with sedge meadows the most preferred foraging habitat and croplands the least favoured; all roosting sites there were in the shallow water along the lake edge (Li Fengshan and Bishop 1999). Although the species was thought never to descend to the lowlands (Oesting and Archibald 1974), the wintering population in Vietnam apparently frequented open ground, grassy plains and ricefields of the lower Red River in winter, flying in the evening to roost on undisturbed fields and the shallow wetlands of the river itself (Fischer 1974); moreover, a tiny wintering population visits or visited the lowlands of West Bengal (Sanyal 1995).

The species appears to be moderately tolerant of people, regularly feeding near small pastoral settlements, fishermen and domestic livestock (Meine and Archibald 1996). In India, birds show little alarm at the approach of local people (Khacher 1981). Pairs or single individuals establish foraging territories (Khacher 1981). Cranes roost together in secluded bogs, the shores of reservoirs, the secondary channels of rivers, sandy riverine beaches, shallow water or fields (Stevens 1930, Betts 1954, Anon. 1981a, Khacher 1981, Dorji 1987, Meine and Archibald 1996). In a few cases paddyfields are used as roost sites (M. A. Bishop 1989a,b). The cranes gather at the roost immediately prior to dusk and usually leave in pairs or family parties shortly after dawn to feed (Anon 1981a, Khacher 1981, Meine and Archibald 1996), at 07h30 in Bhutan according to Chacko (1992b). Some birds also use the roosting sites around midday (Meine and Archibald 1996).

In north-east Yunnan and western Guizhou, Black-necked Cranes often accompany large flocks of Common Cranes in winter (Meine and Archibald 1996). Small numbers (<30 individuals) of Common Cranes have been documented wintering in traditional Black-necked Crane wintering areas in south-central Tibet (Bishop *et al.* in prep.) and at Bumdeling, Bhutan (R. T. Chacko verbally to M. A. Bishop 1996). In south-central Tibet, and occasionally in north-east Yunnan and western Guizhou, cranes may also associate with foraging and roosting flocks of Bar-headed Geese *Anser indicus* and Ruddy Shelducks *Tadorna ferruginea* (Meine and Archibald 1996). Throughout their winter range flocks regularly feed alongside domestic livestock including yak, horse, cows, sheep, goats and donkeys (Meine and Archibald 1996). Interspecific aggression has been observed between breeding crane pairs and both Common Terns *Sterna hirundo* and Ruddy Shelducks, the latter confrontation frequently being violent and culminating with the killing (but also eating) of two ducklings by the cranes, whose irritation appeared to be influenced largely by the ceaseless calling of the ducks and terns, given that "other birds were generally ignored as long as they remained silent" (Pfister 1998). Other pairs showed no aggression towards Bar-headed Geese, Great-crested Grebes *Podiceps cristatus*, Brown-headed Gulls *Larus brunnecephalus* and Ruddy Shelducks breeding in the immediate vicinity of their nest (Pfister 1998). Although some observers have mentioned aggression between members of the same brood of cranes (Li Dehao 1987, Akhtar 1990), this behaviour was not observed in Ladakh (Pfister 1998).

Food The diet of this species includes plant roots, tubers, earthworms, grasshoppers, snails, shrimps, small fish, frogs, lizards, beetles, flies and other small vertebrates and invertebrates (Lu Zongbao *et al.* 1980, Anon. 1981a, Guo Juting 1981, Dorji 1987, Meine and Archibald 1996), including voles *Microtus brandtii* (Meine and Archibald 1996) and probably *Alticola rolei* (Narayan 1987). In the winter quarters, lower-level agricultural fields

are visited, where the cranes consume waste grain in stubblefields (Scott 1989, Meine and Archibald 1996). In south-central Tibet and north-west Yunnan and Bhutan the principal crops include barley and spring and winter wheat, whilst in Arunachal Pradesh and Bhutan rice is also consumed (Meine and Archibald 1996, M. A. Bishop and Li Fengshan *in litt.* 2000). In north-east Yunnan and western Guizhou the cranes forage on other cultivated crops, including maize, oats, buckwheat, carrots, radishes, potatoes and turnips (Wu Zhikang and Li Ruoxian 1985, Meine and Archibald 1996; also Han Lianxian and Zhou Wei 1998). They also dig up small bulbs from swampy ground and appear to feed on hibernating frogs and tadpoles in wetlands (Anon. 1981a). A study in China found that their diet included 47 species of plant (38 wild species, including 25 aquatic plants, and nine crop species); 76.5% consisted of sedges, and they principally ate the underground tubers (Li Fengshan *et al.* 1997, Li Fengshan and Bishop 1999). In Ladakh, the main food is apparently the bulb of an arrowgrass *Triglochin*, and they have also been recorded eating fish and shrimps (Nurbu 1987). In Vietnam, the species was reported to forage partly on cultivated crops such as rice seed and sweet potato that they dig out of the ground in winter (Fischer 1974). In wetlands it feeds on snails, crustaceans, aquatic insects and their larvae (Pfister 1998). During the breeding season in Ladakh it has been observed picking minute prey from water surfaces, probably feasting on huge shoals of shrimp larvae (Khacher 1981); it has also been observed venturing away from the valley floor onto stony or rocky slopes, apparently hunting crickets or lizards (Nurbu 1987, Pfister 1998).

Birds in Bhutan have been observed to forage throughout the day apart from a brief period in late morning when one adult apparently acts as sentinel while the rest of the group rests or preens (Chacko 1993a). One study concluded that the species allocated around 75% of daylight time to foraging (see Pfister 1998). In the Ladakh breeding grounds, most feeding was undertaken between early morning and 11h00, with another flurry of feeding activity in the late afternoon until roosting (Pfister 1998). Two feeding techniques are described for wetlands: in well vegetated or murky areas, individuals sweep with open bills through the water, whereas in clear water they stand motionless like herons, with bills c.30 cm above the surface, darting at prey when it comes into reach, then most frequently carrying it to land before it is consumed (Pfister 1998). While walking through reeds individuals have been observed feeding on rush flowers or collecting insects from the vegetation with a pecking motion, but when feeding on land, a probing technique is employed to extract vegetable matter; cranes observed at Hanle and Lalpari in Ladakh often opened up the dry dung of nomad ponies and the Tibetan wild ass *Equus hemionus*, presumably to extract seeds or insects contained therein (Pfister 1998). Pairs sometimes roam onto rocky slopes to hunt for crickets and lizards (Nurbu 1987, Pfister 1998), and two Ruddy Shelduck *Tadorna ferruginea* chicks were seen being killed and eaten by a pair in Ladakh (Pfister 1998). The cranes apparently tend to drink twice a day, first around midday and then in the evening before roosting (Pfister 1998).

Chicks are mostly fed on insects, other invertebrates and plant tubers, with one reported incident of a chick being offered a small fragment of its own eggshell as food (Pfister 1998). After chicks are mobile, three techniques of feeding by the parents have been observed: first, food can be passed from beak to beak, second, it can be brought by the adult and placed in front of the chick, and third, it can be pointed out by the adult calling and pointing with its bill until the chick arrives (Pfister 1998). Although Gole (1981a) mentioned chicks being able to hunt for their own food only four hours after hatching, Pfister (1998) recorded the first instance of a chick being fed by its parent after 30 hours and found that the chick can feed itself only about one week after hatching, although after two months almost all feeding is conducted by the chick unassisted.

Breeding The Black-necked Crane probably attains adulthood when it reaches between two and three years of age (Meine and Archibald 1996) and can live at least 20 or 30 years in

the wild (Pfister 1998). First-year birds often return to the natal territory but are then evicted by their parents (Pfister 1998).

In Ladakh, estimated breeding territory size is generally between 0.6 km² and 1.2 km² (Pfister 1998). In central Tibet, breeding densities have been estimated at 2.2 pairs/km² (Dwyer *et al.* 1992). Contests between pairs disputing territories are sometimes very protracted in the breeding season, a situation presumably exacerbated in Ladakh by the decline of available nesting areas (Pfister 1998).

Nests are built on small pre-existing grassy islands or in the water, and consist of mud, grass, sedges and other aquatic plants (Meine and Archibald 1996). An undisturbed view is essential (Pfister 1998). In central Tibet, nests are often sites within 0.2–2.0 km of permanent sources of disturbance such as roads, habitation and domestic animals (Dwyer *et al.* 1992). Nests in Sichuan, Qinghai, Ladakh and other parts of Tibet are, however, typically located in areas of deep mud, making them inaccessible to people, livestock and mammalian predators (Meine and Archibald 1996). For example, in Zoigê county in Sichuan, birds select inaccessible sites such as hummocks in the middle of a marsh where the water is deep, or small islands in lakes (Li Dehao *et al.* 1991). In Ladakh, Pfister (1998) considered that nest sites were carefully selected each season in response to local conditions, usually on an inaccessible island or a grassy mound surrounded by still or slow-flowing water between 10 and 50 cm deep. Of 12 nests found there in 1997, two (16%) were located in marshland, while the rest (84%) were in lakes or ponds, five (42%) were constructed by the cranes, while the rest (58%) consisted of existing mounds or islands, and eight (66%) were newly sited, while the rest (34%) were sites re-occupied from the previous year (Pfister 1998). An earlier appraisal of seven nests located in the region concluded that five were sited on raised hummocks while two were on large patches of marsh vegetation (Nurbu 1987).

Nests apparently vary considerably, some being a “mere scratching in the ground with a pretence of lining, just a few reeds and rushes forming a bed for the eggs to lie on”, while in others “quite a pile of grass, rushes and other weeds is accumulated” (Baker 1922–1930). Wang Youhui *et al.* (1991) described five different types of nests found during studies in Qinghai and Sichuan: (1) on dry ground on islands, this being the preferred nesting habitat because the soil is solid and not waterlogged, it is not so close to water and therefore unlikely to be inundated, and it is better protected from mammalian and human predators; (2) on mud in open water, where more effort is required to build a nest by mixing mud and aquatic plants, and nests are vulnerable to strong waves and floods; (3) on grassy mounds, where the soil is more solid but nests are still vulnerable to floods, so that the birds have to build up the structure with mud and plant roots as the water level rises; (4) on vegetation on lake shores and in grassy marshland, where the nests are built by compressing the grass and aquatic vegetation, sometimes also by adding dry grass and plant roots; and (5) temporary nests, usually used by the male cranes as guard posts and not for incubation. Nest building is initiated immediately after occupation of the territory in spring, and the basic nest is built in 1–3 days (Li Dehao 1989, Pfister 1998). Nests built on pre-existing islands were small (mean size 61.5 × 51.7 cm), but those built directly in the water were larger, averaging 106.4 × 91.2 cm and contained more mud and plant rhizomes; plants used for nesting material included *Hippuris vulgaris*, *Batrachium bungeii*, *Kobresia*, *Carex*, and grasses (Dwyer *et al.* 1992).

The usual clutch-size is two eggs, which are incubated for 30–33 days (Li Dehao 1987) and chicks fledge at about 90 days (Meine and Archibald 1996). Of 23 nests studied in Ladakh, 20 (87%) contained two eggs (R. T. Chacko *in litt.* 1997, Pfister 1998). In Tibet, over 20% contained one egg only (Lu Zongbau 1984), and on very rare occasions three eggs are laid (Johnsgard 1983). An interesting observation was made in Ladakh in 1996, when a Black-necked Crane was observed incubating three eggs, including one crane egg and two Bar-headed Goose eggs, and the adult crane successfully raised all three of its “offspring” (Pfister 1997, 1998). Egg-laying occurs primarily from the end of April through to the end of June (Wang Youhui *et al.*

1991), with mid- to late May the peak egg-laying period, and re-nesting attempts observed as late as 13 July (Li Fengshan and Bishop 1999). The chicks hatch from early June to mid-July, mostly in mid-June (Wang Youhui *et al.* 1991). In Ladakh in 1997, eggs were laid between 1 May and 30 June, with 58% laid between the third week of May and the second week of June; egg-laying began while the nest was still under construction, and both egg-layings witnessed took place in the early afternoon, with the interval between laying of the two eggs in each clutch varying between one and three days (Pfister 1998). Egg-laying starts from about 10 May at Zoigê in Sichuan, and the chicks hatch in mid-June (Li Dehao *et al.* 1991). In central Tibet eggs are laid from the first week in May until mid-June, with a mean date of 28 May; an apparent second nesting attempt was begun on 13 July (Dwyer *et al.* 1992). If the first clutch is destroyed, cranes may construct a new nest in the vicinity and re-lay within a few days (Dwyer *et al.* 1992). However, several nests abandoned or destroyed in Ladakh were not replaced, although the pairs remained at or near the breeding site for the remainder of the season (Pfister 1998).

Members of a pair share incubation duties, and the nest is never left unattended except when the birds are directly threatened (further details of behaviour in Li Dehao 1989, Li Laixing 1998, Pfister 1998). The hatching process takes “several hours” (Pfister 1998), 20 hours or “one full day” (Lu Zongbau 1983). The remaining empty eggshells are crushed into small fragments by the adults and hidden under nesting material, presumably to avoid attracting the attention of predators, but sometimes offered to the nestling as food (Pfister 1998). The chick is initially helpless and vulnerable, only being able to stand on the second day after hatching (Pfister 1998). The first flight is generally undertaken after about three months (Pfister 1998). Of 24 eggs laid in Ladakh in 1997, only nine chicks survived, a 37.5% survival rate, with 33% in 1992, 60% in 1995 and 43% in 1996 (Pfister 1998). A large number of wintering pairs in Bhutan are not accompanied by juveniles, indicating their failure to rear any chicks, and it appears that only a few ever raise more than one young (Anon. 1981a). Several studies have found that wintering populations of this species have a lower percentage of juvenile birds compared to other wintering crane species, possibly indicating that the survival rate in young of this species is low (Wang Qishan *in litt.* 1998); for example, Yu Yuqun *et al.* (1995) found that juvenile and immature birds only comprised 7.8% of the wintering cranes on the upper reaches of the Lhasa river in Tibet. On the other hand, based on Bishop (1993a), recruitment in flocks numbering over 100 in south-central Tibet ranged from 9.7 to 16.5%; in the upper reaches of the Lhasa river it has fluctuated from 7%+ to over 12% depending on year (M. A. Bishop *in litt.* 2000).

Migration Relatively little is known about the migration routes or staging areas of this species. Wu Zhikang *et al.* (1993a, 1994) suggested three migratory routes in China, the first two based on banding recoveries: (1) from the breeding area at Zoigê in northern Sichuan to Cao Hai lake in Guizhou, some 800 km to the south, via the Qionglai mountains and the Min Jiang river; (2) from Langbaotan marsh, Yushu county, Qinghai, to Napa Hai, north-west Yunnan, some 700 km to the south, via the Tongbian river, the Jinsha river, the Chola mountains and the Shaluli mountains; and (3) from south-east Xinjiang, western Qinghai and northern Tibet south or south-east to central Tibet. Birds wintering in Bhutan were found to follow the course of the Kuri Chu river during their migration to and from Bhutan (Chacko 1992b, 1993a). In particular, some pairs with very young juveniles, possibly late hatchlings, used Dungkhar and Thangmachu on the Kuri Chu as staging areas during their southward journey, presumably allowing for the fatigue of their offspring (Chacko 1992b, 1993a). Groups have been recorded staging in spring at Damxung, Tibet (Dwyer *et al.* 1992), while in autumn cranes have been recorded staging at Shenzha in northern Tibet (Gu Binyuan and Canjue Zhouma 1993) and at Litang in western Sichuan (Dolan 1939). The distance of migration is usually less than 1,000 km, a journey that takes about two weeks (Meine and Archibald 1996), and in Tibet the movements are sufficiently short in many cases that Ludlow and Kinnear (1944) described the species as “only locally migratory” in Tibet.

Depending on the area, Black-necked Cranes arrive at their breeding sites between late March and mid-May (Meine and Archibald 1996). They arrive on the Ladakh breeding grounds in mid- or late April and early May, departing by mid-October or November (Nurbu 1987, Pfister 1998). After returning in spring, they remain in a small flock that spends around 10 days at a staging site such as Hanle or Chusul, until it gradually disintegrates as separate pairs travel to their breeding sites (Pfister 1998). Some departures from the breeding grounds apparently occur as late as mid-December, usually when late breeding pairs have to wait for their chick to develop sufficiently to undertake the migration (Pfister 1998). The species arrives in Bhutan at the end of October and departs from late February to the start of April (Dorji 1987, Chacko 1992b, Caron 1994), with most birds reaching Phobjikha and Khotokha by mid-November (Chacko 1992b). Local movements for the purposes of feeding and roosting are commonplace. In Bhutan for example, Chacko (1993a) found that crane flocks tended to use Gogona and Kharsa-Khaktang valleys for feeding, Khotokha, Phobjikha, Gyetsa, Thangby-Kharsa and Bumdeling valleys for roosting, and Dungkhar and Thangmachu valleys as staging areas. In Vietnam in the 1960s, a few flocks of 30–40 cranes started to arrive in late November, with numbers building up to the main influx in December; they remained until the northward migration at the beginning of March took them along the Red River valley towards their breeding grounds, and the last birds had departed by April (Fischer 1974).

THREATS *Habitat loss* Degradation and loss of habitat are the main threats facing the Black-necked Crane (Meine and Archibald 1996), linked to increasing population pressure and economic development within its range (Wang Qishan *in litt.* 1998).

China On the breeding grounds at Zoigê marsh in Sichuan, an estimated 1,400 km² had been drained or altered for pastureland by 1991, and the numbers of livestock have been increasing, resulting in overgrazing and encroachment into high-altitude meadows and marshes; although there are currently no tangible impacts on Black-necked Cranes from peat-mining south of Zoigê marsh, excessive mining and lack of wetland conservation are potential threats (Scott 1993, Li Fengshan and Bishop 1999). These changes at Zoigê are causing the conversion of marshland into wet grassland and then gradually into steppe and arid land (Wang Qishan *in litt.* 1998). Habitat pressures are heaviest in the wintering range, probably because it is at lower altitudes and therefore more densely populated (Meine and Archibald 1996). Many wintering areas in Yunnan and Guizhou, e.g. in Lashihai and Zhongdian counties, have been affected by the drainage and damming of wetlands (Li Fengshan and Bishop 1999). At Cao Hai in Guizhou, reclamation has affected the habitats of Black-necked Cranes (Wang Qishan *in litt.* 1998), and their numbers declined correspondingly (Li Fengshan and Bishop 1999). In north-east Yunnan, most wintering areas are in wetlands near reservoirs built for irrigation, but reservoir construction has reduced the shallow water areas needed for wading birds like cranes, and such losses continue to occur throughout wintering areas in south-central Tibet (Li Fengshan and Bishop 1999). Since the 1950s extensive dyking along the Penbo and Nyang rivers has greatly diminished river floodplain and riverine wetlands, and both Shigatse and Lhasa have lost wetland habitats in inverse proportion to their human population and economic growth; cranes used to winter around Lhasa, but the loss of wetlands and croplands to urbanisation has forced them to winter nearby in the Doilungdeqen area (Li Fengshan and Bishop 1999). A proposed dam on the Lhasa river c.25 km north-east of Maizhokunggar could have a tremendous impact on the 1,000+ cranes that winter along the river, and large expanses of trees are being planted in parts of the Lhasa and Yarlung valleys which may constrain roosting areas (Bishop *et al.* 1998). A hydropower station at Cuochu will flood the night-time roost of the cranes that winter at Daqiao Nature Reserve in Yunnan (Wang Gaoxiang 1998).

Black-necked Cranes have been affected by changing agricultural practices in south-central Tibet and north-east Yunnan (Li Fengshan and Bishop 1999). Many farmers now

prefer a higher-yield winter wheat to the traditional barley, spring wheat and broadbean, and in winter this wheat has no grain for the cranes to eat (Bishop *et al.* 1998, Wang Qishan *in litt.* 1998). With the increased emphasis on autumn ploughing to control insects and for the cultivation of winter wheat, less waste grain and other surface residues are available for the cranes, perhaps causing the birds to switch to the winter wheat seedlings (Bishop *et al.* 1998, Li Fengshan and Bishop 1999). In north-east Yunnan, many areas have been assigned to sheep breeding, where non-native grasses have been planted extensively, and in these areas cranes are very scattered, with most foraging occurring on the hilly uplands (Li Fengshan and Bishop 1999). At Qinghai Hu and Ngoring Hu lakes in Qinghai, fish farming and the construction of roads have led to increased human activities, and at Dashanbao and Changhaizi in Yunnan farmers collecting peat, firewood and grass for fuel have caused some losses of wetland habitat (Wang Qishan *in litt.* 1998). The number of summering birds is decreasing at Quanwan, near Qinghai Hu (Li Laixing 1997c), probably because the water level in Qinghai Hu is falling, and Niao Dao (Bird Island) is no longer an island (Wang Qishan *in litt.* 1998). Deforestation has caused problems at Cao Hai in Guizhou and in Zhongdian county in Yunnan: almost all forest at Cao Hai was destroyed in 1958, and by 1982 the forest cover in the area was only 13.7% (35.8% in 1956), leading to soil erosion on the western and northern sides of the lake and siltation of the wetland; forest has also been clear-cut at Zhongdian county and adjacent areas (Wang Qishan *in litt.* 1998; Li Fengshan and Bishop 1999; also Elliot *et al.* 1989, Rank 1994, Meine and Archibald 1996).

India Black-necked Cranes probably disappeared from their wintering ground in Arunachal Pradesh because of an increase in human settlement and the construction of new roads (Bishop 1993a)—and thus should be a warning over what is happening in Ladakh. In the breeding areas of Ladakh, the high-altitude vegetation is slow-growing and sensitive to disturbance, and direct and indirect human interference is having an increasingly detrimental impact (Pfister 1998). Up to the 1960s, the effect of nomadic people and their livestock was minimal and the herb layer lush and abundant, but in the past two decades the landscape has been increasingly degraded by heavy grazing pressure, particularly from yaks (Scott 1989, Pfister 1998). The Changtang and Rupchu areas accommodate 41 villages holding 8,000 indigenous people, either settled or nomadic, and a further 1,500 Tibetan refugees (Pfister 1998). The population growth rate for the area is estimated at between 2.4% (Kitchloo 1997) and 3.2% (Kurup 1996), resulting in new settlements, conversion of more land to agricultural fields, and diversion of watercourses to irrigate them (Pfister 1998). The constant diminution of undisturbed foraging and breeding areas is exerting such pressure on the small Indian population that it is unlikely to survive without assistance in the form of legal and habitat protection (Pfister 1998). Road building on or near the Hanle plain and Chusul is causing disturbance and opening up previously remote areas; houses are being built and areas claimed for agriculture, directly destroying prime habitat for the cranes, while telephone wires have been strung across parts of the plain adjacent to the Lalpari nest site, posing a hazard to flying cranes (Pfister 1998). In the past few years new pressures on the Hanle marshes have emerged: (1) various parts of the marshes are being fenced for large plantations of willows; (2) the influx of Tibetan refugees has continued, their camps “growing bigger and bigger”; (3) the area is heavily disturbed by regular practice firing by the army; and (4) the number of feral/pet dogs is increasing owing the presence of the army (K. Srivastava *in litt.* to Orientalbirding 2000).

Bhutan The population has declined mainly because of the drainage of marshy habitat for the development of pastures, the degradation of grasslands as a result of heavy livestock pressure, and the introduction of mechanised farming and ploughing in winter, which has reduced feeding areas (Chacko 1992b, 1993b, Meine and Archibald 1996). Wetlands used by the birds for feeding and roosting have been drained to bring new areas under cultivation and pasture, in order to support the growing human population and the commensurate

cattle and sheep populations in the Phobjikha, Bumthang and Bumdeling valleys (Scott 1989, Chacko 1993b). Traditional farming in Bhutan always provided ample fallen grain for the cranes to eat, but the introduction of tractors and the practice of ploughing cropfields during winter has reduced this food supply (Chacko 1992b, Chacko 1993b): the decline in crane numbers in the Bumthang and Gyetsa valleys has certainly been attributed to agricultural development (Bishop 1993a). A once-favoured marsh in the Bumthang valley has been drained, causing the wintering crane flock to be more dispersed (Gole 1981b, Clements and Bradbear 1986, Scott 1989). It is possible that a similar fate will befall other areas of bog, eventually leaving the cranes without a roost site (Scott 1989). Barbed-wire fences around agricultural fields (the result of a government subsidy) are gradually replacing the traditional pinewood stakes and rocks, even adjacent to crane habitat at Phobjikha, and while these structures are an effective deterrent to cattle, they may prove harmful to cranes, as some have been reported damaging their wings on these wires when they become invisible after snowfall (Chacko 1993b, Caron 1994).

Hunting and persecution Hunting has become a serious threat in several areas as a result of the increased availability of firearms and improved access to formerly remote areas (Meine and Archibald 1996). However, international trade is of little concern as strict controls are enforced in China and Bhutan, and trade prices are prohibitively high (Meine and Archibald 1996).

China Although Ludlow and Kinnear (1944) observed 60 years ago that “Tibetans never molest this crane, so they are wonderfully tame,” Chinese nationals have begun to hunt them since their occupation of the territory (J. MacKinnon in Caron 1994). In south-central Tibet, crane hunting has been observed at six wintering sites, and local people reported numerous other incidents (Bishop and Canjue Zhouma 1993). Poaching has been observed at Cao Hai lake and on the Tibetan breeding grounds (Dwyer *et al.* 1992, Meine and Archibald 1996). Hunting tours for wealthy tourists on the Tibetan Plateau are now being advertised in China; in summer 1997, a group of hunters were observed aiming their guns at a pair of Tibetan Partridges *Perdix hodgsoniae*, and such opportunistic hunting could also clearly be a threat to the cranes (R. M. Thewlis *in litt.* 1997). Illegal hunting and egg-collection occurs at Zoigê marshes in Sichuan (Li Fengshan and Bishop 1999). Egg-collecting for food is also a problem in some other areas: for example, the Uighur nomads in the Arjin Shan National Nature Reserve (Altun Shan) take eggs from crane nests every summer (Zhang Fan 1992; also Li Fengshan and Bishop 1999). On the breeding grounds in Qinghai, the collectors of duck and Bar-headed Goose eggs also take eggs from crane nests (Wang Qishan *in litt.* 1998). The cranes sometimes cause damage to crops (mainly potatoes, maize and carrots) on wintering grounds in northern and north-east Yunnan and at Cao Hai in Guizhou; in the Xundian area, crop depredation—and consequently the animosity towards cranes by Han and Yi farmers—is a recent phenomenon, and may reflect a switch in behaviour following the loss of natural feeding areas (How-man *et al.* 1994). Although their hunting is prohibited in China, Black-necked Cranes are killed for food by some Han and Yi farmers in Xundian and near Xuanwei in Yunnan and their wings used for scarecrows (How-man *et al.* 1994, He Xiaorui *et al.* 1995). At Hengheliangzi in Yunnan, Black-necked Cranes feed on potatoes planted in February, which again causes conflicts with local farmers (Han Lianxian and Zhou Wei 1998). At Daqiao Nature Reserve in Yunnan, farmers used poisoned grain to kill two Black-necked and five Common Cranes in February 1997 (Wang Gaoxiang 1998).

India The militarisation of Ladakh since the 1970s has resulted in increased hunting of wildlife, including cranes, by military personnel (Scott 1989, G. W. Archibald *in litt.* 1998). Soldiers shot a pair of Black-necked Cranes at Hanle in 1997 (G. W. Archibald *in litt.* 1998). In the Apa Tani valley of Arunachal Pradesh, the increased availability of firearms and the growing prevalence of non-native cultures resulted in the decline and extirpation of wintering Black-necked Cranes by the 1970s (Khacher 1981, Gole 1990, 1993b). Apa Tani tribespeople

left the species unmolested for centuries but practices changed with the arrival of outsiders and firearms in the mid-twentieth century (Khacher 1981).

Bhutan M. A. Bishop (1989a,b) pointed out that the decrease of cranes wintering in Bhutan is influenced by activities occurring in other parts of their range, namely, the socio-political conditions in the Xizang–Qinghai Plateau in China. Cranes in Bhutan are not yet directly persecuted, although the gradual erosion of traditional values might lead to an increase in hunting or disturbance (Scott 1989). Cranes in Bhutan were found to react quickly to a distant rifle shot (Khacher 1981), although this wariness is presumably learnt on Chinese territory.

Vietnam In Vietnam, the species is (or was) threatened by hunting (although apparently with little success) (Fischer 1974).

Disturbance As they are fairly tame in some areas, Black-necked Cranes are perhaps less threatened by disturbance than many other crane species. However, as human populations increase in crane wintering and breeding sites, problems are arising with greater frequency.

China This species seems able to acclimatise to disturbance such as road traffic, human dwellings, and livestock-grazing (Scott 1991, Bishop *et al.* 1998). However, it is possible that human and livestock activity could keep cranes off their nests, allowing domestic dogs to prey on their contents; in Sichuan, birds were found to select inaccessible nest sites where people, livestock and wild animals rarely appear (Dwyer *et al.* 1992). They are warier at certain sites, such as Longbaotan in Qinghai, where individuals apparently vacate nests at a distance of 1 km (Li Dehao 1989), in contrast to Ladakh, where nests are vacated only when people approach closer than 200 m (Pfister 1998), presumably in response to differing levels of human exploitation. At Quanwan, Qinghai Hu lake, the decline in numbers of summering birds (Li Laixing 1997c) is probably due to increased disturbance from tourists and predation by dogs and foxes (Wang Qishan *in litt.* 1998). At Daqiao Nature Reserve in Yunnan, fireworks used in the festivals in January and February cause great disturbance to wintering birds (Wang Gaoxiang 1998).

India Although the cranes were reportedly never molested and the species was described as “secure” in Ladakh (Nurba 1987), this no longer applies. Their territories have been shared with Changpa and Tibetan nomads for centuries as spring pasture for livestock grazing, but since 1970 livestock numbers and therefore overgrazing and disturbance have increased dramatically (Pfister 1998). For example, the Changtang area in Ladakh now supports 140,000 domestic livestock and roughly 5,000 wild ungulates (Kurup 1996, Kitchloo 1997). Livestock is now pushed further into marshland areas to feed on wetland plants until the nomads leave the area in August in search of higher pastures (Pfister 1998). During 12 days of observations at a single nest, incubating cranes were disturbed on 20 occasions for periods of 4–35 (mean 11) minutes (Pfister 1998). The most frequent source of disturbance was the herders and nomads passing through the wetlands and the approach of curious onlookers, and on one occasion a nomad rested with his pony close to the nest, keeping the adults from it for 35 minutes (Pfister 1998). Disturbance was also caused by dogs and vehicles, increasing the length of the incubation period and leaving the eggs vulnerable to predation (Pfister 1998). Egg-predating Common Ravens *Corvus corax* have increased around human settlements, another factor combining with increased disturbance to reduce the breeding success of the cranes (Pfister 1998). Tourism also causes disturbance, especially at Tso-Kar and Startsapuk-Tso (Pfister 1998). Development of new tourist destinations such as Mt Kailash, accessed from Ladakh, may disrupt important crane breeding and feeding areas such as Dungti and Fukche (Pfister 1998). Plans to offer boating opportunities on the high-altitude wetlands are shelved, temporarily at least, as these would be disastrous to breeding pairs of cranes (Pfister 1998). Given that the cranes wintering in Apa Tani valley in Assam occupied less than 26 km², and would not let people in non-native dress approach within c.0.8 km of them, the “advent of outsiders and soldiers with firearms, aircraft, and motor transport” implied that “the birds

have either been shot off or scared away” (F. N. Betts *per* Oesting and Archibald 1974). Cranes no longer occur in the valley, presumably owing to this kind of disturbance. A pair of cranes in Sikkim was reported to have abandoned their nesting attempt “due to biotic interference” (Ganguli-Lachungpa 1998).

Bhutan Maximum levels of disturbance to Black-necked Cranes occur during the first six weeks of their arrival in the autumn, after which people move to their winter homes at lower elevations (Caron 1994). The loss of this species from the Jakhar valley, was attributed entirely to human interference in their habitat (Chacko 1993b). All crane roost sites, except those at Bumdeling, are easily accessible to the rapidly increasing numbers of tourists over-eager to photograph the birds at too close a range (Chacko 1993b, Caron 1994). At Chortenkola (Chhyothen Kora), a flock of these cranes appeared “rather alarmed” by road construction explosions (Ali *et al.* 1996).

Vietnam The species has been judged threatened by human disturbance at wintering sites (Fischer 1974)—although the current challenge is simply to find any such sites.

Pollution and pesticides Mainland China Intensive use of pesticides may have affected this species on its breeding grounds at Zoigê marshes in Sichuan (Li Fengshan and Bishop 1999). In Tibet, farmers using pesticides have caused crane mortalities in at least one area (Gu Binyuan and Canjue Zhouma 1993). Industrial pollution has increased in the Cao Hai lake watershed in Guizhou owing to the recent construction of zinc furnaces (Rank 1992, Li Fengshan 1994). Sewage and garbage from nearby towns and factories have also affected this site, and agrochemicals have polluted the water (Wang Qishan *in litt.* 1998). **India** In Ladakh, refuse disposal by the increasing human population is becoming a problem as there is little care taken: tins, cans, bottles, plastic containers, fabrics and even toxic battery cells are thrown into rivers and wetlands (Pfister 1998). Washing activities in streams near Chushul cause some contamination of the wetland (Scott 1989).

Predation by feral dogs India Predation of eggs and chicks by feral dogs has severely affected the small breeding population in Ladakh (Li Fengshan and Bishop 1999), especially as they can swim across water to reach nests (Chacko 1992c, 1993b). Of 61 eggs monitored in Ladakh in 1992, 1995, 1996 and 1997, 35 (57%) did not survive to fledging, and dogs were responsible for 19 (54%) of these failures, either by killing chicks or destroying eggs (Pfister 1998). In addition, seven eggs (20% of failures) were broken and consumed by Common Ravens (Pfister 1998). The dogs initially accompany nomads or soldiers in the region, many being released to fend for themselves when no longer useful, after which they tend to form packs, scavenging on the leftovers at camps and hunting for food (Pfister 1998). Increasing settlement near wetland areas of Ladakh increases the local population of feral dogs and ravens that feed on refuse, and these in turn predate eggs and chicks of the Black-necked Crane (Scott 1989).

Natural causes China On the Tibetan Plateau, many of the wetlands are small and vulnerable to climatic changes; they may appear and then dry up in a short time, and this is perhaps a factor that affects the breeding success of Black-necked Cranes (Feng Kemin 1991). On the wintering grounds at Daqiao Nature Reserve in Yunnan, food availability is low, especially after deep snow in January and February (Wang Gaoxiang 1998). Potential predators on Tibetan breeding areas include wolf *Canis lupus*, lynx *Felis lynx*, bear *Ursus arctos*, Common Raven, and raptors (Dwyer *et al.* 1991). **India** Fast-rising water after the snow-melt in Ladakh results in zero breeding success in some areas where the cranes breed, e.g. at Startsapuk-Tso, where pairs construct high nests in the absence of natural islands, but rising floodwater often washes the nest contents away (Pfister 1998). **Bhutan** The only natural predators of the cranes are jackals *Canis aureus* and foxes *Vulpes* that often disturb the crane flocks but are rarely successful in their attacks (Dorji 1987). Other potential predators are wolf *Canis lupus* and lynx *Felis lynx* (Dwyer *et al.* 1992). Although most evidence suggests that adult cranes are almost never killed by natural predators (Pfister 1998), two individuals at Phobjikha in 1987 were thought to have succumbed to predation (Dorji 1987).

MEASURES TAKEN *International agreements and cooperation* Conservation action relevant to the species has expanded dramatically since the 1970s (Meine and Archibald 1996). Research conducted in China, India and Bhutan since the mid-1980s has involved cooperative efforts among conservationists and scientists from these three countries and the USA (Harris 1994). At Cao Hai, the Guizhou Environmental Protection Bureau, International Crane Foundation (ICF) and the Trickle Up Program (a New York-based aid organisation) have collaborated since 1994 on a special watershed-scale conservation and community development programme (Harris 1994; also Meine and Archibald 1996). The programme involves four components: community development, scientific research plus an experimental forestry project, management of the Black-necked Cranes and the nature reserve, and GIS-based conservation planning (Li Fengshan 1994).

Legal and cultural protection The Black-necked Crane is listed on Appendix I of the CMS (Bonn Convention, for which see Boere 1991). It is also listed on Appendix I of CITES. Buddhist beliefs in Bhutan, Tibet, Ladakh, Qinghai, western Yunnan and western Sichuan preclude the hunting of wildlife and have played a vital role in ensuring the survival of this species (M. A. Bishop 1989a,b). Black-necked Cranes are regarded as supernatural spirits throughout much of their range, being frequently depicted in religious imagery and considered symbols of good luck and happiness (Bishop 1993b). *China* The Black-necked Crane is a nationally protected species (first class) (Zheng Guangmei and Wang Qishan 1998). Indeed, all cranes have been listed as nationally protected animals since 1990 such that anyone convicted of killing one is imprisoned (Fan Zhongmin *et al.* 1994). In parts of Tibet, fines are issued for egg-collection and illegal hunting (Gu Binyuan and Liu Shauchu 1987). In north-east Yunnan rewards are apparently offered to farmers who bring in sick cranes (Meine and Archibald 1996). In Qinghai, the Black-necked Crane has been declared the "Provincial Bird" and special measures are taken for its protection (He Yubang 1990). *India* The species is legally protected and its hunting prohibited (Meine and Archibald 1996). Soldiers who shot a pair of cranes in 1997 in Ladakh faced heavy fines or prison sentences (G. W. Archibald *in litt.* 1998). *Bhutan* The species is legally protected and its hunting prohibited (Meine and Archibald 1996). Cranes are not harmed by Lamaist Buddhists, and populations of this species are generally found in association with these religious communities (Gole 1992). The lifestyles and livelihood patterns of the local people (especially in Phobjikha and Khotokha valleys) are thought to have had a positive effect on the crane habitat in Bhutan (Caron 1994). They transmigrate to lower altitudes when the crane population is at its highest density, reducing the interaction and potential for confrontation between them; their fields provide additional foraging areas for the cranes, and (at least until recently) were ploughed before the onset of winter and provided insects and plant material in the overturned soil (Caron 1994). Livestock help control grass and bamboo regeneration in the crane's foraging areas (Caron 1994), although overgrazing is also thought to be a problem in some areas (Meine and Archibald 1996).

Protected areas and habitat management *China* Most Black-necked Cranes nest outside protected areas, but a few national, provincial, county and municipal reserves hold small breeding populations (Ma Yiqing and Li Xiaomin 1994), and several hold important non-breeding concentrations (Meine and Archibald 1996). Reserves and proposed reserves with breeding populations include: Arjin Shan (Altun Shan) National Nature Reserve in Xinjiang; Qomolangma Nature Reserve and Xainza (Shenzha) Nature Reserve in Tibet; Niao Dao (Bird Island) Nature Reserve and Longbaotan National Nature Reserve in Qinghai; Da Sungan Hu, Xiao Sungan Hu, Ga Hai, Heihe and Ganhaizi Nature Reserves in Gansu; Qammê (Xiaman) Proposed Nature Reserve in Sichuan. Reserves with wintering populations include: Pengbo in Tibet; Lugu Hu, Bitai Hai, Napa Hai (Nagpag Co), Dashanbao, Maolin, Wuzhai and Huize (including Changhaizi, Daqiao and Huohing Reservoirs) Nature Reserves in Yunnan; and Cao Hai Nature Reserve in Guizhou (Ma Yiqing and Li Xiaomin 1994, Meine and Archibald 1996, Liu Donglai *et al.* 1996, MacKinnon *et al.* 1996, Wang Qishan *in litt.*

1998; see Distribution). ICF established a “Trickle Up Program” at Cao Hai in 1991, which has promoted the understanding of conservation among local communities (Wang Qishan *in litt.* 1998). WWF has assisted the Guizhou Environmental Protection Agency in managing the Cao Hai Nature Reserve by providing support for reserve administration and policy enforcement (Meine and Archibald 1996). Another “Trickle Up Program” at Dashanbao in 1995 has been successful in improving the living standard of the local communities (Dao Meibiao 1997). WWF has worked with government authorities in Sichuan to develop proposed management areas for cranes in the Hongyuan–Ruoergai (Zoigê) breeding grounds (Meine and Archibald 1996). A voluntary Black-necked Crane conservation society has been established in Zhaotong prefecture, Yunnan, and has conducted surveys and started artificial feeding in spring to avoid conflicts between cranes and farmers (Sun Dehui 1999). In cooperation with the Yunnan Geographic Institute, the China Exploration and Research Society initiated a conservation programme at Xundian, Yunnan, in November 1994 aimed at protecting wintering Black-necked Cranes; the programme focuses on wetland restoration, public education and the design and development of a nature reserve (How-man *et al.* 1994).

India The Ladakh breeding population at Chushul, Hanle, Tso Moriri and Tso-Kar occurs within the Changthang Cold Desert Wildlife Sanctuary (Scott 1989, Chacko 1992c), and area also described as the “Changtang Wilderness Area,” the proposed “High Altitude Cold Desert National Park” (Scott 1989, Pfister 1998) and the Changtang Wildlife Sanctuary (Mallon 1989). Owing its location along the Tibetan border, and the partial opening to tourism, management at the site is complex. A recent management plan (Kitchloo 1997) proposed principles which include the protection and restoration of ecosystem integrity alongside the needs of indigenous cultures, and the reduction of detrimental impacts on the wilderness by human interference. Army officials in Ladakh have issued instructions to all units near the breeding areas to mark and protect them, and patrols have been organised to prevent their violation (Meine and Archibald 1996). In Arunachal Pradesh, the crane wintering grounds at Sangti valley will not become a wildlife sanctuary (as suggested in Meine and Archibald 1996) because the local farming practices provide food for the cranes, but (if it continues to hold cranes, none having been seen in several years: M. A. Bishop *in litt.* 2000) the area will function as an unofficial sanctuary with commitments by (a) local people not to hunt the cranes and to plant trees only on slopes away from crane habitat, (b) the army to provide grain in cases of shortage, (c) teachers to promote awareness of the cranes among local children, and (d) a local committee to monitor the situation (Gole 1995).

Bhutan The crane wintering area at Bumdeling has been declared a protected area by the king and incorporated into the Jigme Dorji Wangchuck Sanctuary (Dorji 1987). Suitable habitat in the Phobjikha valley is also being protected (Dorji 1987, RSPN 1991), with agricultural expansion and drainage of marshes being restricted (Scott 1989, Meine and Archibald 1996). To reduce disturbance at Phobjikha, tourists are made to observe the cranes from within distant hides and under the supervision of forest officials (Meine and Archibald 1996). Guesthouses and small shops have opened along the roadway to Phobjikha because of this tourism, and a small percentage of the local population thus accrues financial benefit from the continued survival of the cranes (Caron 1994).

Control of hunting India Although military personnel and immigrants once hunted cranes with impunity in Ladakh, this practice has been curtailed since the mid-1980s through pressure from the authorities (Pfister 1998). **Bhutan** Matthiessen (1994) stated that the cranes were being hunted at Phobjikha, “mostly by boys practicing archery,” until the 1980s when the Royal Society for the Protection of Nature, Bhutan (RSPN) adopted it as a flagship species and hunting of the cranes was punishable by life imprisonment, but this reported is contested by R. Pradhan (*in litt.* 1998), who asserted that little hunting has ever occurred in the area.

Control of predation and disturbance India Some ferocious dogs in Ladakh that were proving a threat to local people and livestock as well as cranes have been culled, but this

measure is not thought to have had any impact on the problem as a whole because the population of domesticated and semi-feral dogs in the area is large (Pfister 1998). In addition to the regular removal of stray dogs, fishing is prohibited at relevant sites and grazing is not permitted in the nesting areas between May and August (Meine and Archibald 1996).

Research Prior to the late 1970s the status and ecology of the Black-necked Crane was very poorly known. Since then, however, field studies in China, Bhutan, and India have provided new information critical to its conservation. *China* Scientists from the Academia Sinica Institutes of Zoology in Beijing and Kunming, the Guizhou Academy of Sciences, the North-west Plateau Institute of Biology, the Shaanxi Institute of Zoology and the Tibetan Plateau Institute of Biology have studied the species throughout its Chinese range (Meine and Archibald 1996). Other data on its wintering ecology have been gathered at Cao Hai Nature Reserve (Zhou Fuzhang *et al.* 1980, Li Fengshan and Li Mingjing 1985, Wu Zhikang and Li Ruoxian 1985, Li Dehao *et al.* 1988, Li Fengshan and Ma Jianzhang 1989a, Wu Zhikang *et al.* 1991, Li Fengshan and Ma Jianzhang 1992) and on its breeding biology at Longbaoton Nature Reserve and the Hongyuan-Ruoergai Plateau marshes in northern Sichuan (Li Dehao and Zhou Zhijin 1985, Lu Zongbau 1986, Li Fengshan and Ma Jianzhang 1989b, Wang Youhui *et al.* 1989, Li Dehao *et al.* 1991). Between 1980 and 1987, surveys of wintering cranes were conducted at Cao Hai and in south-central Tibet (Lu Zongbau 1983, 1986, Gu Binyuan and Liu Shauchu 1987, Li Dehao *et al.* 1988). From the winter of 1988/1989, coordinated Black-necked Crane surveys have been conducted in Bhutan and the Chinese provinces of Yunnan, Tibet and Guizhou under the auspices of ICF (M. A. Bishop 1989a,b, 1991, 1993a). On the breeding grounds, surveys have been conducted in Qinghai (Yao Jianchu 1982, 1986), Sichuan (Scott 1993) and Tibet (Feng Kemin 1989, Dwyer *et al.* 1992, Tobgay and Cherub 2000). Beginning in 1990, ICF and the Tibetan Plateau Institute of Biology undertook a cooperative five-year study of Black-necked Cranes in Tibet: in 1991, a breeding survey was completed, primarily in northern Tibet (Dwyer *et al.* 1992) and winter surveys in south-central Tibet between 1990 and 1994 have provided detailed information on the status and habitat utilisation of the cranes and the threats they face (Bishop 1991, 1993a, Gu Binyuan and Canjue Zhouma 1993, Bishop *et al.* in prep.). The first draft of a management plan for wintering Black-necked Cranes was completed (Bishop and Canjue Zhouma 1993). *India* In Ladakh the 1976 rediscovery of the species stimulated research by several expeditions (Gole 1981a, 1993b, Khacher 1981, Hussain 1984b, 1987, Chacko 1992c). Following the disappearance of cranes from the Apa Tani area in Arunachal Pradesh, nearby valleys were surveyed for remnants of a wintering population (Gole 1990, 1993b). *Bhutan* Scientists and conservationists in Bhutan have conducted surveys of Black-necked Cranes since 1976 (Khacher 1981, M. A. Bishop 1989a,b, Gole 1989b, Chacko 1992a,b). Winter counts of the species have been coordinated by RSPN and the Sherubtse College Nature and Trekking Club (Meine and Archibald 1996). WWF-US has funded the development of a Nature Reserve Centre at Kibethang near the Phobjikha wintering grounds (Meine and Archibald 1996).

Education and training *China* The administrative office of Cao Hai Nature Reserve at Weining contains a public education centre (Meine and Archibald 1996). The China Exploration and Research Society has provided curriculum materials for schools in Xundian and Kunming (Yunnan), and has sponsored field trips by Kunming students to wintering areas in Xundian (Meine and Archibald 1996). International training for conservation officials and administrators, primarily from Guizhou, China, has been organised by ICF (Meine and Archibald 1996). *India* Students in Arunachal Pradesh have been given slide-shows and other educational materials and asked to report the first arrival and last departure of Black-necked Cranes in their region (Meine and Archibald 1996).

Captive breeding and re-introduction Breeding programmes have not hitherto been necessary in the conservation of Black-necked Cranes, although the species breeds relatively easily in captivity. An international studbook was published in 1991 (Meine and Archibald

1991). A limited founder base may cause problems with the captive population, especially as some pairs are breeding prolifically, increasing the likelihood of inbreeding and a reduction of genetic diversity (Meine and Archibald 1996).

MEASURES PROPOSED Conservation priorities for this species include: stronger efforts to control poaching; improved management of existing protected areas and the establishment of some new reserves and agricultural management areas; protection of wetlands (especially in wintering areas) against further deterioration and development; regular coordinated winter counts; studies of migratory movements and roosting habitats; and the development of education programmes (Meine and Archibald 1996).

Legislation and enforcement *China* All wintering populations need to be protected from poaching, with special emphasis in Xundian and Xuanwei counties of Yunnan where this problem is most relevant, and a reward system should be instituted for reporting poaching incidents (Meine and Archibald 1996). Li Chun (1996) also suggested that improved enforcement of wildlife conservation laws was required in Yunnan. The timing and use of pesticides and herbicides should be legally regulated to prevent harm to cranes (Meine and Archibald 1996). In addition, legal measures controlling water management in breeding areas are needed (Meine and Archibald 1996). *India* The Black-necked Crane in Jammu and Kashmir state (which includes Ladakh) should be moved from Schedule IV to Schedule I to confer maximum legal protection on the species (Pfister 1998).

Protected areas and habitat management In general, wetlands in the wintering range of the species require protection against further deterioration and development, and further reserves are required in Yunnan and India (Meine and Archibald 1996). To improve the effectiveness of existing protected areas, it has been recommended that their boundaries should be more clearly determined and defined, management plans developed and implemented, the construction of new roads prohibited, grazing pressure reduced, and wardens hired at key protected areas to collect data, serve as guides and ensure that birds are not disturbed (Meine and Archibald 1996). Farmers in crane areas should be given incentives to practise sustainable farming methods that directly or indirectly benefit the species, and road construction should be prohibited and grazing pressure controlled near important winter roost sites (Meine and Archibald 1996). Key wintering and breeding sites need agricultural management to ensure continued access to waste grain and other food resources (Meine and Archibald 1996).

China There is a need to support and strengthen cooperative efforts amongst the various government agencies that currently manage wetland reserves (Meine and Archibald 1996). Special protected areas have been proposed for breeding Black-necked Cranes in the Xiamen region of the Zoigê marshes in northern Sichuan (Scott 1993). Yang Xuyu *et al.* (1996) also supported the establishment of the Xiamen (Qamme) Proposed Nature Reserve (with a core area of 144 km², and a total area of 2,390 km²), and proposed that drainage of marshes and use of pesticides (including rodent baits) be stopped, the number of livestock kept within the natural carrying capacity of the area, and local people be helped to develop alternative economic activities and raise their standard of living. Alternatively, agricultural management zones (rather than reserves) could be established at breeding sites on the Ruorgai marshes (Zoigê) in Sichuan (including Xiamen), with land uses explicitly defined with a view to preserving habitat suitable for cranes (Bishop and Canjue Zhouma 1993, Meine and Archibald 1996). Elsewhere on the breeding grounds, dense nesting areas such as Luobo Cuo and Mujiu Cuo should be protected by limiting human population in these areas and prohibiting further resource development such as drainage or peat mining (Dwyer *et al.* 1992).

On the wintering grounds in north-east Yunnan and western Guizhou, special protected areas have been established at Xundian in Yunnan, but crane protection still need to be improved (How-man *et al.* 1994, Meine and Archibald 1996). Lashi Hai lake in Lijiang county,

Yunnan, should be established as a nature reserve (Li Yun 1998). Economic improvements in the wintering areas of Black-necked Cranes would reduce habitat destruction by local communities (Li Chun 1996). At Xundian and Dashanbao in Yunnan and at Cao Hai in Guizhou there is a particular need for action to halt the conversion of wetlands for agricultural purposes (Meine and Archibald 1996). At Cao Hai water levels need to be regulated to minimise people–crane conflicts while protecting crane habitat; agricultural incursion into the remaining marsh area and surrounding uplands must be stopped, with restoration programmes focusing on the lake margins; new farming practices are needed that conserve soil while generating increased income; and studies must determine the potential for minimising crop depredation (as also at Huize Nature Reserve and around Xundian) (Meine and Archibald 1996). In addition, a new buffer zone is needed between the core and experimental areas of the reserve, along with a conservation management network for Black-necked Cranes in north-eastern Yunnan and north-western Guizhou (Li Fengshan *et al.* 1997). Ecotourism opportunities should be developed at Cao Hai and south-central Tibet to provide economic benefits for local people, but with care taken to use hides and special trails (as at Phobjika, Bhutan) (Bishop 1996). ICF has proposed to the Tibetan provincial government that Agricultural Management Zones (AMZs) be developed in the cranes' wintering areas because of their close association with farming areas: guidelines would define agriculture and other activities within the zone, crops (especially spring barley and wheat) providing suitable winter food for the cranes would be promoted, and, in areas with a high amount of winter wheat, fewer spring barley and spring wheat fields would be ploughed in autumn (Bishop *et al.* in press). By leaving some harvested fields unploughed between November and March, the preferred waste grain would be more readily available on the surface, and these stubblefields would also lure cranes away from planted winter wheat, thereby minimising crop depredation; each AMZ would include crane roost sites, no hunting of cranes or any other birds would be allowed within the AMZs, and tree planting would be discouraged near riparian roost areas (Bishop *et al.* in press). At Hengheliangzi, Yunnan, it has been recommended that the cranes should be artificially fed, to reduce conflicts with farmers (Han Lianxian and Zhou Wei 1998).

India Breeding areas in Ladakh, including Chusul, Tso-Kar, Startsapuk-Tso, Hanle and the Tso Morari, should be designated as waterbird sanctuaries (Khacher 1981, Scott 1989). The Tso-Kar plain in Ladakh, including Startsapuk-Tso, should be evaluated for Ramsar site status (Pfister 1998). Plans to provide artificially stabilised nesting sites to the Startsapuk-Tso cranes (see Threats) have been accepted by the Department of Wildlife Protection in Leh, and should be implemented forthwith (Pfister 1998). Modifications to the Raar breeding site, which involved the cutting of a small peninsula to form an inaccessible island, should be monitored to assess their success (Pfister 1998). Local wardens have been urged for each nesting site in Ladakh, with bonuses paid for successful breeding (Khacher 1981). In Ladakh, nomads could be persuaded to camp further away from key wetlands, and to keep their livestock from straying too close to nesting cranes (i.e. within 300 m), thereby leaving an area of rich vegetation to be harvested for fodder, so important in winter when food shortages afflict the livestock population; nomads interviewed about this approach agreed to support it (Pfister 1998).

Bhutan The Tashi Yangtse area has been proposed for inclusion in the Bumdeling crane sanctuary (Scott 1989). Wardens should be hired to collect data and serve as guides at key protected areas (such as the Phobjikha and Bumdeling sanctuaries) to ensure that the cranes are not disturbed (Meine and Archibald 1996). Farmers should also be encouraged to replace barbed-wire fencing around their cropfields in the crane habitats with traditional fences made of wooden planks and rocks (Chacko 1993b, Caron 1994).

Control of predation India The impact of dogs on broods of cranes in Ladakh is predicted to increase unless effective controls are urgently introduced (Pfister 1998). One method suggested is to construct wire fences around crane nesting sites to deter dogs, but the potential

problems with this method have not been properly evaluated (Pfister 1998). A coordinated culling programme, perhaps undertaken by the Indian Army stationed in crane breeding areas, with appropriate official guidance, appears necessary, but care is needed to respect local traditions on the sanctity of animal life (Pfister 1998). Alternatively herders' dogs could have a front leg attached to their collars so that they cannot pursue fleeing wildlife (Pfister 1998); or a dog sterilisation programme might be mounted.

Research Maintenance of high-quality wetlands in both breeding and wintering areas is the key to the long-term survival of this species, so studies should be conducted of food availability in different habitats types in relation to land uses (Li Fengshan and Bishop 1999). Agricultural harvest and tillage practices should be studied to determine the most beneficial practices for cranes while minimising crop depredation (Meine and Archibald 1996). A coordinated count at wintering areas is needed every three years to monitor trends in population size (Meine and Archibald 1996; also Li Chun 1996). Collaborative studies should determine the migratory patterns and winter dispersal of the species through banding and satellite-tracking (Meine and Archibald 1996). *China* The potential impacts of hydroelectric projects at Zhikong and Yamdrok Tso, and pollution at Cao Hai, need to be identified (Meine and Archibald 1996). The impact of increased tourism at Phobjikha, Cao Hai and Xundian requires study (Meine and Archibald 1996). More work is needed on the breeding grounds, as little is known about the population and habitat status of breeding Black-necked Cranes, especially in north-west and south-west Qinghai (Li Fengshan and Bishop 1999). Winter roost-site characteristics and foraging ecology remain unstudied along the Lhasa and Yarlung Zsangbo rivers in south-central Tibet, and in Bhutan (Meine and Archibald 1996). Additional potential wintering areas need to be identified in Yunnan, along with the habitat preferences of cranes wintering in north-east Yunnan (Meine and Archibald 1996). *India* In Sikkim the importance and size of any breeding population must be assessed and the reasons for the apparent decline identified (Ganguli-Lachungpa 1998). *Bhutan* Research is needed to locate and monitor populations in winter roosting areas and at stopover sites in central Bhutan at Khotakha, Gyetsa, Thangby and Kharsa (Meine and Archibald 1996). *Myanmar* Surveys are needed to identify potential wintering areas (Khin Ma Ma Thwin *in litt.* 1997). The Nature and Wildlife Conservation Division and ICF proposed a survey in Kachin State in January 1998 (Khin Ma Ma Thwin *in litt.* 1997) although nothing further has been done. *Vietnam* Further winter surveys of the Red River plain in Vietnam are required to identify any current wintering sites and the size of any wintering population (Nguyen Cu *in litt.* 1997).

Education and training Within local communities throughout the breeding and wintering ranges of the species, educational materials should be produced and disseminated from school level upwards (Chacko 1993b). Meine and Archibald (1996) identified the following suite of needs: (1) researchers and reserve personnel require training and equipping in censusing techniques, patrolling, conservation education, community involvement, management planning and wetland ecology; (2) information regarding the protected status of cranes should be transmitted through local radio, newspapers and political and religious leaders; (3) a conservation education centre should be established in Sangti valley (Arunachal Pradesh); (4) education programmes in schools and for the public need to be developed and training opportunities for nature reserve personnel expanded; (5) the cultural and ecological significance of cranes needs to be promoted with local police, military personnel and officials, stressing the existence of laws that protect wildlife and provide for the punishment of transgressors; (6) extension work with local farmers should promote practices that benefit both cranes and farmers; (7) within schools, conservation programmes should include visits by conservation officials and trips for children to key reserves; (8) clubs should be established that encourage children to collect data on cranes and other fauna and flora (Meine and Archibald 1996). However, the education and training of local people and nomadic pastoralists

in areas such as Ladakh present huge problems because of their mobility and illiteracy (Pfister 1998). School teachers, monks and Buddhist priests might be primed to provide simple environmental information and increase awareness of the plight of the Black-necked Crane, instilling enthusiasm for its preservation (Pfister 1998). A tourist information centre could be established to increase awareness of and respect towards Ladakh's fauna and flora while promoting ecotourism (Pfister 1998). Captive-bred cranes might be usefully employed in education programmes at key nature reserves with high tourism potential (e.g. Cao Hai and Xundian).

Captive breeding and re-introduction Meine and Archibald (1996) considered that the distribution, status and needs of the global captive population need to be investigated, especially in China. The recommendations of the GCAR and CAMP for cranes (Mirande *et al.* 1997) should be implemented. Li Chun (1996) suggested that an artificial breeding population of Black-necked Cranes could be established in Yunnan. Proposals for a crane breeding centre in Leh, Ladakh, using second eggs from the local breeding population (Khacher 1981, Archibald 1984) were never followed up, and doubts linger regarding the wisdom of such a scheme because of the difficult access to the site and the lack of infrastructural and institutional capacity (Pfister 1998). Indeed, all the evidence points to the need for better management of the wild population as the fundamental means of preventing the decline in this species, and captive breeding should at this stage merely involve the sensible propagation of existing birds in order to maintain an emergency reserve stock.

REMARKS (1) Three specimens labelled *Grus nigricollis* retained in the University of Hanoi collection have been re-identified as Common Crane *Grus grus* (Nguyen Cu *in litt.* 1997). (2) Pemberton (1839: 75) mentioned shooting the "sarus of Bengal" between c.2,500 and c.2,900 m in the Bhumthang (Boomdungtung), Jugur and Gyetsa (Jaesah) valleys. These birds almost certainly refer to Black-necked Cranes as Sarus Crane *Grus antigone* never occurs at these altitudes, and the sites are all currently known localities for Black-necked Crane.