Threatened Birds of Asia:

The BirdLife International Red Data Book

Editors

N. J. COLLAR (Editor-in-chief),
A. V. ANDREEV, S. CHAN, M. J. CROSBY, S. SUBRAMANYA and J. A. TOBIAS

Maps by

RUDYANTO and M. J. CROSBY

Principal compilers and data contributors

■ ***BANGLADESH*** P. Thompson ■ ***BHUTAN*** R. Pradhan; C. Inskipp, T. Inskipp ■ ***CAMBODIA*** Sun Hean; C. M. Poole ■ ***CHINA*** ■ *MAINLAND CHINA* Zheng Guangmei; Ding Changqing, Gao Wei, Gao Yuren, Li Fulai, Liu Naifa, Ma Zhijun, the late Tan Yaokuang, Wang Qishan, Xu Weishu, Yang Lan, Yu Zhiwei, Zhang Zhengwang. ■ *HONG KONG* Hong Kong Bird Watching Society (BirdLife Affiliate); H. F. Cheung; F. N. Y. Lock, C. K. W. Ma, Y. T. Yu. ■ *TAIWAN* Wild Bird Federation of Taiwan (BirdLife Partner); L. Liu Severinghaus; Chang Chin-lung, Chiang Ming-liang, Fang Woei-horng, Ho Yi-hsian, Hwang Kwang-yin, Lin Wei-yuan, Lin Wen-horn, Lo Hung-ren, Sha Chian-chung, Yau Cheng-teh. ■ ***INDIA*** Bombay Natural History Society (BirdLife Partner Designate) and Sálim Ali Centre for Ornithology and Natural History; L. Vijayan and V. S. Vijayan; S. Balachandran, R. Bhargava, P. C. Bhattacharjee, S. Bhupathy, A. Chaudhury, P. Gole, S. A. Hussain, R. Kaul, U. Lachungpa, R. Naroji, S. Pandey, A. Pittie, V. Prakash, A. Rahmani, P. Saikia, R. Sankaran, P. Singh, R. Sugathan, Zafar-ul Islam ■ ***INDONESIA*** BirdLife International Indonesia Country Programme; Ria Saryanthi; D. Agista, S. van Balen, Y. Cahyadin, R. F. A. Grimmett, F. R. Lambert, M. Poulsen, Rudyanto, I. Setiawan, C. Trainor ■ ***JAPAN*** Wild Bird Society of Japan (BirdLife Partner); Y. Fujimaki; Y. Kanai, H. Morioka, K. Ono, H. Uchida, M. Ueta, N. Yanagisawa ■ ***KOREA*** ■ *NORTH KOREA* Pak U-il; Chong Jong-ryol, Rim Chu-yon. ■ *SOUTH KOREA* Lee Woo-shin; Han Sang-hoon, Kim Jin-han, Lee Ki-sup, Park Jin-young ■ ***LAOS*** K. Khounboline; W. J. Duckworth ■ ***MALAYSIA*** Malaysian Nature Society (BirdLife Partner); K. Kumar; G. Noramly, M. J. Kohler ■ ***MONGOLIA*** D. Batdelger; A. Bräunlich, N. Tseveenmyadag ■ ***MYANMAR*** Khin Ma Ma Thwin ■ ***NEPAL*** Bird Conservation Nepal (BirdLife Affiliate); H. S. Baral; C. Inskipp, T. P. Inskipp ■ ***PAKISTAN*** Ornithological Society of Pakistan (BirdLife Affiliate) ■ ***PHILIPPINES*** Haribon Foundation for Conservation of Natural Resources (BirdLife Partner); N. A. D. Mallari, B. R. Tabaranza, Jr. ■ ***RUSSIA*** Russian Bird Conservation Union (BirdLife Partner Designate); A. V. Andreev; A. G. Degtyarev, V. G. Degtyarev, V. A. Dugintsov, N. N. Gerasimov, Yu. N. Gerasimov, N. I. Germogenov, O. A. Goroshko, A. V. Kondrat'ev, Yu. V. Labutin, N. M. Litvinenko, Yu. N. Nazarov, V. A. Nechaev, V. I. Perfil'ev, R. V. Ryabtsev, Yu. V. Shibaev, S. G. Surmach, E. E. Tkachenko, O. P. Val'chuk, B. A. Voronov. ■ ***SINGAPORE*** The Nature Society (Singapore) (BirdLife Partner); Lim Kim Seng ■ ***SRI LANKA*** Field Ornithology Group of Sri Lanka (BirdLife Affiliate); S. Kotagama; S. Aryaprema, S. Corea, J. P. G. Jones, U. Fernando, R. Perera, M. Siriwardhane, K. Weerakoon ■ ***THAILAND*** Bird Conservation Society of Thailand (BirdLife Partner); U. Treesucon; R. Jugmongkol, V. Kongthong, P. Poonswad, P. D. Round, S. Supparatvikorn ■ ***VIETNAM*** BirdLife International Vietnam Country Programme; Nguyen Cu; J. C. Eames, A. W. Tordoff, Le Trong Trai, Nguyen Duc Tu.

With contributions from: S. H. M. Butchart, D. S. Butler (maps), P. Davidson, J. C. Lowen, G. C. L. Dutson, N. B. Peet, T. Vetta (maps), J. M. Villasper (maps), M. G. Wilson

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

Wellbrook Court, Girton Road, Cambridge, CB3 0NA, United Kingdom
Tel: +44 1223 277318 Fax: +44 1223 277200 Email: birdlife@birdlife.org.uk
Internet: www.birdlife.net

BirdLife International is a UK-registered charity

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

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

First published 2001 by BirdLife International

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

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

GREAT INDIAN BUSTARD

Ardeotis nigriceps

Critical □ —
Endangered ■ C1; C2b
Vulnerable □ D1

This bustard qualifies as Endangered because of its very small, declining population, as a result of hunting and continuing agricultural development.

DISTRIBUTION Historically the Great Indian Bustard occupied a large range in the Indian subcontinent ranging from central Punjab in the far north to central Tamil Nadu in the far south, and from western Orissa in the east westwards into the eastern borderlands of Pakistan, although within this range the great majority of records stem from dry areas, so that when mapped the species's distribution almost entirely fits into the western half of the Indian subcontinent. Records from Bihar, Bengal and Sri Lanka (Baker 1922–1930) are the product of careless editing (Goriup 1983), while reports of the species "on the same ground" as Great Bustard *Otis tarda* in northern China (Fooks 1911) are simply inaccurate. There are also unsubstantiated reports from Nepal (see Remarks 1). However, the notion that the modern range of the species was a mere 1.7% of its original distribution (Mukherjee 1974) is entirely mistaken: in fact the former and current ranges are largely coincident, with instead a massive diminishment of the numbers occupying the areas in question (Goriup 1983).

■ ***PAKISTAN*** The species was once "generally distributed" in desert regions of Sind, having never occurred west of the Indus (Ticehurst 1922–1924), but is now a "rare vagrant" to the country (Roberts 1991–1992). Records are from: ■ ***Sind*** **Khipro**, Thar desert, 18 birds wintered, 1969 (Roberts 1991–1992); **Gadra**, north-eastern corner of Thar Parkar district, one, August 1960 (Roberts 1991–1992); banks of the Indus river, c.22 km from **Hyderabad**, 1878 (Butler 1878); **Karachi**, a bird "once killed" nearby, undated (Hume 1872–1873); **Thar Parkar district** (Thar and Parkar district), undated (Hume 1872–1873; also Butler 1875–1877, Ticehurst 1922–1924), with five collected around 1910 (*J. Bombay Nat. Hist. Soc.* 20 [1910]: 1175); **Nagar Parkar**, several nests, 1940s, including one near Manasiri, August 1948, and another 128 km east of Diplo, near the Indian border (Roberts 1991–1992); ■ ***Punjab*** Cholistan, small numbers in the north, 1970s (Roberts 1991–1992) and two flocks (of 17 and 22), winter 1968–1969 (Ali 1970), presumably including one in the desert beyond **Fort Abbas** (not "east of Bhawalnagar" [cf. Roberts 1991–1992] but east of Bahawalpur), c.20, March–September 1969 (Roberts 1991–1992); "a few miles east" of **Derawar**, three shot, 1965 (Roberts 1991–1992); **Manthar**, Bahawalpur, a pair on "abandoned fallow land", 1930s (Ali 1940).

■ ***INDIA*** In this account the records by Tyabji (1952), although queried by Burton (1953; see Remarks 2) and Dharmakumarsinhji (1953), are accepted, based on Rahmani and Manakadan (1986). Most records have been tabulated by Rahmani (1989e) and Rahmani and Manakadan (1990).

■ ***Punjab*** The only three records are old, although the species was asserted still to occur in the state in the early 1970s (Dharmakumarsinhji 1978): **Firozpur** (Ferozepore), May 1912 (Jones 1912); **Ludhiana district**, reported around 1857 and considered unlikely to persist (Whistler 1919); near **Bhatinda**, February 1906 (Aitken 1912).

■ ***Haryana*** While numbers involved may have been considerable (see Population), the species appears only to have been recorded in one region of the state: **Sirsa**, 1870 (Fisher 1981), nesting, June to August, year unspecified (Oates 1902), and c.20 km from Sirsa around 1905 (Heath 1905); Jorawala (untraced), presumably near **Darba** towards the Bikaner border,

three, 1931 (Koelz 1940); it was, however, asserted still to occur in the state in the early 1970s (Dharmakumarsinhji 1978).

■ ***Rajasthan*** Records are distributed fairly evenly throughout this large and crucially important state, as follows (but see also Measures Proposed): **Sadhowala**, pre-1980 (mapped in Vyas *et al.* 1983); Bhinyad–Kansaur, here presumed to be **Kansar**, 1960s (Gupta 1970); Bethnoke plot, **Bikaner district**, January 1986 (Rahmani and Manakadan 1990), proposed for protection (*fide* Rahmani 1987b); **Gajner Sanctuary**, Bikaner district, presumably in the 1960s (Gupta 1970, 1983, Rahmani and Manakadan 1990); **Kolayat**, 1966 (Y. D. Singh 1983); **Jhajju** (Jhajhu)–Siana, Bikaner district, January 1986 (Rahmani and Manakadan 1990); **Diyatra** (Dayatara) (apparently declared at some stage a closed area: Rahmani 1996a), October 1962 and subsequently (Saxena and Mathur 1983, Y. D. Singh 1983; mapped in Vyas *et al.* 1983), three males in March 1983 and 12 males in January 1986 (Rahmani and Manakadan 1990), 1993–1994 (Rahmani 1996a); **Chheh Tiba**, pre-1980 (Kapoor and Bhatia 1983); **Nokha**–Nachna road, 1963 (Y. D. Singh 1983); **Kanasar**, 1965 (Y. D. Singh 1983); **Bap** (also called "Bap Ramdeora Oran"), 1960 (Y. D. Singh 1983, mapped in Vyas *et al.* 1983), March 1983 and January 1986 (Rahmani and Manakadan 1990), 1993–1994 (Rahmani 1996a); **Ramgarh**, 1976 (Y. D. Singh 1983); **Ghotadu** (Ghotaru), pre-1980 (mapped in Vyas *et al.* 1983); **Khinyan** (Khiyan), March 1983 (Rahmani and Manakadan 1990); **Madhwa**, pre-1980 (Kapoor and Bhatia 1983); **Deh**, pre-1980 (mapped in Vyas *et al*. 1983); **Longwala**, pre-1980 (mapped in Vyas *et al.* 1983); **Shri Mohangarh** (Monangarh), 1963 (Y. D. Singh 1983); **Asu Tar** (Asooda, Asutar), pre-1980 (mapped in Vyas *et al.* 1983); **Phalodi**, pre-1980 (mapped in Vyas *et al.* 1983), and the Phalodi–Chadi road, 1964 (Y. D. Singh 1983); **Kanod**, pre-1980 (Kapoor and Bhatia 1983); **Bandha**, pre-1980 (mapped in Vyas *et al.* 1983); **Baisakhi**, north-east of Jaisalmer, January/February 1977 (Ali 1983); **Buili**, pre-1980 (mapped in Vyas *et al.* 1983); **Khara**, pre-1980 (Saxena 1983); **Lathi**, pre-1980 (mapped in Vyas *et al.* 1983); **Sarkari**, pre-1980 (mapped in Vyas *et al.* 1983); **Ramdeora** (Ramdevra), early 1960s (Prakash and Ghosh 1963, Y. D. Singh 1983), early 1970s (Vardhan and Chavda 1983), and "thriving" around 1980 (Sharma 1983), and Ramdeora–Mawa, 1960s (Gupta 1970); **Akalpur**, March 1983 (Rahmani and Manakadan 1990); **Chandhana**, pre-1980 (mapped in Vyas *et al.* 1983), and Chandan–Jaisalmer road, 1960s (Gupta 1970); **Kishangarh**, pre-1980 (mapped in Vyas *et al.* 1983); **Sambhar**, near Sambhar lake, 1870s (Adam 1873); **Khinwasar**, 1968 (Y. D. Singh 1983); near **Jaisalmer**, December 1986 (K. Kazmierczak *in litt*. 1999), including Jaisalmer Girav, 1976 (Y. D. Singh 1983), and Deva, north-east of Jaisalmer, January/February 1977 (Ali 1983); **Pokaran** (Pokhran) to Chandan, 1962–1963 (*fide* Ali 1983), August 1970 (Gupta 1974; also in Vyas *et al*. 1983), and Pokaran to Chacha, 1960s (Gupta 1970); **Lawan**, pre-1980 (Saxena 1983); **Dechu** (Dechoo), pre-1980 (mapped in Vyas *et al.* 1983); **Jodhpur district**, "uncommon" according to A. O. Hume, nineteenth century (Whistler 1938), at Dhawa closed area, January–February 1986, and at Nausar plot, December 1985 (Rahmani and Manakadan 1990); **Dhanana**, 1978 (Kapoor and Bhatia 1983, Y. D. Singh 1983); **Osian** (Osian Tinwari), pre-1980 (mapped in Vyas *et al.* 1983); **Sankara**, 1971–1972 (Y. D. Singh 1983), February 1986 (Rahmani and Manakadan 1990); **Devikot** (Devekot-Rasla), 1976 (Y. D. Singh 1983), apparently mid-1980s (Rahmani and Manakadan 1990); **Tiloni** (Teloni), pre-1980 (mapped in Vyas *et al.* 1983); **Desert National Park**, Khuri and Tejsi, pre-1980 (Kapoor and Bhatia 1983), January 1986 (Rahmani and Manakadan 1990), at Sam (Sum), 1976 (Y. D. Singh 1983), January 1986 (Rahmani and Manakadan 1990), 1993–1994 (Rahmani 1996a), Sudasari (Sudasri Nari), pre-1980 (Kapoor and Bhatia 1983), January 1986 (Rahmani and Manakadan 1990), 1993–1994 (Rahmani 1996a), February 1994 (K. Kazmierczak *in litt*. 1999), Mialjar, pre-1980 (Kapoor and Bhatia 1983), January 1986 (Rahmani and Manakadan 1990); **Khakhou** (Khakholi), pre-1980 (mapped in Vyas *et al.* 1983); **Balesar**, 1969 (Y. D. Singh 1983); **Kalu** (Kalu Jor), 1964 (Y. D. Singh 1983); **Tarnot**, pre-1980 (mapped in Vyas *et al.* 1983); **Korna**, January 1969 (Gupta 1970); **Manpura**, pre-1980 (mapped in Vyas *et al.* 1983); outside **Ranthambhore National Park**, Sawai Madhopur

district, June 1988 (Rahmani and Manakadan 1990); **Kalanpur**, December 1948 (one in FMNH); **Sonkhaliya** (Shokaliya, Shoklya) closed area, Ajmer, continuously from August 1978 to September 1980 (Rathore 1983; also Saxena and Sen 1983, Vyas *et al.* 1983), January 1986 and 1994 (Rahmani and Manakadan 1990, Rahmani 1996a), eight in February 1993 and three in 1998 (P. Alström, U. Olsson and D. Zetterström *in litt*. 2000); **Balotra**, pre-1980 (mapped in Vyas *et al.* 1983); north of **Utarlai**, 1964 (Y. D. Singh 1983); **Pali**, Guda Endla, 1964 (Y. D. Singh 1983) and Kholla–Pali road, 1960s (Gupta 1970); the roads between **Barmer** and Gadra (the latter just over the border in Pakistan), 1963 (Y. D. Singh 1983), and between Barmer and Jaisalmer, 1983 (Y. D. Singh 1983); **Shahpura**, Bhilwara, winter 1974 (Vyas *et al.* 1983, Rahmani and Manakadan 1990); **Siwana**, pre-1980 (mapped in Vyas *et al.* 1983); **Sarwari**, pre-1980 (mapped in Vyas *et al.* 1983); **Jalore**-Rohat road, 1968 (Y. D. Singh 1983); **Kundanpur**, pre-1980 (mapped in Vyas *et al.* 1983), July 1981 (B. Singh 1983), February 1984 (Ali and Rahmani 1985), this becoming the Sorsan (Sorson) closed area in which birds continued to be seen down to 1992 (Rahmani 1989e, 1996a, Rahmani and Manakadan 1990); **Bhinmal**, pre-1980 (mapped in Vyas *et al.* 1983), this perhaps the record from Hatamtai Jor, 1960s (Gupta 1970).

Details of some of these areas, and the records established in early 1983, broken down by district (Kota, Ajmer, Bikaner, Jodhpur and Jaisalmer), are provided by Rahmani and Manakadan (1985) and Rahmani (1986a). This and other evidence assembled above (notably the continuous presence of the species at Sonkhaliya, Ajmer) tends to contradict the assertion (in Kapoor and Bhatia 1983) that the species is confined north-west of a line from Bikaner through Phalodi to Mialjar, only crossing it south-east during the period October–March. Untraced localities include: Bilada (possibly Bilodra in northern Gujarat), 1969 (Y. D. Singh 1983); Ghanana (note: *not* Dhanana), 1976 (Y. D. Singh 1983); and unspecificic localities include: Rajputana (Rajpootana), indicating a huge area largely covered by present-day Rajasthan, around 1890 (Barnes 1888–1891); and north of Mount Abu, 1870s (Butler 1875–1877).

■ ***Gujarat*** The species was once widespread in the state; on the Kathiawar Peninsula, which forms a major part of Gujarat, it was found in all areas except the forest areas of Gir, Girnar and Barda hills (Dharmakumarsinhji 1957). Ali (1970) mentioned Lakhpat, Abdasa and Mandvi talukas (tehsils), all of which are listed below. By the end of the 1980s it was definitely known only from around Jamnagar and Kutch, with a few birds recorded from Surendranagar and Rajkot (Rahmani and Manakadan 1990). Rahmani (1996a) referred to Lala as a site in 1984, 1991 and 1994, apparently not one of the sites listed here (area established as a reserve in 1990). Records for the state are from: **Deesa** (Disa), two, c.1889 (Nurse 1900); Nerona, **Banni**, 1967 (Rahmani and Manakadan 1990; also Ali 1970), this area being proposed as a sanctuary (*fide* Rahmani 1987b), also at Chota Bhitara, 30 km from Dhordu, and Udma village, both in Banni, 1984 (Rahmani 1985, Rahmani and Manakadan 1990); **Bhadra**, Lakhpat, undated but prior to 1984 (Rahmani and Manakadan 1990), possibly the record mentioned by Ali (1970) for 1962–1967; Nanda bet in the **Little Rann of Kutch**, November 1986 (Rahmani and Manakadan 1990); Dhaneti, **Bhuj**, 1946 (Rahmani and Manakadan 1990); **Malia**, mid-1970s (Rahmani and Manakadan 1990); **Dhrangadhra**, "ideal habitat for this species", undated (Dharmakumarsinhji 1953), "commonly seen" in the 1940s ("dozens"), but very difficult to find in the area by 1960s (Ramanjulu 1966), when there were sightings between here and Wankaner (Ali 1970), still present in the mid-1970s (Rahmani and Manakadan 1990); Bhada and **Panchatia** villages, west of Mandvi, January 1985 (Rahmani and Manakadan 1990); **Vani** on the Virangam–Rajkot rail tract (*sic*), December 1985 (Rahmani and Manakadan 1990); **Mandvi**, nine individuals (including one albino) 29 km to the north-west of the town, January 1926 (Vijayraji 1926), near Mandvi in the period 1962–1967 (Ali 1970), and nearby at Badamoiti, Godhra and Don villages in Mandvi taluka (although apparently only one bird was sighted), January 1984 (Rahmani and Manakadan 1990), and Layaja village, 15 km west of from Mandvi on the Naliya road, January 1985

(Rahmani and Manakadan 1990); **Nalsarovar**, Ahmedabad, 1960s (Gupta 1970, 1983); **Wankaner**, mid-1970s (Rahmani and Manakadan 1990); **Jamnagar**, at Ghoghera Talab, January 1985 (Rahmani and Manakadan 1990), at Gowane, till 1962, and considered still there in small numbers, 1984 (Rahmani and Manakadan 1990), Khangarpur-Mehmana vidis, January 1985 (Rahmani and Manakadan 1990), and Mahadevia vidi, monsoon 1983 (Rahmani and Manakadan 1990); **Hadmatia** in Kalyanpur taluka, Jamnagar, August 1986 (Rahmani and Manakadan 1990); Dadle grassland near Hingolgarh, **Rajkot**, February 1982 (Rahmani and Manakadan 1990); **Dwarka**, two, around 1918 (*J. Bombay Nat. Hist. Soc.* 26: 314); **Okha Rann**, September 1981 (Karpowicz and Goriup 1985; record apparently missed in Rahmani and Manakadan 1990); Kakerbet grassland near **Bhatia** village, Jamnagar, January 1971 (Yealland 1971), five birds in January 1984 (Rahmani and Manakadan 1990), this evidently being developed into the "Bhatia Reserve" (Rahmani 1996a); **Velavadar National Park**, Bhavnagar, 1980s (Rahmani and Manakadan 1990); **Jasdan**, Kathiawar, nesting in 1940s (Yuvraj of Jasdan 1947), and still a few there and near Babra around 1970 (Ali 1970); Sorath Prant, presumably near **Choki Sorath**, Kathiawar, regular around 1910, with 50 in 1912 (Carter 1912); at Mamaya and Kanakpur villages on **Kotara** (Kothara)–Mothada road, Abdase (Abdasa) taluka, Kutch, June and October 1987 (Rahmani and Manakadan 1990); Balrampur (untraced), 1960s (Gupta 1970); Lala and Naliya (the latter at 23°16′N 68°49′E) (not mapped), currently (Rahmani 2001).

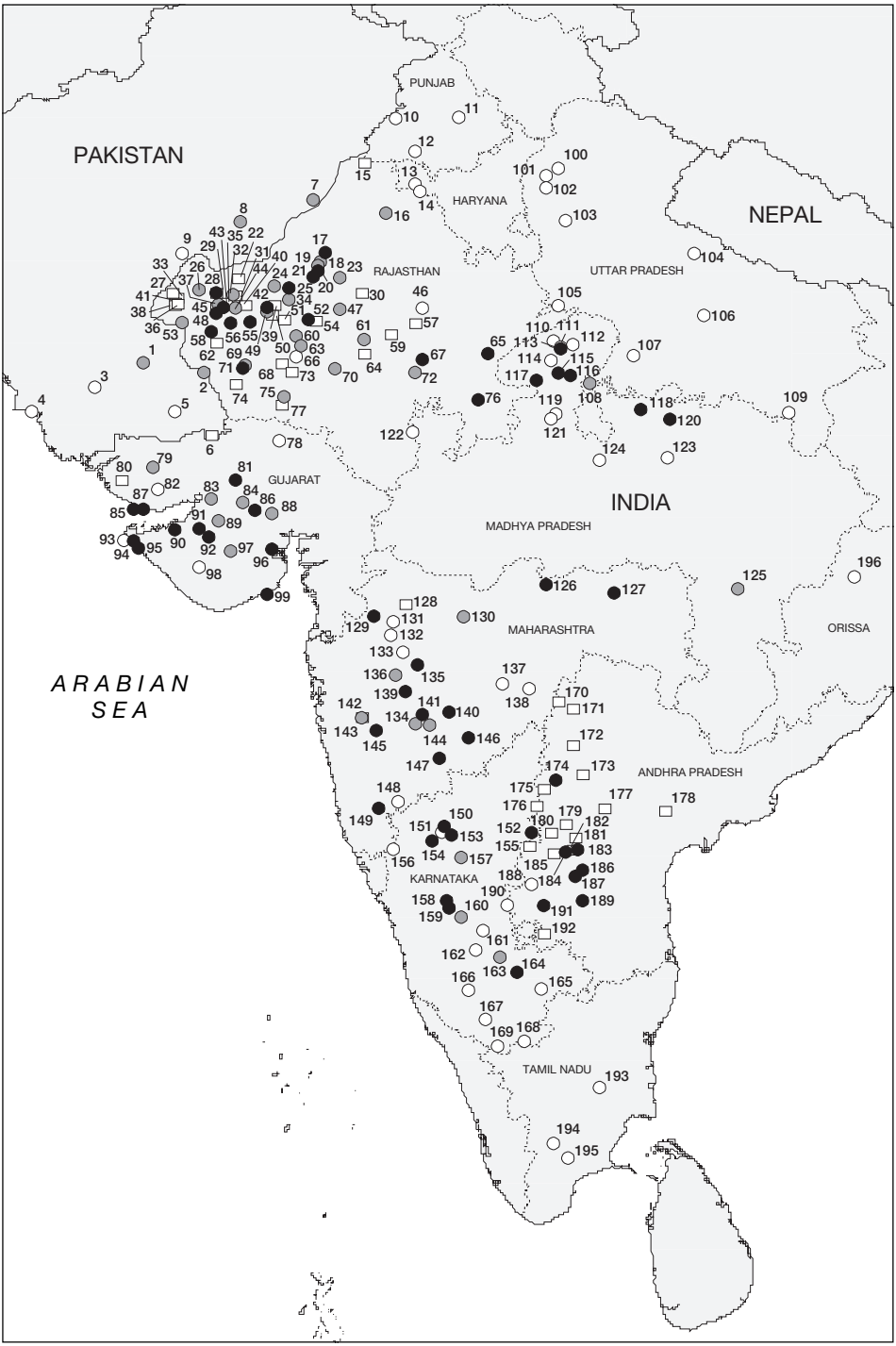
Unspecified localities include: Kutch, uncommon, c.1870 (Stoliczka 1872), and breeding in 1940s (Vijayraji 1943, Ali 1945); Kathiawar, common, 1870s (Lloyd 1873, Butler 1875–1877).

■ ***Uttar Pradesh*** Records indicate that the species was once widespread at least in the western half of the state, and particularly in the north-west sector. It is now thought to have disappeared from this latter sector, with "chances" of sightings now only in the south, in Agra, Etawah, Banda, Lalitpur and Jhansi districts (Rahmani 1989, Rahmani and Manakadan 1990), although it is not clear how these areas were identified. Records for the state are from: **Roorkee** to Ghazeeabad, late 1870s (Butler 1879); east of **Deoband**, late 1870s (Butler 1879); **Muzaffarnagar** (Mozuffemugger), late 1870s (F. W. Butler 1881), and to the east (*Stray Feathers* 8 [1879]: 490 [or Wilson 1879]); c.20 km from **Garhmuktesar** (Gurmukhtesar), in the Ganges, Meerut district, one, June 1894 (Rayment 1894); **Kheri district** in two unspecified localities, 1870s (Tweedie 1879); Tundha, **Agra district**, 1925 (Rahmani and Manakadan 1990); Jallalnugger, Avadh ("Oudh"), on the Gomati river ("Goomti") and thus probably near **Lucknow**, occasional, 1857–1860 (Irby 1861); **Orai**, Jalaun district, three, 1911 (Gudlestone 1911); **Jhansi**, January 1956 (Ganguli 1975; presumably also Gupta 1970); **Mirzapur district**, around 1918 (Allen 1919) and to the south, nesting, August 1943 (Lowther 1949).

■ ***Madhya Pradesh*** Although a large state, records are concentrated in the north-west "peninsula" and from one area in the south-east, thus: near **Jora** (Jaura), Morena district, 1930s (Ali and Whistler 1939–1940); **Morar**, Gwalior, 1860s (Beavan 1865–1868); near **Tighara** and Pagara, west of Gwalior city, 1930s (Ali and Whistler 1939–1940); **Ghatigaon Bustard Sanctuary**, Gwalior, November 1986 (Rahmani and Manakadan 1990), records in the area going back to 1977 and many local sites for drinking and roosting listed in Hasan (1983) but apparently going unseen at the site for eight years before eight individuals were recorded in June 1999 (*Oriental Bird Club Bull*. 30 [1999]: 52–56); near **Mohana**, Gwalior, 1930s (Ali and Whistler 1939–1940); **Narwar**, Shivpuri, May 1983 (Rahmani and Manakadan 1990); **Karera Bustard Sanctuary**, Shivpuri, 1980s (Rahmani 1988, 1989e, 1990, Chandra 1990, Rahmani and Manakadan 1990), some records being detailed in Hasan (1983), but now extinct in the area (V. Tiwari *in litt*. 2000); **Pohri**, 1984 (Rahmani and Manakadan 1990), also "along portions of the road from there to Shivpuri, 1930s (Ali and Whistler 1939–1940), and at "Boodha", 44 km from Pohri on Mohana road, October 1984 (Rahmani and Manakadan 1990); Chhatipur, here presumed to be **Chhatarpur**, 4–5 individuals, and breeding recorded

in May 1981 (Rahmani and Manakadan 1990); at **Isagarh** (Esagarh), 1930s (Ali and Whistler 1939–1940) and along the Desarda (Deharda)–Isagarh road, 1930s (Ali and Whistler 1939–1940); Gunnaur-Pedeu, 22 km from **Panna**, a feather collected in January 1988 (Rahmani and Manakadan 1990); and along Pachchar–Isagarh road near **Saraskheri** (Saruskheri), 1930s (Ali and Whistler 1939–1940); **Nimach** (Neemuch), nesting in July, 1883–1885 (Barnes 1886); **Rithi**, December 1947 (three in FMNH); **Sagar** (Saugor), July 1934, but "very rare in these parts" (Deeks 1935); **Raipur**, undated (Ball 1876, 1878) and between Tilda S.E. Railway and Khorora on the Pallare road, Raipur district, Chhattisgarh, 1965 (Rahmani and Manakadan 1990).

■ ***Maharashtra*** Records of the species indicate its former fairly even spread through at least the western two-thirds of this large state. The assertion that it "still survives in some parts" is based on its sometime presence in the 1980s in Solapur, Ahmednagar, Aurangabad, Osmanabad, Beed, Kolhapur and Pune, and on unconfirmed reports from Nagpur (but see Umbergaon below) and Nashik districts (Rahmani and Manakadan 1990), indicating that the general range has altered relatively little in the twentieth century, perhaps contracting westwards somewhat. Records from the state—other potential sites are listed in Rego (1983) and additional local reports are listed in Ali and Rahmani (1985)—are from: Aurangabad district, undated (Ali and Whistler 1934–1935), with sightings from Sirajgaon, here presumed to be **Sirasgaon**, Aurangabad, 1983–1984 (Rahmani and Manakadan 1990); **Nagpur**, an egg, undated (D'Abreu 1935), and more recently the species seen at Umbergaon in Nagpur district, October 1991 (Garde 1993); **Dhule** (Dhulia), nesting, undated (Rahmani and Manakadan 1990), possibly on the basis of historical records nearby; Virgaon plot, presumably near **Virgaon**, Aurangabad, June 1980 (Rego 1983), 1983–1984 (Rahmani and Manakadan 1990); **Deulgaon** (within the original Ahmednagar-Solapur Proposed Sanctuary: Cornwallis 1983), Ahmednagar, September 1978 to January 1979 (Rego 1983); **Malegaon** (Malegaun), c.1840 (Fraser 1881); Ahmednagar–**Manmad**, 1923, and Kotagaon station, 40 km from Manmad, 1926 (Tyabji 1952); **Vaijapur** (Vijapur), two males shot, October 1924 (Ali and Whistler 1934–1935); **Karjat**, Ahmednagar, July 1978 (Rego 1983), this being written "Kanjat" and listed with Newase and Shrigonda as localities by Ali (1983); Singhpur in **Gangapur** taluka, Aurangabad, July 1980 (Rego 1983), with Gangapur mentioned as a site from the 1960s or earlier (Gupta 1970); **Deolali** (within the original Ahmednagar-Solapur Proposed Sanctuary), 1970s (Cornwallis 1983); **Parbhani**, reported, undated (Ali and Whistler 1934–1935); **Nander**, reported, undated (Ali and Whistler 1934–1935); Ahmednagar district, where 961 birds were shot by a Col. Mansfield in the 25 years 1808–1833 (Elliot 1880), with records in the 1870s (Fairbanks 1876) and more recently from the **Ahmednagar** region at Babulkheda (untraced), September 1978 (Rego 1983), and Chapedgaon plot, September–October 1983 (Rahmani and Manakadan 1990), 1992 (Rahmani 1996a) and at Nagar, c.1880 (E. A. Butler 1881); **Chausala**, near the Osmanabad boundary, Beed, September 1983 (Rahmani and Manakadan 1990); **Arangaon** (Araugaon), east of the Mendhaka river, October 1966 (Dangre 1966), and nearby at the VRDE (Vehicle Research and Development Establishment), Ahmednagar, 1982 (Rahmani and Manakadan 1990); **Khadki**–Aljapur (within the original Ahmednagar-Solapur Proposed Sanctuary), 1970s (Cornwallis 1983); **Pune**, undated (Rahmani and Manakadan 1990); **Pande** (within the original Ahmednagar-Solapur Proposed Sanctuary: Cornwallis 1983), January 1979 (Rego 1983); **Jejuri**, 45 km south-east of Pune, March 1986 (Nalavade 1991), Jejuri, 24 km south-east of Pune on Saswad road, Pune, March 1986 (Rahmani and Manakadan 1990); Mouze-Aste, Paranda taluka, **Osmanabad**, July 1984 (Rahmani and Manakadan 1990); **Solapur**, at Madha plot, 1981–1982 (Rahmani and Manakadan 1990), Karmala plot, 1978 (Rego 1983), 1981–1984 (Rahmani and Manakadan 1990), Scindaghi, October 1829 (Elliot 1880), Boramani, undated (Rahmani and Manakadan 1990), and Gangaiwadi (Kasegaon) plot, 1986–1988 (Rahmani and Manakadan 1990), Nanaj (Nannaj) plots (now Nanaj Bustard Sanctuary), October 1978 (Rego 1983), 1981–1984 (Ali and Rahmani 1985, Rahmani and Manakadan 1990), two in August 1986 (P. Bradbeer *in*


PUNJAB
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ORISSA
ARABIAN SEA
ANDHRA PRADESH
KARNATAKA
TAMIL NADU

litt. 1999), Mirajgaon plot, June–November 1978 (Rego 1983), 1981 (Rahmani and Manakadan 1990; see Remarks 3); **Miraj**, Solapur, breeding, c.1880 (E. A. Butler 1881, 1888–1891); Khadrapur, Shirole taluka, **Kolhapur**, May–July 1987 (Rahmani and Manakadan 1990).

Details of some of these areas, and the records established in 1981–1982, broken down by district (Solapur and Ahmednagar), are provided by Rahmani and Manakadan (1985). Gabale (1983) mentioned Mohal and Mangalwedha tehsils as areas in which the Great Indian Bustard is resident. Rahmani (1996a) referred to "Kamuni" as a site in 1981–1984 and 1992, which is presumably one of the sites listed above. Untraced localities include: Mahi-Jalgaon woodlot and nearby Malki land, August 1978 (Rego 1983); and Muktapur and adjacent Pittalgaon and Jalka, October 1978 (Rego 1983).

■ ***Karnataka*** Records indicate that the species once occurred fairly widely in the lowlands of the interior (and particularly the eastern dry belt) of the state, which however was not adequately surveyed in the Bombay Natural History Society project, so that it was concluded that "there must be many more bustard populations in Karnataka yet to be discovered" (Rahmani and Manakadan 1990). Some sites mentioned as reportedly containing bustards by Neginhal (1983a) are listed in Measures Proposed. Records are from: **Bilgi**, Bijapur, July 1988 (Rahmani and Manakadan 1990); Kulladghee, here presumed to be **Kaladgi**, 1844 (Hamilton 1892); Pagededinne, Sindhanur taluka, **Raichur**, c.1985 (Ali and Rahmani 1985, Rahmani and Manakadan 1990) and Rampura village, 4 km from Raichur, September 1989 (Rahmani and Manakadan 1990); "Tulsigeri and Govinkoppa plantation" in **Bagalkot** range, Dharwad, 1986 (Rahmani and Manakadan 1990); **Barkurki** (Batkurki) and Varchagal between Ramdurga and Bijapur, 1981–1982 (Ali and Rahmani 1985, Rahmani and Manakadan 1990), Bijapur having been known as an important year-round area in the nineteenth century

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The distribution of Great Indian Bustard *Ardeotis nigriceps* (map opposite): (1) Khipro; (2) Gadra; (3) Hyderabad; (4) Karachi; (5) Thar Parkar district; (6) Nagar Parkar; (7) Fort Abbas; (8) Derawar; (9) Manthar; (10) Firozpur; (11) Ludhiana district; (12) Bhatinda; (13) Sirsa; (14) Darba; (15) Sadhowala; (16) Kansar; (17) Bikaner district; (18) Gajner Sanctuary; (19) Kolayat; (20) Jhajju; (21) Diyatra; (22) Chheh Tiba; (23) Nokha; (24) Kanasar; (25) Bap; (26) Ramgarh; (27) Ghotadu; (28) Khinyan; (29) Madhwa; (30) Deh; (31) Longwala; (32) Shri Mohangarh; (33) Asu Tar; (34) Phalodi; (35) Kanod; (36) Bandha; (37) Baisakhi; (38) Builí; (39) Khara; (40) Lathi; (41) Sarkari; (42) Ramdeora; (43) Akalpur; (44) Chandhana; (45) Kishangarh; (46) Sambhar; (47) Khinwasar; (48) Jaisalmer; (49) Pokaran; (50) Lawan; (51) Dechu; (52) Jodhpur district; (53) Dhanana; (54) Osian; (55) Sankara; (56) Devikot; (57) Tiloni; (58) Desert National Park; (59) Khakhou; (60) Balesar; (61) Kalu; (62) Tarnot; (63) Korna; (64) Manpura; (65) Ranthambhore National Park; (66) Kalanpur; (67) Sonkhaliya; (68) Balotra; (69) Utarlai; (70) Pali; (71) Barmer; (72) Shahpura; (73) Siwana; (74) Sarwari; (75) Jalore; (76) Kundanpur; (77) Bhinmal; (78) Deesa; (79) Banni; (80) Bhadra; (81) Little Rann of Kutch; (82) Bhuj; (83) Malia; (84) Dhrangadhra; (85) Panchatia; (86) Vani; (87) Mandvi; (88) Nalsarovar; (89) Wankaner; (90) Jamnagar; (91) Hadmatia; (92) Rajkot; (93) Dwarka; (94) Okha Rann; (95) Bhatia; (96) Velavadar National Park; (97) Jasdan; (98) Choki Sorath; (99) Kotara; (100) Roorkee; (101) Deoband; (102) Muzaffarnagar; (103) Garhmuktesar; (104) Kheri district; (105) Agra district; (106) Lucknow; (107) Orai; (108) Jhansi; (109) Mirzapur district; (110) Jora; (111) Morar; (112) Tighara; (113) Ghatigaon Bustard Sanctuary; (114) Mohana; (115) Narwar; (116) Karera Bustard Sanctuary; (117) Pohri; (118) Chhatarpur; (119) Isagarh; (120) Panna; (121) Saraskheri; (122) Nimach; (123) Rithi; (124) Sagar; (125) Raipur; (126) Sirasgaon; (127) Nagpur; (128) Dhule; (129) Virgaon; (130) Deulgaon; (131) Malegaon; (132) Manmad; (133) Vaijapur; (134) Karjat; (135) Gangapur; (136) Deolali; (137) Parbhani; (138) Nander; (139) Ahmednagar; (140) Chausala; (141) Arangaon; (142) Khadki; (143) Pune; (144) Pande; (145) Jejuri; (146) Osmanabad; (147) Solapur; (148) Miraj; (149) Kolhapur; (150) Bilgi; (151) Kaladgi; (152) Raichur; (153) Bagalkot; (154) Barkurki; (155) Tungabhadra; (156) Belgaum; (157) Gajendragarh; (158) Guttal; (159) Ranibennur Sanctuary; (160) Davangere; (161) Chitradurga; (162) Hosdurga; (163) Bukkapatna; (164) Tumkur; (165) Bangalore; (166) Nelamangala; (167) Bilikere; (168) Biligirirangan hills; (169) Gundlupet; (170) Basar; (171) Nizamabad; (172) Medak; (173) Hyderabad; (174) Vikarabad; (175) Kodangal; (176) Narayanpet; (177) Devarkonda; (178) Achampet; (179) Wanaparthy; (180) Gadwal; (181) Kolhapur; (182) Nandikotkur; (183) Rollapadu Sanctuary; (184) Kurnool; (185) Gudur; (186) Nandyal; (187) Banganapalle; (188) Guntakal; (189) Jammalamadugu; (190) Rayadrug; (191) Anantapur; (192) Penukonda; (193) Samayapuram; (194) Madura district; (195) Aruppukkottai; (196) Sambalpur.

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

(Neginhal 1983a); presumably near **Tungabhadra**, early 1980s (Cornwallis 1983; see Remarks 4); **Belgaum**, c.1880 (E. A. Butler 1881) and Parasagad, 1880s (*fide* Neginhal 1983); Hagedal, near **Gajendragarh**, 1975 (Neginhal 1983a); Guttal plantation, presumably near **Guttal**, Dharwad, 1982 and 1984 (Rahmani and Manakadan 1985, 1990); Ranibennur and Karajgi in the nineteenth century (Fenton 1884), and more recently at **Ranibennur Sanctuary** (Ranibennur Blackbuck Sanctuary), Dharwad, throughout the 1970s (Neginhal 1983a), with a nest found in May 1976 (Neginhal 1999), birds present in 1982–1989 (Rahmani and Manakadan 1985, 1990) and currently (Rahmani 2001); Kondajji, near **Davangere**, Chitradurga district, 1975 (Rahmani and Manakadan 1990); Hiriyur–**Chitradurga** (Chitaldrug), reported, undated (Ali and Whistler 1934–1935, 1942–1943); **Hosdurga** (Hosadurg), Chitradurga (Chitaldrug), nineteenth century (Russel 1900 in Neginhal 1983a); **Bukkapatna**, Sira taluka, Tumkur, 1973 (Rahmani and Manakadan 1990); Yediyar area, **Tumkur**, 1987 (Rahmani and Manakadan 1990); c.15 km west of **Bangalore**, undated (Baker and Inglis 1930); Mysore district, undated (Ali and Whistler 1934–1935), and at **Nelamangala** (Nelamangalam), c.64 km from "Mysore city", January 1940 (Ali and Whistler 1942–1943); **Bilikere**, between Seringapatan (Shri Rangapatna) and Kannur (Cannanore), January 1910 (Baker and Inglis 1930); **Biligirirangan hills** (Biligiri Rangana hills), nineteenth century ("Hawkeye" in Neginhal 1983a); **Gundlupet**, a pair, November, 1930s (Phythian-Adams 1940).

■ ***Andhra Pradesh*** Records of the species come from the length of the more arid western areas of the state: **Basar**, Adilabad, undated but pre-1980 (Kumar 1983); **Nizamabad** district, undated but pre-1980 (Kumar 1983); **Medak** (West), undated but pre-1980 (Kumar 1983); environs of **Hyderabad**, undated but pre-1980 (Kumar 1983); Chevalla, near **Vikarabad**, Ranga-Reddy district, 1980s, and in the same district at Shamshabad (untraced), 1983 (Rahmani and Manakadan 1990); in Mahbubnagar at Jatpole (untraced), and in the same district at **Kodangal**, undated but pre-1980 (Kumar 1983); **Narayanpet**, Mahbubnagar, undated but pre-1980 (Kumar 1983); **Devarkonda** (Devarakonda), Nalgonda, undated but pre-1980 (Kumar 1983); **Achampet**, Mahbubnagar, undated but pre-1980 (Kumar 1983); **Wanaparthy** (Wanaparthi), Mahbubnagar, undated but pre-1980 (Kumar 1983); **Gadwal**, Mahbubnagar, undated but pre-1980 (Kumar 1983); **Kolhapur**, Mahbubnagar, undated but pre-1980 (Kumar 1983); **Nandikotkur**, Kurnool, undated (Kumar 1983); Kurnool district in the 1880s (Tostems 1881), 1953 (Burton in Rao 1995a) and subsequently **Rollapadu Sanctuary**, Kurnool, since August 1982, when three nests were found (Manakadan and Rahmani 1989, Rahmani and Manakadan 1990), February 1995 (K. Kazmierczak *in litt*. 1999); Nellibanda, 60 km from **Kurnool**, March 1985 (Rahmani and Manakadan 1990), and Peddapadu, 5 km from Kurnool on the Bellary road, 1985–1987 (Rahmani and Manakadan 1990); Palakurti, on the **Gudur**–Kodmur road, undated (Rahmani and Manakadan 1990); Siruvella, 25 km from **Nandyal**, towards Cuddapah, May 1986 (Rahmani and Manakadan 1990); **Banganapalle** (Bangarapalle and, presumably, Banganapiliny), Kurnool, undated (Elliot 1880, Kumar 1983), November 1985 (Rahmani and Manakadan 1990); **Guntakal**, towards Gazerapally, 17 in one day, between 1893 and 1895 (Burton 1953); near Kovelakuntla, 30 km from **Jammalamadugu**, 72 km north-west of Cuddapah, 50+ birds apparently around the start of 1997 (*Pitta* 71 [March 1997]: 1); **Rayadrug** (Rayadurg, Raidroog), close to the Karnataka border, 1860s ("Vagrant" [McMaster] 1868), c.1900 (Francis 1904 in Neginhal 1983a), undated and possibly on the basis of historical records (Kumar 1983); **Anantapur**, Kalayandurg, undated but pre-1980 (Kumar 1983) and Hanimireddy-palli, 30 km from Anantapur, on the Kalayandurg road, Anantapur, 1987 (Rahmani and Manakadan 1990); **Penukonda**, Anantapur, undated but pre-1980 (Kumar 1983).

Rahmani and Manakadan 1990 included the generalisation "Hyderabad State (including Hyderabad, Farahabad, Borgambad, Nelipaka, Poloncha, Narsampet and Asifabad)", but it is not clear whether this is coincident with the range which results from a mapping of the above point localities.

■ ***Tamil Nadu*** Records are relatively few: **Samayapuram**, 15 km north of Tiruchirappalli (previously Trichinopoly), February, year not specified (Leigh 1924); **Madura district**, 1860s (Nichols 1943–1945), 1880s in the Madura–Tinnevelly/Tirunelvelly plains (Tostems 1881), but by 1940s near extinction (Nichols 1943–1945); 5 km west of **Aruppukkottai**, 1880s (Tostems 1881); "plains", occasionally (Hamilton 1892).

■ ***Orissa*** The species appears only ever to have been recorded in one district, all well over a century ago: **Sambalpur**, at Burga, 1870s (Ball 1876), and unspecified localities south of the Mahanadi river, 1870s (Ball 1878). The species was asserted still to occur in the state in the early 1970s (Dharmakumarsinhji 1978).

POPULATION The species was once thought "most abundant" throughout its range by Jerdon (1839–1840), who reported that "often flocks of 20 or more are seen feeding in company". That a decline in numbers has occurred since that time is abundantly clear: flocks of 10–12 were still "evidently not uncommon" in the early twentieth century, but by the 1950s the species was almost always encountered in groups of 1–3 (Burton 1953). Although the modern range of the Great Indian Bustard has shrunk relatively little (see above), the populations within that range have diminished drastically (Goriup 1983, Rahmani and Manakadan 1990). As is usual with rather cryptic species, whether big or small, their disappearance from better known areas (as lamented by, e.g., Phythian-Adams 1935, Ali 1945, 1970, Yuvraj of Jasdan 1947, Editors 1952, Dharmakumarsinhji 1953, Shivrajkumar 1962, Spillett 1968) and the ignorance of their status in unexplored regions tend to combine to create the impression that they are near extinction, and the Great Indian Bustard was first thought to be in serious danger as long ago as 1952 (see Ripley 1952, Tyabji 1952), with several subsequent expressions of grave concern (Ali and Ripley 1968–1998, Dharmakumarsinhji 1978), including a total population estimate of fewer than 1,000 in 1966 (Ramanjulu 1966), 1,260 in the late 1960s (R. S. Dharmakumarsinhji in Ali 1970), and 1,000 in 1971 (Ali 1970, Dharmakumarsinhji 1972). It was listed as globally threatened in 1966, when described as "very rare and apparently decreasing" (Vincent 1966–1971), and later placed in what was then the highest category of threat, Endangered, when its numbers were reported as doubtless well below the 1,000 estimated for the species in 1971 (King 1978–1979). By the early 1980s the view was being promulgated that as few as 200 birds were left in the wild (*WWF-India Newsletter* 4[3], no. 46 [1983]: 17–18). However, the total population for the six states targeted for research in the 1980s, as assessed in 1983, came to 650–900 individuals (Rahmani and Manakadan 1985), and, as assessed in 1990, to 770–1,920 individuals (Rahmani and Manakadan 1990). Relaxing these figures to rounder values, and (presumably) allowing for small numbers in several other states, it was judged that the total population might lie between 1,500 and 2,000 birds, so long as the species is largely resident; however, if it is very mobile, which means that considerable double-counting could have

Sanctuary/Area	1985 population	1999–2000 population
Karera Bustard Sanctuary	25–30	0
Ghatigaon Bustard Sanctuary	15–18	2–3
Ranibennur Sanctuary	5–10	2–3
Nanaj area, Solapur	15–25	30–40
Sorsan	10–15	0?
Sonkhaliya	80+	declining
Desert National Park	200–400	declining
Rollapaddu	60+	15–20
Lala and Naliya	–	25–30
near Nashik	–	8–10
Nashik–Aurangabad border	–	20–25

Table 1. Decline of Great Indian Bustard populations in India in 1980s and 1990s (following Rahmani 2001).

occurred in the surveys from which the state population estimates below were derived, then total numbers might have been as low as 500 (Rahmani and Manakadan 1990). In accepting the former scenario as more likely, Rahmani (1996a) indicated that poaching in Rajasthan and ineffective habitat protection everywhere had led to a halving of the 1980s population, and that fewer than 1,000 might remain in the country. Most alarming of all is his suggestion that, roughly in the years 1983–1993, the population of Rajasthan (including inside Desert National Park, *contra* the impression given in Sekhar 1998), the global centre of the species's population, *declined by half* (Rahmani 1996a; also Rahmani 2001). Rahmani (2001) further states that the species "is locally extinct from almost 90% of its former range" and, most ominously, that it has "disappeared from three sanctuaries made especially for its protection" (see Table 1).

The current population of the species at known localities in India is around 102–131 (see Table 1) with, in addition, the main population scattered in the Thar desert although this perhaps constitutes fewer than 500 individuals (Rahmani 2001). In total, therefore, and bearing in mind that one or two unknown populations probably survive in the vast Deccan plains, the number of individuals in India is possibly around 600–700 and probably below 1,000 (Rahmani 2001).

Pakistan Hume (1872–1873) was reliably told that it was found "not uncommonly" in Thar and Parkar districts of Sind. Indeed it was later asserted to be "common" in these districts (Butler 1878), but very rare in the greater part of Sind (Butler 1875–1877). On the basis of these statements, and other historical records, Ticehurst (1922–1924) concluded that the species was a "not very uncommon" resident in the Thar and Parkar districts of Sind, but "rare" in Upper Sind and a "straggler" elsewhere. It is now a "rare vagrant" to the country, although small numbers bred in the Thar desert until late in the twentieth century (Roberts 1991–1992). Although it is conceivable that this continues to be the case, it was "declining rapidly" in the 1960s (Holmes and Wright 1968) and the population must now be tiny and its future highly precarious.

India *Uttar Pradesh* Around 15 birds were considered by R. S. Dharmakumarsinhji to survive in the state in the late 1960s (Ali 1970). Although earlier thought to be completely exterminated in the state (Rahmani and Manakadan 1985), the species is now reported to have "totally disappeared" only (or at least) from the northern parts of the state (Rahmani and Manakadan 1990). *Haryana* Although only ever recorded around Sirsa, it appears that numbers of birds there may have been considerable, given the collection of over 100 eggs in the Sirsa area (Oates 1902, Goriup 1983). Around 30 birds were considered by R. S. Dharmakumarsinhji to survive in the state in the late 1960s (Ali 1970). The species is now reported to have "totally disappeared" from the state (Rahmani and Manakadan 1985, 1990). *Punjab* Around 30 birds were considered by R. S. Dharmakumarsinhji to survive in the state in the late 1960s (Ali 1970). The species is now reported to have "totally disappeared" from the state (Rahmani and Manakadan 1985, 1990). *Madhya Pradesh* Based on a review of assembled evidence, it has been judged that the species was possibly a common bird in the state, especially the north-west. However, it was "becoming increasingly rare" in Gwalior, where it was "met with sparingly and rather sporadically" (Ali and Whistler 1939–1940). None was seen during c.30 years (1926–1955) in the state and it was thought possibly extinct (Hewetson 1956). However, around 400 birds were considered by R. S. Dharmakumarsinhji to survive there in the late 1960s (Ali 1970), although this was thought far too high (Ali 1970). In the 1970s and 1980s birds were found in evidently small but apparently viable numbers in the Gwalior, Shivpuri, Pohri and Panna areas, all in the north-west, but the area around Raipur in the south-east was also reported to hold birds (Rahmani and Manakadan 1990; also Hasan 1983). In 1983 the total state population was estimated to be 40–50 birds (Rahmani and Manakadan 1985), and in 1990 50–100 birds (Rahmani and Manakadan 1990). By the mid-1990s the status of the species in the state was considered "precarious", with only

10–15 birds judged to persist there (Rahmani 1996a). *Rajasthan* The species was clearly once common in the state, with much hunting and egg-collecting (100 eggs taken by one man in the Bikaner region) in the nineteenth century (Jerdon 1862–1864, Hume 1872–1873, Butler 1878, Barnes 1886, 1888–1891, Hume and Oates 1889–1890, Blanford 1895–1898, Baker 1922–1930); it was "met with in great numbers in various parts of the desert" (Adams 1899). Some 500 bustards were judged by R. S. Dharmakumarsinhji to survive in the state in the late 1960s (Ali 1970), and by 1980 it was thought that as few as 180 birds remained (Razdan 1983), but these appear to have been considerable underestimates (Rahmani and Manakadan 1990). Currently the main stronghold is around Jaisalmer, although this was not mentioned historically as a site, with the 10 other known or reported sites being Barmer, Jodhpur, Bikaner, Pali, Jalore, Ajmer, Bhilwara, Tonk, Kota and Sawai Madhopur (Rahmani and Manakadan 1990). In the Jaisalmer district alone there were judged to be at least 200 birds around 1980 (Kapoor and Bhatia 1983). In 1983 the total state population was estimated to be 500–600 birds (Rahmani and Manakadan 1985), although a later reconsideration of the evidence suggested that the numbers at that time were between 500 and 1,500 birds (Rahmani and Manakadan 1990). In 1993–1994 it was judged that the state population had declined by half in the course of the previous decade, and that probably only 500 birds survived (Rahmani 1996a). *Gujarat* The species was clearly once "very common" on the huge Kathiawar Peninsula but "not at all common" in northern Gujarat (Butler 1875–1877). At one time, virtually no grassland in Kathiawar was without a population, and droves of 30–40 were found in suitable habitats for most of the year (Dharmakumarsinhji 1957). At Kharagoda, near the Little Rann of Kutch, over 100 eggs were taken, suggesting considerable numbers (see Baker 1932–1935), and around Sorath Prant, Kathiawar, 50 were counted in one small area in 1912 (Carter 1912). In the Kutch region further north it was also fairly common in the nineteenth century (Stoliczka 1872, Hume 1872–1873), but had already become rare there in the first half of the twentieth (Ali 1945). In Kathiawar a startling decline was also recorded before 1950 (Yuvraj of Jasdan 1947) and around 100 birds were considered by R. S. Dharmakumarsinhji to survive in the state in the late 1960s (Ali 1970). Throughout the state a marked decline was recorded during surveys in 1970–1971, when the last stronghold was judged to be at Jamnagar (Dharmakumarsinhji 1978). This decline continued, and by around 1980 Jamnagar was again regarded as the main area for the species, the total state population being put at 75 birds by one observer and at 50 by another (Sinha 1983). In 1983 the total state population was estimated to be below 50 birds (Rahmani and Manakadan 1985), and in 1990 20–30 birds (Rahmani and Manakadan 1990). Thus indeed "a massive decline" in Gujarat had occurred (Rahmani 1987b). By the mid-1990s the status of the species in the state was considered "precarious", the total number of birds perhaps being as low as 15 (Rahmani 1996a). *Maharashtra* The Great Indian Bustard was a common breeding bird in the Deccan in the mid-nineteenth century (Sykes 1834, Davidson and Wendon 1878), and still "found in considerable numbers" at the start of the twentieth century (Simcox 1913). The Ahmednagar district was clearly one major centre of abundance, since 961 birds were shot by a single hunter (Col. Mansfield) in a 25-year period in the first half of the nineteenth century (see Distribution), an average of 39 birds per year. A hundred years later the population in the area was still fairly strong, with 200–300 birds between Ahmednagar and Manmad, 1923, and 400 at Kotagaon station, 40 km from Manmad, 1926 (Tyabji 1952; see Remarks 2). However, since that time the species has clearly greatly declined, including in the Ahmednagar area (Editors 1952). Around 100 birds were considered by R. S. Dharmakumarsinhji to survive in the state in the late 1960s (Ali 1970). Although there was some evidence of a recovery in areas where grasslands were enclosed (see Measures Taken), the total state population in 1983 was estimated to be 50–100 birds (Rahmani and Manakadan 1985), and in 1990 70–100 birds (Rahmani and Manakadan 1990). This however stands in contrast to the comment that the proposed 7,818 km^2 reserve in the state (see Measures

Proposed) would cater for the small local bustard population, "which may not exceed 300 birds" (Dharmakumarsinhji 1983). The actual reserve created, Nanaj, apparently held only eight birds in 1981 but 37 were seen there in 1993 and the population was estimated at 45, with 60 birds speculated for the entire state (Rahmani 1996a). *Andhra Pradesh* The species was considered "common" by Davidson and Wenden (1878), principally in the Bhima valley (on the Deccan plateau). None was recorded during the Hyderabad State survey, although it was said to be "fairly numerous still in remoter areas, but almost shot out in some of their former haunts" (Ali and Whistler 1933–1934). Around 10 birds were considered by R. S. Dharmakumarsinhji to survive in the state in the late 1960s (Ali 1970). Although one recent estimate was of no more than 15 birds for the entire state (Kumar 1983), fieldwork in the 1980s yielded records from Kurnool, Anantapur and Rangareddy districts, with possible presence (i.e. persistence) in Mahbubnagar district, and in 1983 the total population was estimated to be under 50 birds (Rahmani and Manakadan 1985) and in 1990 100–150 birds (Rahmani and Manakadan 1990). The population at and around Rollapadu Sanctuary in the late 1980s was "in the range of 60–100 birds" (Manakadan and Rahmani 1989), and 50 were counted there in 1994–1995, when perhaps the population of the entire state was 60–80 birds (Rahmani 1996a). The record, apparently in 1997, of over 50 birds at one site (Kovelakuntla; see Distribution) is encouraging. *Karnataka* The Great Indian Bustard was common in the open country of the state ("Mysore") in the nineteenth century (Sanderson 1882), and around 1928 there were "plenty of bustards" ("droves of 15 to 20") in the districts of Raichur and Dharwad (Ghorpade 1983). However, by the mid-1930s the Great Indian Bustard was considered the species which had most declined in the state, with its survival there being in doubt without protection (Phythian-Adams 1935 in Neginhal 1983a). At this time there were "a few left" in Mysore district, three having been shot and several more seen in the 1930s (Phythian-Adams 1940), and it occurred "sparingly" in the Hiriyur-Chitradurga region (Ali and Whistler 1942–1943). Around 60 birds were considered by R. S. Dharmakumarsinhji to survive in the state in the late 1960s (Ali 1970). In 1983 the total state population was estimated to be 20–50 birds (Rahmani and Manakadan 1990) and in 1990 30–40 birds (Rahmani and Manakadan 1990), but these were in the absence of surveys to confirm reports from many districts, and must have been set as an absolute minimum given expectations of new populations to be discovered (see Distribution). Notwithstanding, by the mid-1990s the status of the species in the state was considered "precarious", and probably only 10 birds were by then left (Rahmani 1996a). *Orissa* Around 15 birds were considered by R. S. Dharmakumarsinhji to survive in the state in the late 1960s (Ali 1970). Although earlier thought to be completely exterminated in Orissa (Rahmani and Manakadan 1985), it is in fact simply not known whether the species survives there or not (Rahmani and Manakadan 1990); however, it is probable that any persisting population would be very small. *Tamil Nadu* The species was left off the list of states and their estimated late 1960s populations provided by R. S. Dharmakumarsinhji to Ali (1970), suggesting it was then assumed to be extinct there. It is not known whether it survives in the state or not, but any persisting population would probably be very small (Rahmani and Manakadan 1988b, 1990).

ECOLOGY ***Habitat*** The Great Indian Bustard is a bird of sparse grassland with scattered low scrub, bushes and cultivation in open, stony and frequently slightly rolling semi-desert country (Neginhal 1983b, Rahmani and Manakadan 1986). Although access to water is likely to be an important determinant of habitat use when it is available, in at least parts of the species's range for most of the year the habitat is entirely dry and it is assumed that birds obtain moisture from fruits, shoots and invertebrates (Vyas and Jacob 1983). Habitat lies in areas receiving 12.5–75 cm of rain per year (Gupta 1970). In the Thar desert in Rajasthan the Great Indian Bustard inhabits flat or undulating plains with shrubs of *Capparis*, *Ziziphus* and *Calotropis* or with tall *sewan* grass *Lasiurus* (Prakash 1983). In Madhya Pradesh birds

range over open areas during the rains and winter (July–January) but are confined to shadier places along rivers and "gorges" in the summer (February–June), feeding in the evening in more open areas but retreating to cooler sites (including stony outcrops) over the day (Hasan 1983). In Maharashtra this is a bird of open dry scrubby plains and undulating country, with scattered patches of thorn, tall grass and cultivation; but it avoids irrigated land (Rego 1983); a list of typical flora of habitat is in Dharmakumarsinhji (1983). In Karnataka it was reckoned to inhabit the same ground as the Indian antelope or blackbuck *Antilope cervicapra* but to show "a marked preference for such parts of it as are well clad with short scrub or bushes" (Russel 1900 in Neginhal 1983a), supplied at Ranibennur by the genera *Acacia*, *Euphorbia*, *Dodonea*, etc. (Neginhal 1983b). The importance of vegetation for concealment was documented long ago by Jerdon (1862–1864), and this may hold the key to an understanding of the species's movements (or their lack) (see Migration). It apparently prefers grass that is below the height of its eye (i.e. below 1 m), presumably so that vigilance is not impaired (Rahmani 2001). Roosting may occur at different sites each night (Rahmani 1985a), although in the breeding season territorial males may use the same area, which tends to be bare of vegetation and slightly elevated, giving slightly greater security from nocturnal predation (Rahmani and Manakadan 1987). The birds will associate with blackbuck and chinkara *Gazella gazella bennetti* in order to profit from their vigilance (Dharmakumarsinhji 1985). Breeding-age males will form small groups outside the breeding period, whereas immature birds of both sexes remain in (single-sex) groups throughout the year (in general the largest flocks form in the winter, when insect abundance is lowest and particular plants, notably certain crops, draw birds together); at Nanaj females live in groups typically of 2–10 in the winter and spring, with reproductively active birds becoming solitary for nesting and chick-rearing, July–November (Rahmani and Manakadan 1986, Rahmani 1989e, 1991). Flocks of over 20 birds have been recorded (Jerdon 1839–1840), with the largest flock reported being 34 around 1875 (Baker 1921–1930). In general, the species requires four subtly different types of habitat: (1) *nesting habitat*, consisting of open areas with moderate to short grass, mainly on well-drained stony ground; (2) *display habitat*, involving open ground, usually slightly elevated to provide greater visibility; (3) *feeding habitat*, composed of many different types of open country (scrubland, grassland, pasture, cropfields and stony wasteland) but rarely ever with a damp substrate; and (4) *roosting habitat*, supplied by bare ground at night and, where possible, a shaded site (e.g. next to or under small trees or shrubs) by day (Rahmani 1989e).

Food Major studies are reported in Rahmani (1989e) and Bhushan and Rahmani (1992). The Great Indian Bustard is an omnivorous opportunist, but in general its diet changes with the seasonal abundance of commonly available food items, showing a strong dependence on animal food when breeding, and part-substituting plant material in the colder, drier parts of the year: thus at Karera birds began the year finishing a supply of *Ziziphus* drupes at a time when insect abundance is low, shifting more to crops of soeha *Eruca sativa* and Bengal gram *Cicer arietinum* in February and March, gram and wheat in April and, as the temperature rises, increasing numbers of reptiles and insects, especially orthopterans, in the period May–September, returning to *Ziziphus* and crops such as groundnuts *Arachis hypogea* in October as animal abundance wanes, and adding soeha from November (Bhushan and Rahmani 1992). Animal food is largely invertebrate: among the types listed in the literature are grasshoppers (especially *Chrotogonus*), locusts, crickets, mole-crickets, mantids, beetles (dung-beetles sometimes being heavily targeted, and blister beetles *Cantharis*), alate termites (individual birds keeping others away from the termitarium as the insects emerge), large ants (e.g. *Camponotus*), caterpillars, centipedes, spiders and worms, with vertebrates including many types of reptile and snake (up to c.60 cm long), birds' eggs (an unbroken quail's egg was found in the stomach of one bird) and even occasionally birds, mice, rats, gerbils and other small dry-country mammals (Roberts 1991–1992, Bhushan and Rahmani 1992 and references therein; also Jerdon 1839–1840, 1862–1864, Carter 1912, Kulkarni 1983, Rego 1983, Vyas *et al.* 1983,

Rahmani and Manakadan 1987). Among vegetable food there is a great propensity for cultivated crops such as bengal gram, groundnut, soeha, til *Sesamum indicum*, millet *Sorghum vulgare* and other *Sorghum* spp. and wheat *Triticum vulgare*, with occasional use of mustard *Brassica campestris*, cowpea *Vigna sinensis* and linseed *Linum usitatissimum* (Hasan 1983, Rahmani and Manakadan 1987, Bhushan and Rahmani 1992); drupes and berries of *Carissa*, *Capparis* and *Ziziphus*, plus *Salvadora*, *Citronella* (shoots), *Hibiscus*, *Triumfetta* and *Cucumis*, are among the common wild foods reported (Jerdon 1862–1864, Dharmakumarsinhji 1957, Rego 1983, Bhushan and Rahmani 1992). Stomachs often contain several small stones and one even contained large fragments of a brass bangle (Jerdon 1839–1840).

Breeding A detailed review of breeding biology is supplied by Rahmani (1989e); see also Dharmakumarsinhji (1962b). *Territorial and nest-site fidelity* In the breeding season, individual males are solitary (Rahmani and Manakadan 1986). Although at least 20 "territorial fights" between adult males were witnessed in four years of study, it could not initially be established whether the same male occupies the same area every year or whether there is any form of interchange, nor despite witnessing seven copulations in the same period was it possible to determine whether the Great Indian Bustard is polygynous or promiscuous (Rahmani 1985a). Subsequently, for males, both scenarios have proved true: a marked male occupied the same territory for three years, but following his disappearance a new male took over exactly the same spot in the next breeding season (Rahmani 1991). Indeed, shikaris at Rollapadu reported that a particular territory was repeatedly used, and in a single season five displaying males were snared on it (Manakadan and Rahmani 1989). Females, by contrast, are considerably more wide-ranging and unpredictable (Rahmani 1991). For three consecutive years at two different sites a nest with a single egg was found at almost exactly the same spot, but it could not be confirmed that the same female was involved, although this seemed very probably (Rahmani 1985a; also Manakadan and Rahmani 1986). *Bonds* The Great Indian Bustard forms no pair-bond, and reports of pairs (e.g. Ali and Ripley 1968–1998, Gupta 1970, Kapoor and Bhatia 1983, Kulkarni 1983, Neginhal 1983b) would either refer to a very temporary association between adult male and female or to a somewhat more protracted one between a female and her immature male offspring (Rahmani and Manakadan 1986, Rahmani 1991). *Periodicity* Breeding has been recorded in all months of the year, but mainly from March to September (Goriup 1983); this is the apparently exclusive season in Maharashtra, coinciding there with the monsoon (Rego 1983). In Kutch, north-west Gujarat, the species bred during the monsoon (Baker 1922–1930, Vijayraji 1943, Ali 1945). In Rajasthan nesting is from June to September (Kapoor and Bhatia 1983), although in the north-west it reportedly occurs May–July (Vyas *et al.* 1983). In Madhya Pradesh, eggs were found in the 1970s and 1980s in July and August (Hasan 1983); at Karera the season ran from mid-March to August (Rahmani 1989e). In Andhra Pradesh, at Rollapadu, a minor breeding season spans the period of drizzle from late April to early June, followed soon after (August) by a major breeding season, with egg-laying lasting through into January (Manakadan and Rahmani 1989, Rahmani 1989e). At Nanaj, the season ran from the end of June to early November (Rahmani 1989e). *Nest site* Nests tend to be situated either on open ground on slight rises, so that the incubating birds have a clear view of the surrounding area, or else in crops (Hasan 1983, Manakadan and Rahmani 1986). At Rollapadu a distinct preference was shown by females for stony ground (areas locally called *rallabarkas*), with avoidance shown of non-stony (*galsubarkas*) or black-soil areas (Manakadan and Rahmani 1986). Fallow fields and scrubland were used at Karera, with a slight preference for the former (Rahmani 1989e). At Nanaj nests were sited chiefly in places with sparse or no cover, indicating the importance of visual security for the incubating female (Rahmani 1989e). Barnes (1886) found an egg "under a tuft of sarpat grass in July" at Nimach. *Clutch size, hatching success, relaying, incubation period* Males take no part in incubation or parental care (Roberts 1991–1992). At Karera, of 39 nests seen, all consisted of a single egg; hatching success was 67%, and 10% of nest failure

could be attributed to predation (Rahmani 1989e). At Nanaj, very similar results were obtained, as was strong circumstantial evidence that replacement clutches may sometimes be laid when first eggs are lost (Rahmani 1989e). Two eggs which hatched were known to be incubated for 27 days, but it is not certain when they were laid; an infertile egg was incubated for 40 days (Rahmani 1989e). *Growth of offspring* A hand-reared bird only became independent of bill-to-bill feeding at 200 days (Manakadan and Rahmani 1990), although wild juveniles are capable of feeding independently after one week (Roberts 1991–1992): it was capable of short-distance flight at 65 days, and sustained flight at 210 days; at 120 days its growth rate, in terms of height, greatly slowed (it grew another 10 cm over the next 300 days), but its weight continued to grow steadily over that period (2.8 kg at 120 days, 6.8 kg at 420 days), slowing only at the end of the first full year of life, at which time, however, it was certainly not sexually mature (Manakadan and Rahmani 1990). In the wild, the offspring will commonly remain with its mother until the following breeding season, and even continue to be fed occasionally bill-to-bill; in one case an incubating female was seen to be accompanied by its presumed offspring from the previous year, and her eventual desertion of the nest may have been caused by the juvenile's continued presence nearby, since when she relayed she became increasingly intolerant of it and finally drove it away (Rahmani 1989e).

Migration The influence of rains on the occurrence of the Great Indian Bustard in various parts of India has long been noted (e.g. Jerdon 1862–1864, Davidson and Wenden 1878, Hume and Marshall 1879–1881, Fraser 1881, Baker 1922–1930). The species has been described as resident and seasonally nomadic (Ali and Ripley 1968–1998), and it has been suggested that its increasing rarity and the destruction of its habitat will have caused it to "become more erratic" in its movements (Rahmani and Manakadan 1986). The movements of this species are so poorly understood that estimation of total numbers is compromised by the possibility that populations at particular sites have already been counted elsewhere, even perhaps in other states (see Population). The number of bustards at Nanaj (Maharashtra) and Rollapadu (Andhra Pradesh) varies seasonally, with maxima being encountered during the monsoon (July–October) and minima in late winter and summer (January–June), whereas in Sudasari (Desert National Park, Rajasthan) birds are reported to be most plentiful in the hot months of May–June, with fewer during the monsoon (although this might best be explained by the attraction of the Sudasari waterhole in the high summer) (Rahmani and Manakadan 1990). Long-distance (e.g. interstate) movements of bustards may occur (one notion is that birds may move between the two arid areas of India, the Thar desert and the Deccan tableland: Rahmani and Manakadan 1990), and this possibility needs investigation through research (see Measures Proposed). However, the balance of probability is that birds disperse locally, since at Nanaj and Rollapadu, as well as on the Kathiawar Peninsula, unseasonal showers and cloudy weather, even during summer, often result in temporary immigration of birds, indicating their presence in the vicinity (Dharmakumarsinhji 1957, Rahmani and Manakadan 1986, 1990). This reconvention at short notice on known breeding grounds is probably not undertaken, as Dharmakumarsinhji (1957) judged, "in the hope of finding better food", but rather as a response to the possibility of breeding which, as noted above, can occur at any time of year if conditions happen to permit. The notion that dispersal from breeding grounds might be a short-distance phenomenon is supported by Jerdon's (1862–1864) observations that the species in effect follows long grass, being found in such habitat and in wheatfields towards the end of the rains and in colder weather, shifting, when the plains are bare, to river margins, edges of tanks or low jungle where conditions allow longer grass to persist. Thus the so-called migrations of the Great Indian Bustard may largely be a matter of perception, the presence/absence circumstance at site level being in reality a seen/unseen one at a slightly larger scale.

THREATS ***Habitat loss*** *India* Great Indian Bustard habitats have been made suboptimal or entirely inhospitable by various common developmental factors operating alone or more

usually in combination, namely: an increase in land under cultivation (disturbance, loss of wild land); an increase in land under intensive cultivation (disturbance, pesticide usage and its effects, exclusion by irrigation and by new choices of crops, fragmentation of remaining habitats); an increase in the numbers of livestock (disturbance, nest losses, degradation); an increase in the general accessibility of areas, expressed as roads and motorised vehicles (disturbance, elevated hunting pressure); an increase in pressure from fuelwood-gathering (disturbance, degradation). The loss of the species from Punjab, Haryana and northern Uttar Pradesh has been attributed to poaching and, most importantly, grassland destruction, following the irrigation of many areas for crop farming through a network of canals: Punjab and Haryana have now become "the granary of India", and cropfields cover the fertile northern plains of Uttar Pradesh from Saharanpur to Lucknow (Rahmani and Manakadan 1990, Rahmani 1998a). In at least the Nachana area of Rajasthan expanding cultivation, combined with growing sheep- and camel-breeding operations, was diminishing suitable habitat (expected to continue owing to the development of the Indira Gandhi Nahar Project [IGNP], previously the Rajasthan Canal), and even in the seemingly undisturbed interior of Jaisalmer district "biotic interferences" were being noted (Kapoor and Bhatia 1983). Neglectful management inside Desert National Park resulted in disturbance of some major core areas, e.g. Mialjar, Sam, Phulia; moreover, the IGNP will have a direct influence on 11% of the Thar desert, but its indirect influence will be on the entire ecosystem, especially in bustard areas (Rahmani 1997a, 1998a). This irrigation canal will bisect the park, and greatly increase human use and disturbance of the area which is already considerable given the estimated population of 30,000 living within its boundaries (Rahmani 1998a). Around the park, the IGNP "has opened up huge areas in the western part of the Thar for human colonization", as a result of which "tremendous ecological, demographic and sociological changes" are afoot (Rahmani 2001), developments that are sure to depress populations of desert fauna including this species. Land-use changes in Maharashtra are also the primary reason for the species's decline in the state, backed by pesticide deployment (Rego 1983). Indeed, the general "development" of India has meant increases in numbers of livestock, resulting in losses of nests to cattle trampling (Lowther 1949, Rego 1983, Sinha 1983), disturbance of once remote areas through new road access (Gupta 1970) and the confinement of birds to suboptimal habitat where breeding performance may be poor (Dharmakumarsinhji 1978). Traditional grasslands (*vidis*) are poorly managed and ever-diminishing in number and extent (Sinha 1983). Even the use of new crops may make a difference: thus the substitution of groundnuts for millet and cotton in Gujarat has been regarded as detrimental, owing to the greater "exposure of young" in the former (Sinha 1983). Habitat at Rollapadu Bustard Sanctuary continues to shrink owing to agricultural encroachment and livestock grazing (Rao 1995a). *Pakistan* Lack of water meant that only 4% of plainsland east of the Indus in Sind was cultivable in the mid-nineteenth century, but by 1921 the irrigated area had risen to 15% and, following the completion of the first Indus barrage in 1932, coverage rose towards 100%, and with it there was a near-doubling of the human population from 3.5 million in 1931 to 6 million in 1961, thus dramatically altering the landscape and habitats of the province: "huge expanses of formerly monotonous scrubby desert have been replaced by a lush fertility" (Holmes and Wright 1968–1969), and it appears that the Great Indian Bustard may not have been able to accommodate these changes. It should noted that grasslands in India readily develop into scrub and then woodland if the factors that maintain it as grassland are removed; in this way if grazing is totally stopped habitat will generally become unsuitable for bustards within 2–3 years (Rahmani 2001). The fact that grazing or burning is "absolutely necessary" to maintain bustard habitat (Rahmani 2001) needs to be borne in mind when planning management regimes for protected areas.

Human exploitation Despite the species apparently being "not good to eat" (Rahmani 2001), the Great Indian Bustard has been known as a prized quarry for hunters ever since the invasion of the Moghul emperor Babar in 1526 (Ali 1927). Bustard hunting was recorded around

Ludhiana c.1857, and by 1919 the species had been exterminated from the area (Whistler 1919). Even "scientific" egg-collecting (i.e. for preservation rather than consumption) is thought to have contributed to the decline of the species, since it usually only lays a single egg (often perhaps without a replacement in cases of loss; but see Breeding) and at least three collectors are recorded as having taken 100 eggs each from three different parts of the species's range (see Goriup 1983). Poaching by nomadic pastoralists and others was considered around 1970 to be probably the most serious problem facing the species (R. S. Dharmakumarsinhji in King 1978–1979), although another view at that time was that the "post-war universal menace—the jeep—is the most culpable and potent single factor in bringing about the sorry plight of the bustard", used by "unscrupulous poaching 'sportsmen'—often in the shape of irresponsible, ignorant and vandalistic military personnel" (Ali 1970), so that "wherever the four-wheel vehicle could reach, the bustard disappeared" (Rahmani 2001). In the Thar desert there are villages with shikaris who persistently hunt Great Indian Bustards (Prakash 1983); Ali (1970) reported that "military and police personnel... are usually the chief culprits", while Kapoor and Bhatia (1983) referred simply to "trigger-happy neo-shikaris" taking a heavy toll in the recent past, and Sinha and Thakur (1983) mentioned that hunting also occurs because of the meat's reputation as an aphrodisiac. However, in 1993–1994 Rahmani (2001) was informed that it was "poaching by outsiders", most of them coming for Houbara and sandgrouse, that had caused the drastic recent decline. Killing birds has been judged the first reason for the species's decline in Gujarat (Sinha 1983). In Maharashtra blame has again been placed on the advent of the jeep, facilitating access for "military personnel, district officials and unscrupulous 'sportsmen', itching for shikar" (Rego 1983). The open and relatively flat habitats frequented by the species, along with its large size and the conspicuous nuptial display of the male, mean that poachers intent on hunting the species can drive freely (Rahmani 2001) and locate it easily (Rao 1995a). Until recently this threat had not affected the interior of the Thar desert, as the sandy regions of Barmer, Bikaner and Jaisalmer had remained out of reach, but recent improvements in all-terrain vehicles means that even these areas are now all accessible, and hunting of the species in its last stronghold has begun in earnest (Rahmani 2001). Tourist agents on both sides of the Pakistan border even organise hunting trips for tourists; bustards are not usually the primary target of these tours, but if they find one "not many leave it alone" (Rahmani 2001). In Pakistan the situation is similar, if not worse. The human population has risen dramatically in Sind and the network of roads has improved so that "all parts of the plains are now readily accessible" (Holmes and Wright 1968–1969), factors that have undoubtedly raised hunting pressure.

The naturally low productivity and high longevity of the species are factors that further exacerbate the impact of hunting pressure (Ramanjulu 1966, Rahmani 2001); individuals take several years to reach sexual maturity, thereafter producing a maximum of one young per annum and therefore require long lifespans to rear enough offspring to balance rates of mortality. Because of this problem current levels of persecution are unsupportable and must be curtailed.

Predation and disturbance Nesting female Great Indian Bustards show considerable alarm in the presence of Egyptian Vultures *Neophron percnopterus*, much less with other vulture species, suggesting that the Egyptian's egg-breaking habit extends to bustards (Rahmani and Manakadan 1987, Rahmani 1992b). Eagles cause avoidance reactions, although one adult male bustard was once seen to attempt to defend his position at a termite hole when the insects were emerging from an eagle which "took over" the site (Rahmani and Manakadan 1987). Jungle cats *Felis chaus*, desert cats *F. libyca*, jackals *Canis aureus* and stray dogs occasionally take chicks (Saxena and Sen 1983, Sharma 1983). The wolf *Canis lupus* will prey on the species (Sharma 1983, Dharmakumarsinhji 1985) and is suspected to have taken an incubating female at night, when the egg itself was left intact (Rahmani and Manakadan 1987). Foxes *Vulpes vulpes* and crows *Corvus splendens* and/or *C. macrorhynchos* are

documented egg-predators, and the Indian mongoose *Herpestes edwardsi* and the monitor *Varanus benghalensis* are a similar threat (Dharmakumarsinhji 1962a, Saxena and Sen 1983, Rahmani and Manakadan 1987). The point of listing natural predators is merely to indicate that general management regimes need to take account of different ecological balances to be struck, so as to avoid creating undue but often unrecognised pressures on such already disadvantaged species as Great Indian Bustard.

A more urgent problem appears to be posed by the impact of high numbers of either domestic or protected ungulates. At Nanaj abnormally high numbers of blackbuck may increase the chances of nest-trampling, and circumstantial evidence of this was found (Rahmani and Manakadan 1987). In addition, the great proliferation of blackbucks in the erstwhile Karera Bustard Sanctuary (to 3,000 individuals after re-introduction in the absence of natural predators) caused severe problems as the vegetation was eaten down and eggs of the bustard were crushed (V. Tiwari *in litt*. 2000). Rahmani (2001) points out that during the "crucial phase" of breeding, "the egg is frequently destroyed by the hordes of useless cows which roam all over its range".

Mismanagement of habitat and inadequate protection While modern poachers possess high-quality vehicles and plenty of fuel, the relevant forest departments are woefully understaffed and underfinanced: in the vast 200,000 km^2 Thar desert, there are only two wildlife wardens, one in Bikaner and another in Jodhpur and both with "totally inadequate" resources (Rahmani 2001). Meanwhile, in the Desert National Park—the abiding hope for the fauna of arid India—the park authorities have only two vehicles, and the funds for their maintenance and fuel are inappropriately "meagre" (Rahmani 2001). Added to this is the general ignorance of the bird's plight that affects most areas of rural India within its range: in Rajasthan, for instance, everyone questioned knew that hunting Common Peafowl *Pavo cristatus* was illegal but few knew that the Great Indian Bustard was also totally protected (Rahmani 2001). Rahmani (2001), on which this entire paragraph is based, states that although hunting and habitat loss were the major factors in its historical decline, these pressures have been superseded by habitat mismanagement, protection of "problem animals" and corruption as the likely culprits in its final extermination. As a case study of management problems in protected areas, Karera Bustard Sanctuary is a prime example. Initial moves to protect habitat involved totally protecting a 20 ha grassland plot, a measure that led to it becoming overgrown and entirely unsuitable for the species (which only returned when the protected site was burnt by "a disgruntled farmer"). Protection within the entire 202 km^2 area of the sanctuary caused the number of blackbuck to increase; these in turn caused considerable damage to villagers' crops and these villagers in turn, after readily supporting conservation around Karera, turned against the bustard and are even thought to have purposefully damaged nests. This situation was repeated at Sorsan in 1998 when three bustards were poisoned by villagers in retaliation for blackbuck damage to their crops. By 1989, despite repeated pleas to stem the decline of Great Indian Bustards at Karera, the Forestry Department claimed that the population had reached 40 and was still increasing. In 1994, the last bustard disappeared from the sanctuary, despite an official estimate of 16 birds, and it was two years before the Forestry Department admitted that the project had failed. It is believed that the Karera bustard population merely died of old age, unable to reproduce because of breeding failure. The cover plate to the new field guide to the birds of the Indian subcontinent (Grimmett *et al*. 1998) depicts the Great Indian Bustard in the landscape of Karera Bustard Sanctuary, an image that, rather than instilling hope in the future of this species, is a poignant reminder of this conservation "fiasco" and of how easily the species might slip inexorably to extinction unless efforts to defend it are increased and improved.

MEASURES TAKEN The Great Indian Bustard has been the subject of various types of intervention, direct and indirect, for many years. However, the great majority of relevant

information on its status, and indeed the greatest impetus for its conservation, was generated by fieldwork conducted by the Bombay Natural History Society (see Conservation-oriented Research below).

Statutory protection The Great Indian Bustard was fully protected under Indian law in 1952 (Dharmakumarsinhji 1957), and had in fact been on the protected species list long before that time, although the lack of "constructive steps" taken resulted in a continuing decline and provided "proof of the futility of paper rules" (Ramanjulu 1966). It was included in Schedule I of the Wildlife (Protection) Act, 1972, providing it with complete protection and imposing severe penalties for killing a specimen (Khetan and Vardhan 1985). It is legally protected in every Indian state in which it is known to occur (King 1978–1979). It is listed on Appendix I of CITES. Rao (1995a) reported that in the 1980s only two cases of bustard poaching were noted in the Rollapadu area, Andhra Pradesh, and that both were successfully prosecuted, leading to more effective control of hunting. Rahmani (2001), however, had not encountered any attempted prosecutions and suggested that these were generally very rare.

Conservation campaigns The Tourism and Wildlife Society of India (TWSI) campaigned against Arab falconry reputedly targeting this species in the 1970s, and in late December 1978 and early January 1979 successfully petitioned through the Rajasthan High Court to restrain a foreign hunting party, backed by a nationwide campaign which brought huge publicity to the plight of the Great Indian Bustard in India; in 1982 the species was declared state bird of Rajasthan (Khetan and Vardhan 1985). In the Kurnool district of Andhra Pradesh, wherein lies Rollapadu Bustard Sanctuary, the Great Indian Bustard is used as a logo for the bus corporation and many local people view the species and its protection as the "pride of their district" following long-term awareness campaigns (Rao 1995a). It would clearly be of benefit to the species to replicate this approach elsewhere. An education and aid campaign was recently initiated around Sorsan closed area, with a view to improving cooperation with villagers (*Oriental Bird Club Bull.* 24: 7–12). In February 2000 a "padayatra" (a type of pilgrimage) for bustard conservation was undertaken across the Thar desert involving education and discussion programmes with students and elders and distribution of posters and pamphlets to activate the current of sympathy for wildlife conservation in desert areas; since this project the organisers have received more that 400 letters of support for bustard conservation (Rahmani 2001).

Conservation-oriented research A symposium arranged by TWSI in 1980, stimulated by the scare of an Arab hunting party in December 1978, brought together a wide range of Indian biologists and conservationists to present evidence on the modern status and needs of bustards and in particular the Great Indian Bustard (Goriup and Vardhan 1983). Fieldwork on the ecology and distribution of the Great Indian Bustard was undertaken by the Bombay Natural History Society in the years 1981–1987, targeting six of perhaps eight key range states but really concentrating survey effort on only two, Gujarat and Rajasthan (Ali and Rahmani 1983, 1985, Ali *et al.* 1984, 1985a,b, Manakadan and Rahmani 1986, 1989, 1990, Rahmani 1985a,b, 1986a, 1987a,b, 1988, 1989e, 1990, 1991, 1994, 1996a, Rahmani and Manakadan 1985, 1986, 1987, 1988a,b, 1990).

Protected areas *Madhya Pradesh* In 1980, in response to the discovery of the persistence of the species in the Gwalior district, sanctuaries for it were established near Karera (202 km^2) and Ghatigaon (512 km^2) (details of both in Rahmani 1989e); however, the Karera Sanctuary—which had been called for earlier, apparently as a part or extension of Shivpuri National Park (Gupta 1970)—contains 33 villages and both human and livestock densities are high (26,000 people, 36,000 livestock in 1990), and lack of management mediation resulted in a decline in birds there in the late 1980s (Hasan 1983, Chandra 1990, Rahmani 1990, Rahmani and Manakadan 1990, Bhushan and Rahmani 1992), so that by the mid-1990s the populations in the two reserves had dwindled away (Rahmani 1994a, 1996a). Indeed, the Madhya Pradesh government (in "an admittance of failure") decided to denotify the Karera

Bustard Sanctuary in 2000, as the species had not been sited there for over a decade (V. Tiwari *in litt*. 2000). *Rajasthan* Desert National Park contains Great Indian Bustards, but it "is not in the bustard country" (Prakash 1983); "closed areas" were established at several localities at the start of the 1980s, outlawing hunting for a 10-year period (e.g. Saxena and Sen 1983), and the Gajner Sanctuary, called for in 1970 (Gupta 1970), was established (Gupta 1983), although its present status and value are unknown (not listed in Rahmani 1987a,b). However, the control of livestock and human pressures on the environment in the Thar desert has been ineffective, and the Desert National Park was in the mid-1990s about to be bisected by a tributary canal to the IGNP, which will result in mass settlement of that part of the reserve; moreover, the closed areas merely received one or two guards with no vehicle or motivation (Rahmani 1996a). A bustard sanctuary was proposed to secure the relict population at Kundanpur (Ali and Rahmani 1985) and, *fide* Rahmani (1987a,b, 1989e), this was established ("Sorson closed area") with an area of 10 km^2. Sonkhaliya (17 km^2) was also a closed area (Rahmani 1987a,b, 1989e). *Gujarat* The Dadhli grassland near Jasdan was "completely protected" to preserve habitat for the species, although at that time it no longer occurred there (Sinha 1983); and in 1990 a small reserve at Lala was established for the species (Rahmani 1996a). *Maharashtra* In 1980 it was also announced that a major "Ahmednagar-Solapur Proposed Sanctuary" (Cornwallis 1983), urged back in 1970 (Gupta 1970) and projected to cover 7,818 km^2, was under designation (details in Rego 1983; also Dharmakumarsinhji 1983); in fact, the total area designated as "Bustard Sanctuary" became even larger, at 8,496 km^2, with the addition of Nanaj and other areas (details in Ali and Rahmani 1985, and especially Rahmani 1989e), but in reality "more than 90% of the land is under human occupation, with numerous villages, towns and crop fields", leaving fragments totally only about 400 km^2 under the Forest Department (Rahmani 1996a). This latter appears to include the Nanaj Bustard Sanctuary (see Distribution), which has greatly benefited from grassland protection by the Forest Department, resulting in an increase in bustard numbers there (Rahmani 1996a). *Andhra Pradesh* The Rollapadu Bustard Sanctuary is also an important achievement—"the best bustard grassland seen by us in South India" (Ali and Rahmani 1985)—although it only covers 6 km^2 (Manakadan and Rahmani 1989; details in Rahmani 1989e). *Karnataka* The Ranibennur Blackbuck Sanctuary is clearly important, although afforestation with eucalypts, just prior to gazettement, presented serious problems, with only 7 km^2 of the 120 km^2 reserve actually being open country and with grazing at maximum intensity (Vardhan and Chavda 1983)—but in recent years some eucalypt stands have been cleared, grassland created and bustards seen (Rahmani 1997b); in the same state the Tungabhadra Sanctuary is supposed to hold the species (Cornwallis 1983).

Habitat management In 1976 the Drought-Prone Areas Programme (DPAP) was introduced, leading to the rehabilitation of a number of grasslands (Rahmani and Manakadan 1986). This programme was certainly credited with improving habitat and increasing numbers of Great Indian Bustards in the Solapur district of Maharashtra (Gabale 1983, Ali and Rahmani 1985), although it was pointed out that restoration of vegetative cover can be favourable to the species in the initial stages but thereafter becomes the opposite (Cornwallis 1983).

MEASURES PROPOSED Synthesising proposals is extremely problematic when they come from many different quarters over many years and, indeed, when they arise from compilations of data such as the above (e.g. some will have been enacted, and new proposals made, or part-enacted, and *some* new proposals made, and some will have been ignored or superseded owing to new information or circumstances, or to simple difference of opinion). Moreover, a detailed conservation strategy has already been published (Rahmani 1996a). The following account conflates as many as possible of the currently appropriate recommendations, and makes some of its own.

Conservation-oriented research *Migration studies* Amongst the most pressing management requirement is for clarification of the patterns of movements in the Great Indian Bustard: there can be no dependable plan for its conservation until its seasonal patterns of land use and migration are established, with evidence from each major range state. For this reason the satellite-tracking of birds from relatively well known sites across India should be undertaken as soon as possible, using methods of capture, release and monitoring in line with the techniques now available from similar work on the Houbara (e.g. Combreau *et al.* 1999, Seddon *et al.* 1999, Launay 2000). Indeed, it has reasonably been argued that cooperation with Pakistan is essential to make sense of local patterns of movement and habitat use in Rajasthan (Gupta 1983). *Distribution studies* The Bombay Natural History Society project focused on six of the most important states for the species (Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh and Karnataka), but thus left out Uttar Pradesh with its wealth of former records as well as Orissa and Tamil Nadu. More importantly, it was inevitably unable to achieve complete coverage of the six states targeted, and large areas remain to be investigated. Based chiefly on Rahmani and Manakadan (1990), but with reference to certain other evidence assembled above, amongst the most important areas to survey further are: (*Uttar Pradesh*) southern districts as given under Distribution; (*Madhya Pradesh*) Guna (towards Shivpuri) and Biora, where "extremely good bustard habitat is present" (Rahmani 1994a), plus Gunnaur-Pedeu (22 km from Panna) (Rahmani 1994a) and Raipur; (*Rajasthan*) throughout (except for known areas), given the admission that despite three major surveys in the 1980s "we still could not cover all the bustard areas", and given the fact that Jaisalmer was only discovered to be important in the 1960s, suggesting certain other remote areas may yet prove to be important (Rahmani and Manakadan 1990); Sheo (north-west Barmer), Sanu towards Nadai, and Nadai-Digha (both in north Jaisalmer), Loharki-Nachna (north-east Jaisalmer) and Ramgarh-Ghotaru (north-west Jaisalmer), all places from which reports were received in 1977 (Ali 1983); (*Gujarat*) various vidis and Velavadar National Park, in which the species was reported, without apparent rigorous investigative follow-up, in the 1980s (but no fresh survey should be undertaken without prior reference to Ali *et al.* 1985b); (*Maharashtra*) Nagpur and Nashik, and with greater intensity around Ahmednagar, which was once such a stronghold of the species and which still appears to have considerable potential, plus Mohal and Mangalwedha tehsils; (*Andhra Pradesh*) throughout, involving all sites listed under Distribution apart from Rollapadu, since clearly inadequately investigated statewide; (*Karnataka*) throughout, since not adequately surveyed in the 1980s (Rahmani and Manakadan 1990), with particular emphasis on Dharwad, Bijapur, Raichur, Bellary, Chitradurgha, Tumkur, Hassan, Kolar and Mysore districts (including, in Mysore, the Nangangordu area: Ali and Rahmani 1985), Neginhal (1983a) having further identified records from the Chitradurga–Challakere road, Chitradurga–Bellary road, Chitradurga–Hospet–Hungund roads, Kolar road near Hoskote, and the Gulburga district. (*Other states*) Apart from the above, detailed surveys of former sites for the species in Punjab, Haryana, Orissa and Tamil Nadu are required to ensure that no populations have been missed through mere assumption of their non-existence in the regions.

Protected areas *Madhya Pradesh* In the mid-1980s it was believed that the preservation of the Great Indian Bustard at Karera Bustard Sanctuary was achievable through improved productivity of grasslands for the benefit of local farmers and pastoralists, while altogether six areas within the large reserve were recommended as core breeding sites for the species (Rahmani 1988). However, such was the neglect of management in the subsequent decade, particularly with respect to protection of breeding areas (detailed in Rahmani 1994a, 2001; see Threats), that neither the reserve nor even the state figured in the extensive strategy for Great Indian Bustard conservation outlined by Rahmani (1996a). Nevertheless, Ghatigaon Sanctuary still contains a few birds, as does the Pohri area, and there may be other areas in the state (see previous paragraph) with the species, so the creation of new protected areas

(map of proposed area at Pohri in Ali and Rahmani 1985) and the improvement of at least Ghatigaon (suggestions in Rahmani 1994a) might be a state component of the hoped-for "Project Bustard" (see below). *Rajasthan* Better protection of the highly important Desert National Park could be achieved by resettling people outside the park with suitable compensation, banning irrigation in the area and redemarcating the boundaries and developing core areas (Rahmani 1998a). It has been argued that modification of a seasonal lake at Ramdeora would provide water through the year in an area already highly attractive to the species (a holy shrine there means that wildlife in the area is unmolested: Sharma 1983), so that, along with a 10 km^2 area fenced against grazing animals (although see Threats), this would provide the basis for a permanent sanctuary for the species (Prakash 1983). A sanctuary was also proposed at Bethnoke (Rahmani 1987b). What happened in these two instances is not clear. Subsequently, large sanctuaries permitting traditional grazing have been proposed at Ramgarh and Sultana (Rahmani 1996a). Grassland/pasture plots should be developed in the command area of the IGNP where cultivation is unviable; indeed, the realignment of the canal is called for, and at least an environmental impact analysis (Rahmani 1996a, 1998a). The Satellite Conservation Units of Desert National Park should be expanded, and enclosures established near Diyatra, Tokla, Bajju, Dantur, Bap, Khara, Undu, Khinya-Mandha, Sultana, Ramgarh and other places (Rahmani 1996a; see his Table 3 for other recommendations). *Gujarat* Vincent (1966–1971) revealed that a recommendation had been made to the Indian Board for Wildlife for the establishment in Gujarat of a sanctuary, but that "little progress has been made in the matter". One such site was Nalsarovar, declared a bird sanctuary in 1969 but regarded as capable of serving also as a bustard sanctuary (Gupta 1970). In the early 1980s a plea was made for the establishment of a small sanctuary near Bhatia ("Bhatiya–Kalyanpur Area") at Okha Rann, Gujarat, for the Great Indian Bustard and other species (Karpowicz and Goriup 1985; also Ali and Rahmani 1985, Rahmani 1987b), but although this apparently came to nothing it transpired that the Gujarat government was, in the mid-1990s, planning to establish, albeit perhaps too late (see Population: Gujarat), a reserve for the five or so remaining birds at Bhatia (Rahmani 1996a). Reserves at Banni and Abdase were also proposed (*fide* Rahmani 1987b), apparently without implementation. However, the protected area at Lala, currently 2.5 km^2, offers huge potential for conservation, since "vast grasslands still survive for at least 20 km", many of them hosting Lesser Florican *Sypheotides indica*, Houbara, chinkara and wolf; thus it is strongly recommended that the area under protection should be expanded to include grasslands in Bitta, Prajau, Bara, Tera, Sindrodi, Vanku and Kothara, and extend across to embrace the Pingleshwar coastal area, vital as nesting grounds of the olive ridley turtle *Lepidochelys olivacea*, and that planting of mesquite *Prosopis chilensis* and poaching of game should be countered with the strictest controls (Rahmani 1996a). *Maharastra* Rahmani (1996a) made 13 recommendations relating to Nanaj Bustard Sanctuary in the state, of which the broadest is the suggestion that the boundary should be redrawn to exclude large human populations and include some excellent bustard areas in Beed, Aurangabad and Osmanabad; he also indicated the need to control blackbuck crop damage and to pay administrative attention to lesser known bustard areas like Karmala, Gangiawadi, Dahiwadi, Mirajgaon, Kamuni and Chapedgaon, since the success of Nanaj will eventually result in the increasing value of such areas. *Andhra Pradesh* In Andhra Pradesh a call to establish "bustard sanctuaries" (Kumar 1983) was only partly answered by the creation of Rollapadu (Manakadan and Rahmani 1989e). A closed area at Banganpalli was called for (Rahmani 1987b). Following further studies of the range of the species in the state, further land should be set aside for it in the most important areas (indeed, expansion of the sanctuary area at Rollapadu has already been proposed: details in Ali and Rahmani 1985). Moreover, Rollapadu itself is suffering from burgeoning blackbuck numbers, poaching, encroaching tree cover and the lack of an administrative presence (sanctuary headquarters being 165 km away), all of which now urgently need to be addressed (Rahmani 1996a). *Karnataka* The Ranibennur

Blackbuck Sanctuary was, in 1980, becoming totally unsuitable for Great Indian Bustards and indeed blackbuck, and proposals were made to revamp the reserve radically (Vardhan and Chavda 1983); the entire state was omitted from recommendations by Rahmani (1996a), suggesting little hope for the species there, although some eucalypt clearance at Ranibennur has led to recolonisation by bustards (Rahmani 1997b) and, earlier, areas at Guttal and Bagalkot had been proposed as bustard sanctuaries (Rahmani 1987b).

Moreover, "several reserves, sanctuaries and other protected areas have been recommended as the result of a survey of this species undertaken in 1971", along with increasing the wardening capability of existing reserves and areas where the species is present (King 1978–1979). As Dharmakumarsinhji (1983) pointed out, to offset the effects of habitat fragmentation caused by intensified agriculture within its former range, reserves must be "*large and under full control*". However, the nomadic nature of the Great Indian Bustard, coupled with the intense pressure on land in India, means that reserves for the species can best be achieved through the use of large buffer zones where only traditional agriculture and grazing is permitted, with much smaller core areas, protected from all interference in the breeding season (Rahmani 1996, which see for details on buffer and core area characteristics and administration).

Appropriate land use Great Indian Bustards range widely and cannot be conserved within protected areas alone, however important these may be as havens to maximise breeding success. Indeed, 80% of the remaining population is thought to fall outside protected areas, meaning that the participation of local communities in conserving the species is essential (Rahmani 2001). Therefore the perpetuation of traditional grassland management, the introduction of rotational grazing under controlled conditions, and the minimisation of biocide usage would be of great benefit to bustards (Dharmakumarsinhji 1983, Neginhal 1983c). Planning of land use for forest and pastures comes under several organisations within India, and it is important that this work proceeds with due consultation of wildlife experts in relation to the needs of the Great Indian Bustard in given areas (Cornwallis 1983). The need for traditional farming methods in large buffer zones around reserves has been identified in the previous paragraph.

"Reboisement" using local plant species such as *Ziziphus*, *Carissa*, *Acacia*, *Euphorbia*, *Dodonea*, *Cassia*, *Limonia* and *Ixora* has been urged for certain areas likely to attract numbers of bustards (Neginhal 1983c), and a general review of the potential for recovering vegetation types in Rajasthan through closure and other methods is in Saxena (1983).

If further conservation efforts are to succeed the lessons learnt at Karera Bustard Sanctuary must be applied wherever possible. Three vital steps to take in areas protected for bustards are: (1) controlling of blackbuck populations (through culling or, preferably, translocation) so that the inevitable conflict with villagers and their crops is minimised; (2) ensuring that a sufficient number of safe havens are provided so that bustards can be kept free of disturbance in the breeding season; and (3) managing other grassland areas through regulated grazing or burning to maintain appropriate habitat (Rahmani 2001).

Legal enforcement and education An independent anti-poaching task force has been called for to counter the persistent poaching of game by hunting tribes (Dharmakumarsinhji 1983), and the criminal gangs of well-equipped city-based poachers that threaten wildlife even in remote portions of the Thar desert (Rahmani 2001). This could or should be a service modelled on the US Fish and Wildlife Service and outside the control of the Indian Forestry Department (Gupta 1983). For Rajasthan Rahmani (1996a) proposed six points for the strengthening of the Wildlife Wing, three points for the strengthening of the capabilities of wildlife staff, and four points for publicising the plight of the Great Indian Bustard (see also the detailed and extensive site-specific recommendations in his Table 3).

Local crop farmers commonly welcome the Great Indian Bustard because it feeds on crop pests such as locusts and gerbils (Kapoor and Bhatia 1983). Because it is a benign and

impressive creature, it is often popular with local people, and it is important to work with this positive image to generate further goodwill and cooperation by communities living in areas important for bustards (Rahmani 2001).

Captive breeding The augmentation of wild populations through the release of young birds bred in (semi-)captivity was suggested around 1970 (Dharmakumarsinhji 1971 in King). This is, however, unnecessary and even potentially counterproductive (Collar 1983, Dharmakumarsinhji 1983); and, as experience has shown, it is unrewarding (Vardhan 1985).

Miscellaneous One alternative technique for conservation of this species involves the payment of rewards to villages near which bustards are sighted, and larger rewards when breeding is proved. This was thought by Yealland (1971) to be the "only possible plan with a chance of success" as it was likely to motivate the people who lived alongside the Great Indian Bustard. However, reward schemes can be divisive and counter-productive (see Measures Taken: Adopt-a-Nest under Philippine Eagle *Pithecophaga jefferyi*).

"Project Bustard" Such is the plight of the four species of bustard in India (three breeding species, Great Indian Bustard, Lesser Florican and Bengal Florican *Houbaropsis bengalensis*, plus the wintering Houbara), as well as their grassland habitat, that the time has now come for an integrated national project along the lines of Project Tiger and Project Elephant. The aims of this project would be to conserve all four bustards in India and their habitat types, to establish more bustard sanctuaries, to upgrade existing closed areas, to coordinate the management of sanctuaries, to coordinate research on the species and their habitats, and to integrate grassland conservation with national grazing policy (Rahmani 1996a). A whole suite of other threatened and endemic animal species would benefit from this initiative, including wolf, jackal, chinkara, blackbuck, Swamp Deer *Cervus duvaucelii* and Swamp Francolin *Francolinus gularis* (see relevant account) (Rahmani 1996a).

REMARKS (1) The species was reported from Nepal in the first half of the nineteenth century. A specimen in B. H. Hodgson's collection apparently comes from Nepal (Gray and Gray 1846), although this is not listed by Sharpe (1894, see also Biswas 1960–1966). Another report occurred in the 1960s, "near Champaran District of Bihar" (Gupta 1970), although this was doubted by B. Biswas (Gupta 1970). There are no confirmed records for the country. (2) The counts of 200–300 individuals on one day and 400 on another near Rotagaon station (Tyabji 1952) were doubted by Dharmakumarsinhji (1953) and by Burton (1953), who was stationed in the area in 1891–1892 and again in 1903, during which time he never heard report of more than seven in a day. (3) Mirajgaon was listed as in Ahmednagar district by Rego (1983). (4) According to Cornwallis (1983), one of only a few reserves in India in which the Great Indian Bustard was to be found was the Tungabhadra Wildlife Sanctuary, yet such a site appears not to have been mentioned elsewhere in the literature.