

Threatened Birds of Asia:

The BirdLife International Red Data Book

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JAVAN HAWK-EAGLE

Spizaetus bartelsi

Critical —

Endangered C1; C2b

Vulnerable D1

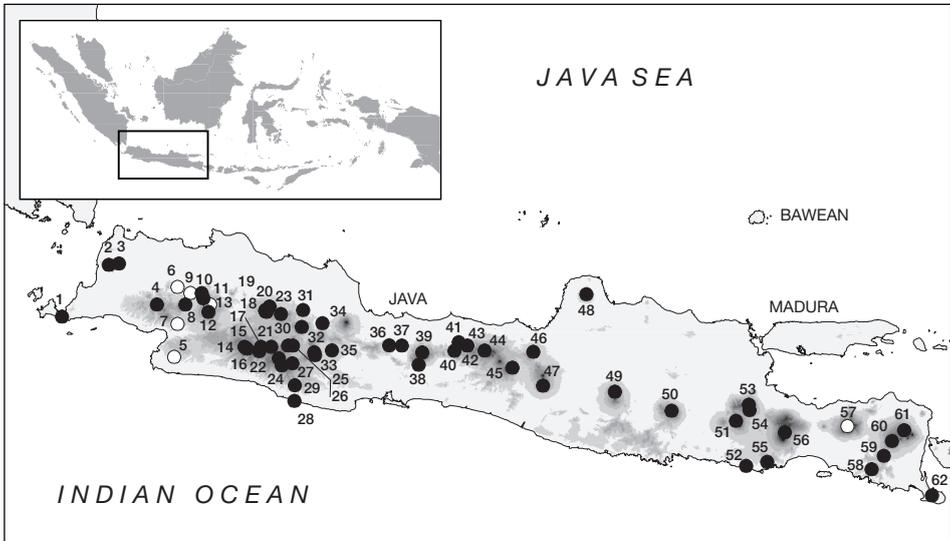


The population of this impressive raptor is very small. Moreover, given the destruction, disturbance and degradation that is currently being inflicted on its preferred habitat, it is inferred to be declining and increasingly fragmented, a circumstance that qualifies it as Endangered.

DISTRIBUTION The Javan Hawk-eagle (see Remarks 1) is endemic to the island of Java, Indonesia, where it has been recorded from numerous sites extending across the entire island, all of which are (or were at the time of the record) forested. There are large areas, particularly in the north and centre of the island, where the species has never been recorded, which presumably lies behind the notion that it may be commonest in the south (Hoogerwerf 1948a); but this may simply be an effect of observer bias and/or deforestation levels. Most records come from hilly forest, and the species has been characterised ecologically as a “slope specialist” (Wells 1985); but this, too, may be an effect of the above factors, as there are certainly some records from sea-level, suggesting that when Java was fully forested the eagle may have ranged through the entire island. Around 1980 there were 2,590 km² of lowland and 2,640 km² of hill forest on Java (FAO 1981–1982). Records (see Remarks 2)—many (but not all) of which were recently detailed and mapped in Sözer *et al.* (1998) and van Balen *et al.* (1999a)—are from:

■ **INDONESIA** Java ■ **West Java Ujung Kulon National Park**, north coast of the isthmus, 10 m, Pandeglang, June 1994 (Sözer and Nijman 1995a,b, van Balen *et al.* 1999a); **Gunung Asepun**, June 1991, September 1997 (van Balen *et al.* 1999a), including Curug Gendang, 100 m, June 1991 (P. J. Heath *in litt.* 1992), July 1999 (C. Bell *in litt.* 1999), and above Carita, November 1998 (K. D. Bishop *in litt.* 2000); **Gunung Karang**, April 1995 (van Balen *et al.* 1999a); **Gunung Halimun National Park** at c.900 m above Cikotok, Lebak, 1994 and 1995 (D. Liley *in litt.* 1996), juvenile in April 1995 (SvB), at Ciptarasa (six pairs in mid-1990s) (Rov *et al.* 1997), and at Nirmala, 1,000–1,100 m, Sukabumi, 1981–1989 (SvB, Meyburg *et al.* 1989, van Balen *et al.* 1999a); **Jampang** at Cibusun, Sukamaju and Jampang Kulon, 1927–1928, near Pelabuhanratu, April 1983, at Ciracap, July 1997, and at Cigaru, September 1997 (van Balen *et al.* 1999a); **Gobang**, February and August 1948 (van Balen *et al.* 1999a); **Gunung Masigit** (see Remarks 3), Sukabumi, nesting in January 1928 (Rozendaal 1981); **Gunung Salak**, Sukabumi (see van Balen *et al.* 1999a), including on the west side, undated (Hoogerwerf 1948a), but also at Ciomas, 600–1,000 m on the north side, undated (Hoogerwerf 1948a), 1981–1995 (van Balen 1991, SvB), above Sukamantri, September–October 1987 (van Balen 1990), above Cidahu on the south-east slope, April 1981 (SvB) and probably at Pasirreungit, Gunungbunder, 1,000–1,200 m on the north-west slope, October 1986 (Meyburg *et al.* 1989); **Bogor**, historically (Hoogerwerf 1948a), with a male from Bogor county, August 1940 (in MZB); **Gunung Pancar**, c.600 m, north-east of Bogor, October 1986 (Meyburg *et al.* 1989) and December 1991 (SvB); **Megamendung**, Bogor, 1981–1986 (SvB, Meyburg *et al.* 1989, van Balen *et al.* 1999a); **Gunung Gede-Pangrango National Park** (see van Balen *et al.* 1999a) at Cikahuripan (“Tji Kahoeripan”), April 1927 (egg in RMNH), at Cibodas, c.1,400–1,700 m and above, for a century since 1898 (female in USNM, Delsman 1926, Dammerman 1929, Hoogerwerf 1948a, 1950b, Amadon 1953, Rozendaal 1981, Andrew 1985, P. Hurrell *in litt.* 1990, van Balen *et al.* 1995, Nuraeni *et al.* 1999), at Cisarua (including Pasir Pogor, near

Tapos), 1994–1994 and late 1998 (SvB, Sözer and Nijman 1995a,b, Nuraeni *et al.* 1999), at Cimande, late 1998 (Nuraeni *et al.* 1999), at Bogodol, late 1998 (Nuraeni *et al.* 1999), at Nagrak, late 1998 (Nuraeni *et al.* 1999), at Cimungkat, above Pasir Datar, 1909–1998 (specimens and eggs in RMNH, Bartels 1924, Hoogerwerf 1948a, Nuraeni *et al.* 1999, SvB), with nesting recorded in April at Cikahuripan (Hellebrekers and Hoogerwerf 1967), at Selabintana, including Perbawati, July–August 1986 (Meyburg *et al.* 1989) and in late 1998 (Nuraeni *et al.* 1999), at Gedeh, late 1998 (Nuraeni *et al.* 1999), at Goalpara, late 1998 (Nuraeni *et al.* 1999), and at Gunung Putri, late 1998 (Nuraeni *et al.* 1999); **Telaga Warna** and adjacent Gunungmas (Cibulao or Cibulau), Puncak, Bogor, June 1922 (male in MZB; see Remarks 1), 1979–1986 (SvB), breeding in 1997 and in 1999 (KPB CIBA–Cianjur 1999, van Balen *et al.* 1999a, Nijman *et al.* 2000, V. Nijman *in litt.* 1999); **Situ Patenggang**, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999); **Cimanggu**, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999); **Gunung Patuha** at Koleberes, 1927–1928 (Bartels 1931, Hoogerwerf 1948a, van Balen *et al.* 1999a) and at Brussel, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Tilu** at Ciwidey, Pangalengan and Gambung, 1908–1933 (five specimens in MZB; van Balen *et al.* 1999a) and at Riung Gunung and Gambung, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.*



The distribution of Javan Hawk-eagle *Spizaetus bartelsi*: (1) Ujung Kulon National Park; (2) Gunung Aseupan; (3) Gunung Karang; (4) Gunung Halimun National Park; (5) Jampang; (6) Gobang; (7) Gunung Masigit; (8) Gunung Salak; (9) Bogor; (10) Gunung Pancar; (11) Megamendung; (12) Gunung Gede-Pangrango National Park; (13) Telaga Warna; (14) Situ Patenggang; (15) Cimanggu; (16) Gunung Patuha; (17) Gunung Tilu; (18) Gunung Burangrang; (19) Gunung Melati; (20) Gunung Tangkuban Perahu; (21) Gunung Malabar; (22) Gunung Puntang; (23) Bukit Tunggul; (24) Gunung Papandayan; (25) Kawah Kamojang; (26) Gunung Guntur; (27) Gunung Cikuray; (28) Leuweung Sancang Wildlife Reserve; (29) Gunung Simpang; (30) Gunung Masigit-Karembi Hunting Park; (31) Gunung Tampomas; (32) Gunung Talaga Bodas; (33) Gunung Galunggung; (34) Gunung Jagat; (35) Gunung Sawal; (36) Gunung Segara; (37) Karanganyar; (38) Curug Cipendog; (39) Gunung Slamet; (40) Gunung Cupu/Simembut; (41) Linggoasri; (42) Gunung Lumpung; (43) Lebakbarang; (44) Gunung Kemulan; (45) Banaran; (46) Gunung Ungaran; (47) Gunung Merapi; (48) Gunung Muria; (49) Gunung Lawu; (50) Gunung Liman-Willis; (51) Gunung Kawi; (52) Balekambang; (53) Gunung Arjuno; (54) R. Soerjo Grand Forest Park; (55) Lebakharjo; (56) Gunung Bromo Tengger Semeru National Park; (57) Hyang Plateau; (58) Meru Betiri National Park; (59) Kalibaru; (60) Gunung Raung; (61) Gunung Ijen; (62) Alas Purwo National Park.

○ Historical (pre-1950) ● Recent (1980–present)

1999); **Gunung Burangrang** at Blok Komando, Curug Cijalu and Curug Cipurut, three pairs, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Melati**, Cikondang, Bandung, April 1909 (male in RMNH; also van Balen *et al.* 1999a; see Remarks 4); **Gunung Tangkuban Perahu** including at Panaruban (see Remarks 5) and Pangheotan, six pairs, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Malabar** at Citiis, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Puntang** at Seles, Muara and Curug Candung, two pairs, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Bukit Tunggul**, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999); **Gunung Papandayan** at Darajat, September 1987 (Meyburg *et al.* 1989, van Balen *et al.* 1999a; see Remarks 6), one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999), plus two pairs elsewhere, between April 1998 and June 1999 (Setiadi *et al.* 1999); **Kawah Kamojang**, July 1991 (H. Kobayashi *in litt.* 1992, van Balen *et al.* 1999a), one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999); **Gunung Guntur** at Danu Pangkalan, April 1922 (male in RMNH) and at Gunung Kancing, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Cikuray** at Cihurang, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Leuweung Sancang Wildlife Reserve**, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999); **Gunung Simpang** at Datar Pari, Cihanjawan, Cilamajang, Cisuren, Cigombong, Gunung Kuning, Cipacet and Keredut, six pairs, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Masigit-Kareumbi Hunting Park** (see Remarks 3) at Cikobet and Curug Kancana, two pairs, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Tampomas** at Narimbang and Puncak Manik, three pairs, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Talaga Bodas** at blocks T-21 and T-13, Garut, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Galunggung** at Cipanas, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Jagat** at Kiara Koneng, one pair, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); **Gunung Sawal** at Ciwalen and Curug Tujuh and Ciharus/Seda, four pairs, between April 1998 and June 1999 (Setiadi *et al.* 1999, YPAL *in litt.* 1999); ■ **Central Java Gunung Segara** above Gandoang at 500–600 m on south-south-east slope, Pembarisan mountains, July 1994 (Sözer and Nijman 1995a), December 1998 (Kutilang IBC *in litt.* 1999); **Karanganyar** (Bumiayu), 200 m, 15 km east of Gunung Segara, Pembarisan mountains, July 1994 (Sözer and Nijman 1995a); **Curug Cipendog**, December 1998 (Kutilang IBC *in litt.* 1999); **Gunung Slamet** (see van Balen *et al.* 1999a) on the north-west slopes at Guci, March 1994 (M. Linsley *in litt.* 1997) and December 1998 (Kutilang IBC *in litt.* 1999), at Pancuran Tujuh, c.600–940 m, May 1990 (R. Seitre *in litt.* 1990), April–September 1994 (Sözer and Nijman 1995a,b), December 1998 (Kutilang IBC *in litt.* 1999), and above Pekandangan, 1,300–2,200 m, north-west slope, June 1994 (Sözer and Nijman 1995a,b); **Gunung Cupu/Simembut** complex, May 1994 (van Balen *et al.* 1999a); Dieng Mountains (see van Balen *et al.* 1999a) at **Linggoasri**, c.600–700 m, August 1994 (Sözer and Nijman 1995a,b), with evidence of breeding in June 1995 and September 1998 to January 1999 (V. Nijman *in litt.* 1999), at **Gunung Lumpung**, 1,100 m, October 1998 (V. Nijman *in litt.* 1999), south of **Lebakbarang**, 800 m, December 1998 (V. Nijman *in litt.* 1999), on **Gunung Kemulan**, 900 m, December 1998 (V. Nijman *in litt.* 1999), at **Banaran**, 1,775 m above Bawang, west of Tretep on east slope of Gunung Prah, Kendal/Tegal counties, April 1994 (Sözer and Nijman 1995a,b); **Gunung Ungaran** above Gonoharjo, April–May 1994 (M. Linsley *in litt.* 1997, van Balen *et al.* 1999a), October 1998 (Kutilang IBC *in litt.* 1999); **Gunung Merapi** at Gunung Turgo, 1,150–1,250 m, Sleman, June 1994 (Sözer and Nijman 1995a,b, van Balen *et al.* 1999a), October 1998 (Kutilang IBC *in litt.* 1999), and at Gunung Plawangan, 1,275–1,300 m, Sleman, June 1994 (Sözer and Nijman 1995a,b, van Balen *et al.* 1999a), October 1998 (Kutilang IBC *in litt.* 1999); **Gunung Muria** (Muryo), Colo, Kudus, July 1995 (van Balen *et al.* 1999a); **Gunung Lawu**, Tawang Mangu,

Solo, November 1998 (Kutilang IBC *in litt.* 1999); ■ **East Java Gunung Liman-Wilis** at Sendang, 1,140 m, July 1995 (Sözer and Nijman 1995a,b), and in the Gunung Sigogor reserve, 1,300 m, July 1995 (van Balen *et al.* 1999a); **Gunung Kawi**, north slope above Coban Rondo, September 1997, north-east slope above Coban Manten at c.2,200 m, April 1993, and west slope at Dadapan, 1,100 m, May 1993 (van Balen *et al.* 1999a, SvB); **Balekambang** (recreation forest), Bantur, September/October 1997 (van Balen *et al.* 1999a, V. Nijman *in litt.* 1999); **Gunung Arjuno**, Pasuruan, November 1927 (Rozendaal 1981; male in AMNH), including Gunung Dorowati, April 1993 and at Trawas, Gunung Penanggungan, December 1992 (van Balen *et al.* 1999a); **R. Soerjo Grand Forest Park** (incorrectly “Ratu Suryo” in van Balen *et al.* 1999a, who made this a subsite of Arjuno), 1996–1997 (Astuti and Kumiawan 1997), including a pair at Wonosalam Jombang, 1998 (Astuti *et al.* undated); near **Lebakharjo** village at c.100 m, Lenggoso protection forest, October 1989 (van Balen 1990), with two inactive nests, 1997 (Astuti and Kumiawan 1997), and four birds, 1998 (Astuti *et al.* undated); **Gunung Bromo Tengger Semeru National Park**, at least eight birds, October–December 1998 (Astuti *et al.* undated); **Hyang Plateau**, Probolinggi, 1930s (Kooiman 1940, 1941, van Balen *et al.* 1999a); **Meru Betiri National Park** at Summersari, Permisari, Teluk Hijau and Sukamade, since 1975 (Rozendaal 1981, Thiollay and Meyburg 1988, Meyburg *et al.* 1989, Tobias and Phelps 1994, Astuti and Kumiawan 1997, van Balen *et al.* 1999a); near **Kalibaru**, Banyuwangi, December 1989 (van Balen 1991, van Balen *et al.* 1999a); **Gunung Raung**, 11 km north-west of Sempol, Banyuwangi, July 1990 (van Balen 1990, van Balen *et al.* 1999a); **Gunung Ijen** above Lijen at 800–900 m on the east slope, Banyuwangi, 1930s (Kooiman 1940, Hoogerwerf 1948a) and June 1990 (SvB); **Alas Purwo National Park** at Pasirputih and Sadengan, May 1990 (van Balen 1991) and November 1997 (van Balen *et al.* 1999a), and at Gua Istana, 1998 (Astuti *et al.* undated; see also Grantham *in press*).

Unconfirmed observations include: (West Java) Sukaesmi, Gunung Halu, south Bandung, April 1994 (T. Sibuea *per SvB*); (East Java) near Taman Hidup (this being a lake on the Hyang Plateau, mentioned above for East Java), July 1989 (SvB); Baluran National Park, Banyuwangi, July 1988 (*OBC Bull.* 7 [1988]: 34–40; withdrawn by K. D. Bishop *in litt.* 1992), October 1988 (van Balen 1991).

POPULATION Population estimates until very recently have been very low, based on the estimated size of individual territories divided into the amount of suitable habitat remaining. Thiollay and Meyburg (1988) estimated a territory or home range at 20–30 km², while Meyburg *et al.* (1989) considered that suboptimal habitat could impose a home range of 120 km². Extrapolation using some of these values (and assuming that the areas involved were non-overlapping) Meyburg *et al.* (1989) indicated a total global population of 50–60 pairs. Reworking these data and allowing for possible new areas, van Balen and Meyburg (1994) indicated 52–61 pairs with another possible 15–20 pairs from unsurveyed areas (i.e. 67–81 pairs in total). Building on this and following new fieldwork, Sözer and Nijman (1995) proposed a new total of 81–108 pairs, with a further 23–31 pairs in as yet unsurveyed fragments. Using the forest cover data for Java (see Threats) and assuming a non-overlapping average home range or territory size of 40 km², van Balen (1996a) indicated that 5,230 km² of forest (see first paragraph under Distribution) would support about 130 pairs of eagles, but adding that many forest patches that make up the total would be too small to hold pairs.

Subsequently some of these small forest patches have been found to hold one or more pairs (van Balen *et al.* 2000b), and other fieldworkers have suggested much lower densities than those used in the above calculations (see below). Despite this, however, observations at two sites (Gede and Dieng) have suggested that birds use home ranges in the order of 30–40 km², so that if it is assumed that these home ranges do not overlap, the density of the species will (at least in some areas) remain relatively low (V. Nijman verbally 2000). However, allowing slightly smaller home ranges, but continuing to take a precautionary review of the

situation, has yielded the figures in Table 1 (van Balen *et al.* 2000b), in which case 141–195 pairs are present on Java; indeed, Nijman *et al.* (2000) referred to their view that the “total world population of the species is currently... a maximum of c.200 pairs”.

The relatively precautionary nature of this last estimate (i.e. van Balen *et al.* 2000b), which itself is carried in a paper entitled “misconceptions about rarity and threat”, reviewing past underestimates and presumptions, is reflected in two ways. First, not every site for the species is included in Table 1 (as the authors readily admit), and if, for example, some of the new data from surveys around Bandung are added (see Distribution: results of Setiadi *et al.* 1999), then the total may increase by some 42 pairs. Second, the density values used may (at least in some cases) be at the lower end of the range of possibilities (see next paragraph).

In 1997 intensive studies on Gunung Halimun (which may, however, be atypically favourable) found six neighbouring territorial pairs within a linear distance of about 10 km, leading to the preliminary conclusion that in lower montane rainforest in West Java the species may live at a density of one pair per 5 km² (Rov *et al.* 1997). On Gunung Salak the distances between neighbouring nests proved to be c.2 km, and a radio-tracked adult male proved in the course of 1998 to have a home range of a mere 3 km²; on Gunung Gede-Pangrango a pair's home range was mapped as 5.3 km² (J. O. Gjershaug *in litt.* 1999). If the forest cover figures used by van Balen (1996a) are combined with a density value of a pair per 5 km², a total of just over 1,000 pairs of eagles may be estimated. However, in another initiative at Gede-Pangrango a conflation of evidence suggested that home ranges there might be c.12 km², yielding a population of some 15 pairs in the park (Nuraeni *et al.* 1999). If this value is applied to all Java, a total population of 436 pairs is derived; and indeed it is the informal view of the Halimun team that there are probably around 400 pairs of birds on Java (J. O. Gjershaug *in litt.* 1999). When van Balen *et al.* (2000b) extrapolated from their

	Area (km ²)	km to next block	Elevation range	Number of pairs
West Java				
Ujung Kulon	125	65	0–623 m	3–4
Gunung Aseupan	30	50	100–1,174 m	1–2
Gunung Karang	30	45	1,000–1,778 m	1–2
Gunung Halimun/Salak	500	15	400–2,211 m	16–25
Jampang	100	9	100–500 m	2–3
Gunung Gede-Pangrango	200	15	500–3,019 m	6–10
South Bandung	900	32	300–2,821 m	23–30
North Bandung	100	30	1,000–2,076 m	2–3
Central Java				
Pembarisan Mts	130	40	300–1,351 m	3–4
Gunung Slamet	150	45	700–3,418 m	4–5
Dieng Mts	250	45	250–2,565 m	6–8
Gunung Ungaran	75	37	1,000–2,050 m	2–3
Gunung Merapi/Merbabu	80	50	950–3,142 m	2–3
Gunung Muria	90	102	600–1,602 m	2–3
East Java				
Gunung Liman/Wilis	250	38	600–2,563 m	6–8
Gunung Kawi/Arjuno	500	20	300–2,886 m	13–17
Bantur/Lebakharjo	180	12	0–250 m	5–6
Bromo/Tengger/Semeru	200	20	800–3,676 m	5–7
Yang [Hyang] Highlands	100	22	1,125–3,088 m	2–3
Meru Betiri	500	2	0–1,223 m	13–17
Ijen/Raung/Maelang	830	2	100–3,332 m	21–28
Alas Purwo	160	35	0–360 m	3–4

Table 1. Population of the Javan Hawk-eagle in its major known forest blocks (all data from van Balen *et al.* 2000b).

141–195 pairs to allow for immatures, their total for the species was 600–900 birds (i.e. 282–390 breeding adults rounded to 300–400 multiplied by 2–2.25); on this basis 400 breeding pairs would reflect a total population of 1,600–1,800 birds. Nevertheless, at this stage it is appropriate to take the figures supplied by van Balen *et al.* (2000b) as those on which to assess the species's conservation status and on which to base further conservation action.

There are relatively few observations from before the 1980s, and evidence of a population decline is therefore difficult to give. However, the decreasing area of suitable habitat with an ongoing human population increase in the last 4–5 decades has undoubtedly had a negative impact (compare Figures 3 and 4 in Sözer and Nijman 1995a). Notwithstanding the presumed decline, most if not all historical localities appeared still to support the species in the 1980s, and more Javan Hawk-eagles and localities have been found in the past 10 years than ever before. However, this is clearly the effect of intensified and more directed observer activity and increased accessibility to formerly unexplored habitat, not an actual increase in the species's numbers. Given the evidence under Threats, it is most probable that the population has been in steady decline for many decades.

ECOLOGY *Habitat* The normal present-day habitat of the Javan Hawk-eagle is the inaccessible rugged primary tropical lowland evergreen and lower and upper rainforest, at 500–2,000 m (van Balen 1991, Sözer and Nijman 1995a, Rov *et al.* 1997). An early account indicated that it favours lower slopes at 200–1,200 m (Kuroda 1933–1936) and the claim that it ranges from sea-level as high as 3,000 m (MacKinnon and Phillipps 1993) seems to be based on an anomalous record of 3,000 m in Sody (1956); but in southern West Java it was recently found from sea-level to 2,500 m, with greatest numbers at 500–1,000 m (YPAL *in litt.* 1999). Whether it is less often found at lower altitudes owing to preference or to absence of habitat is not clear (see Distribution). In 1997 birds were also found to use secondary forest for both hunting and nesting, although extensive areas of primary forest were always close by and were doubtless necessary for breeding success (Rov *et al.* 1997). The presence of pairs breeding in production forest was, however, evidence that such areas are of some value (Rov *et al.* 1997). Although the range of this species appears to overlap mainly with areas of highest rainfall, territories may also be held in drier types of forest, such as the tropical semi-deciduous forest at Alas Purwo (van Balen 1991).

Food Although hunting in slow soaring flight close to the canopy has been observed (Sözer and Nijman 1995a), the Javan Hawk-eagle chiefly hunts from perches in small trees inside forest, where it mostly takes small to medium-sized arboreal mammals such as tree-shrews and squirrels but also fruit-bats, flying-lemurs, young monkeys and even (based on the smell of a museum skin) stink badger *Mydaus javanicus*; less often it takes birds, including pigeons and domestic fowl, and reptiles including snakes, lizards and chameleons (Hoogerwerf 1950b, Becking 1989, Rov *et al.* 1997, V. Nijman *in litt.* 1999, YPAL *in litt.* 1999; also Bartels 1931, P. Hurrell *in litt.* 1990). Food brought to nests consisted of 54 mammal prey, eight bird prey and two reptile prey (it was calculated that an eaglet requires 109–116 prey items between hatching and fledging); the majority of the mammal prey was composed of squirrels and tree-shrews, while the birds consisted mainly of ground-perching species (*Gallus*, *Turnix*, *Chalcophaps*, *Streptopelia*) and one cryptic tree-perching species (Javan Frogmouth *Batrachostomus javensis*) (Prawiradilaga *et al.* in press). Disturbance of nests of Lesser Adjutant *Leptoptilos javanicus* was thought to expose the eggs to predation by the species (Grantham in press). The relatively short second toe is evidence that this eagle is not adapted to catch birds in flight, and indeed birds with good powers of flight appear to be much less afraid of Javan Hawk-eagles than they are of falcons and accipiters (Mooney 1997). At Gunung Halimun the species readily enters secondary growth when hunting (D. Liley *in litt.* 1999). Most hunting activity appears to be in the mid- to late morning; in the breeding season this is the period in which most food transfers (male to female, parent to offspring) occur (V. Nijman *in litt.* 1999).

Breeding Always accepting that data from East Java are less complete and this drier region may impose a more synchronised regime, most egg-laying takes place in the first half of the year, from December–January to June–July (Bartels 1924, Hoogerwerf 1950b, Hellebrekers and Hoogerwerf 1967, van Balen and Rudyanto 1994, van Balen *et al.* 1994, Sözer and Nijman 1995a, Rov *et al.* 1997, Nijman *et al.* 2000). Courtship displays take place between March and September; copulations have been noted in the pre-incubation and incubation periods (Nijman *et al.* 2000); in southern West Java copulations have been seen in April–May and October–December, and may therefore occur year-round (YPAL *in litt.* 1999). Nests have been built in rasamala trees *Altingea excelsa* (Bartels 1924, van Balen *et al.* 1994, Sözer and Nijman 1995a, Rov *et al.* 1997, Nijman *et al.* 2000), and this appears to be the favoured nest-tree species (it is strongly dominant in West Javan forests: SvB); but oaks *Lithocarpus* and *Quercus*, pine *Pinus*, puspa *Schima wallichii*, riung anak *Castanopsis*, kitambaga, kibodas and *Eugenia cuprea* have also now been recorded (Rov *et al.* 1997, Nuraeni *et al.* 1999, YPAL *in litt.* 1999). Although some recent nests have been found close to edges and in patchworks of primary and disturbed habitats, with eagles tolerating a degree of human presence (see van Balen *et al.* 1994, in press, Sözer and Nijman 1995a), it seems that extensive primary forest needs to be close by for hunting purposes (Rov *et al.* 1997). Nest trees in Gede-Pangrango National Park, 1998, were long-stemmed (>25 m) and located on slopes, near a river and/or waterfall, 1,200–1,400 m (Nuraeni *et al.* 1999). Elsewhere it was noted that nest trees are commonly emergents, slightly isolated, with surrounding vegetation having five strata (Setiadi *et al.* 1999). A single egg is laid (Hellebrekers and Hoogerwerf 1967, Sözer and Nijman 1995a, van Balen 1996a). Incubation lasts 47 ± 1 days, and over 95% is by the female, while the male provides her with food (Nijman *et al.* 2000). In one account fledging takes place at 60–70 days (8–10 weeks), but fledged birds may stay around the nest for several months afterwards (Rov *et al.* 1997); in another it takes place at 11–12 weeks, and not only does the young remain within 100 m of the nest for at least two months but it may also stay with its parents for a year or more (Nijman *et al.* 2000). In one study an eaglet that fledged in mid-October had a home range for each of the first five months of life: 0.9 ha, 1.4 ha, 3.1 ha, 14.0 ha and 50.8 ha (Setiadi *et al.* 1999). There is evidence that pairs may be able to re-lay within the breeding season if a young bird dies or is taken (Rov *et al.* 1997), but otherwise pairs may not re-enter the breeding cycle for a full year or more (Bartels 1924, van Balen 1996a). Age of first breeding is estimated to be 3–4 years (Sözer and Nijman 1995a). The observation of eleven pairs, eight of them with single young, in late 1998, at Gede-Pangrango National Park, suggested a high (73%) breeding success and indicated that the park is still in good condition to support the species (Nuraeni *et al.* 1999).

Migration There is no true migration in this species, but birds evidently disperse across open country, given the number of very isolated forest patches in which the species survives: it is assumed that genetic interchange must be continuing for these populations to be viable (van Balen *et al.* 2000b).

THREATS The Javan Hawk-eagle is one of (now) four threatened members of the suite of 20 bird species that are entirely restricted to the “Java and Bali Forests Endemic Bird Area”, threats and conservation measures in which are profiled by Sujatnika *et al.* (1995) and Stattersfield *et al.* (1998). There are two chief threats to this species, habitat loss and trade.

Habitat loss Around 1980 there were only 2,590 km² of lowland forest and 2,640 km² of hill forest (total 5,230 km²) left in Java (MacKinnon *et al.* 1982). The area in question is certainly small and represents a massive decline from and fragmentation of the area of forest that is believed to have blanketed Java originally: in the lowlands 2% of the original vegetation cover is left, in the hills 22% and in the mountains 57% (FAO 1981–1982). Even the remaining areas are insecure, with many of the localities for the species in the hills and mountains being found within areas recently made available for development. Although geothermal projects

on Gunung Salak, Gunung Papandayan, Gunung Patuha, Gunung Talaga Bodas and Kawah Kamojang have little direct impact as the loss of habitat is small, the roads that provide access to these areas are likely to have serious long-term consequences in the form of illegal timber removal and poaching (SvB, YPAL *in litt.* 1999). Encroachment of agricultural activities along the edges of forest blocks, although proceeding slowly, similarly has a long-term cumulative effect (SvB). Some reserves important for Javan Hawk-eagles are inadequately protected and suffer from hunting and encroachment along the edges and cash-crop enclaves inside the areas; this particularly affects Ujung Kulon, Gunung Halimun, Gunung Simpang (protection forest) and Kawah Ijen/Ungup-ungup (van Balen 1996a, Setiadi *et al.* 1999, V. Nijman *in litt.* 1999, YPAL *in litt.* 1999), where the accumulated effects of small-scale damage can become serious (Mooney 1997). Moreover, most territories studied in 1997 were in production forests beyond park boundaries, and upgraded protection of these forests is urgent to protect them from clearance (Rov *et al.* 1997). Furthermore, key habitat in many places in the hills and mountains has recently been made available for development (Sözer *et al.* 1998); sometimes substantial patches of valuable habitat are cleared at once, as happened on the south-west slopes of Gunung Ijen, the north-west parts of Gunung Dieng, and in enclaves of parks such as Gunung Halimun and protection forest such as Gunung Simpang (van Balen 1996a). In Soerjo Grand Forest Park annual uncontrolled fires are becoming a serious threat, while at Lebakharjo the protected forest is being opened up for coffee (Astuti and Kumiawan 1997). Fire caused by draught and charcoal production is also a risk on mountains such as Masigit, Kareumbi, Patuha, Guntur, Talaga Bodas and Malabar (YPAL *in litt.* 1999). Gunung Merapi suffered a major volcanic explosion in February 2001, presumably causing significant mortality to wildlife and loss of forest habitat (Rudyanto *in litt.* 2001).

If birds are not good dispersers through heavily man-modified habitat, then there could be genetic isolation between the now highly fragmented pockets of habitat in which the species survives (SvB). Although short-distance dispersal may occur, such that hawk-eagles in adjacent fragments can soar between sites without difficulty, there is much less confidence that long-distance dispersal is possible. For this reason, the preservation of tracts of habitat in Central Java, where few nature reserves currently exist, is considered an essential investment in the long-term security of the species.

Trade The past decade has seen an increase in reports of Javan Hawk-eagles being offered for sale, notably in Jakarta markets (Thiollay and Meyburg 1988, Meyburg *et al.* 1989, Sözer and Nijman 1995a), and because the species builds traditional, obvious and locally well-known nests, it is easy to collect nestlings (van Balen 1996a). Surveys consistently show that 30–40 Javan Hawk-eagles are openly offered for sale in the bird markets of Java each year (Nursahid *et al.* 1997). These birds are, of course, the survivors: others must be expected to have died in the process of trapping and transport, and others still will have been sold undetected, so that (in a pessimistic view) quite possibly the number taken might equal the entire year's recruitment (Sözer and Nijman 1995a). The elevation of the Javan Hawk-eagle to status of national bird may have increased interest in its possession as a status symbol (Sözer and Nijman 1995a); staff of certain foreign embassies are also known to have acquired birds (van Balen 1996a). In the 1990s trade in the species appeared limited to Java, and in most cases it consisted of downy nestlings taken from nests, with smaller numbers of trapped immatures and adults (Mooney 1997). In November 1999 an adult bird was being offered for sale at Mataram, Lombok, for three times the normal price on Java, suggesting that the vendors were fully aware of the value of the animal (V. Nijman *in litt.* 2000).

MEASURES TAKEN This eagle has been the target of concerted attention in several quarters.

Legislation In 1970 the Javan Hawk-eagle (Elang Jawa), along with Indonesia's other diurnal raptors, was protected by statute, and since 1990 rare and endangered species have received extra protection: penalties can total fines equivalent to US\$50,000 and imprisonment

for up to five years (Mooney 1997, Nijman *et al.* 2000). The species is also listed on CITES Appendix II, which prohibits all international trade without a licence. In January 1993 it was declared the Republic of Indonesia's national bird, on account of its resemblance to the mythical Garuda (Widyastuti 1993).

Fieldwork Several surveys of the species have been conducted since 1986, some supported by the World Working Group on Birds of Prey and Owls, the BP Conservation Programme and BirdLife International (Thiollay and Meyburg 1988, Meyburg *et al.* 1989, van Balen 1991, van Balen and Meyburg 1994, Sozer and Nijman, 1995a,b, Setiadi *et al.* 1999), and several studies on various aspects of its biology have been undertaken (van Balen *et al.* 1994, Nijman and Sozer 1995a,b, 1996, 1998, Rov *et al.* 1997, Setiadi *et al.* 1999). Almost all historical and potentially suitable areas have been re-surveyed, with many of the former being reconfirmed and some new sites being found (SvB).

Protected areas An extensive network of nature reserves exists on Java, with the most important forest blocks included in Gunung Halimun, Gunung Gede-Pangrango and Meru Betiri National Parks, and other patches in protection forest such as at Gunungs Burangrang, Tangkuban Perahu and Simpang (YPAL *in litt.* 1999); other forested localities with protected areas include Gunung Papandayan Nature Reserve, Plawangan Turgo reserve, the Yang Highlands, R. Soerjo Grand Forest Park (with Arjuno Lalijiwa Nature Reserve), Meru Betiri National Park, Alas Purwo reserve and Kawah Ijen Merapi Ungup-ungup Nature Reserve (SvB; also Astuti and Kumiawan 1997). Despite this, many of these sites face problems (see Threats).

Control of trade In a registration programme, initially aimed at the Bali Starling *Leucopsar rothschildi* (see relevant account), but extended to all protected and endangered species, an inventory of these animals kept in captivity (or preserved and mounted) was made in the early 1990s; an as-yet unknown number of Java Hawk-eagles was retrieved (SvB). Although most eagles were registered, this actually made them semi-legal so the programme had the net effect of enhancing trade (SvB).

Action Plan An action plan now exists for the long-term conservation of the Javan Hawk-eagle (Sözer *et al.* 1998). In October 1996, in response to a call in van Balen (1996a), a Javan Hawk-eagle Conservation Working Group was formed to develop this plan (Rov *et al.* 1997), and has representatives from national and international NGOs, national and international research institutes, zoos and government organisations. A plan for the development of a protected area in the Dieng Mountains of Central Java was published and distributed, and a network established to develop and implement the plan (SvB). A small replanting programme to connect up Cibulao Nature Reserve with Telaga Warna Nature Reserve was undertaken in direct response to the action plan's assertion of the need to increase habitat availability for this species (KPB CIBA-Cianjur 1999).

Awareness campaign In 1999, BirdLife, JICA and LIPI produced a field identification guide for raptors, focusing on the Javan Hawk-eagle (SvB); and an eagle identification leaflet, called for chiefly as a means of controlling trade (van Balen 1996a), was also produced (Sözer *et al.* 1999). To introduce the Strategic Plan and Action Plan for the Dieng Mountains, roadshows were conducted in August–September (SvB). The Javan Hawk-eagle Conservation Working Group helped develop a network of local NGOs which can relate their activities to the cause of the eagle, raising awareness by many small-scale initiatives such as radio work, T-shirts, newspaper items, surveys, nest-watches, etc.; as a result there has been much interest shown at local government level (V. Nijman *in litt.* 1999; also Setiadi *et al.* 1999). The eagle's image now appears on stamps, telephone directories and billboards in Jakarta (van Balen 1996a).

MEASURES PROPOSED Sözer *et al.* (1998) identify the following subject areas in the recovery process. The first of these has been modified to accommodate suggestions on possible new protected areas.

Protected areas The single most important step for the conservation of the species would be the establishment of reserves in Central Java at Dieng mountains (Gunung Prah) and Gunung Slamet (as advocated by Nijman and Sözer 1996), but most importantly including the intervening lower-altitude forests, since these are subject to encroachment for agriculture, illegal logging and conversion to forest plantations (R. F. A. Grimmett *in litt.* 2000). The Dieng reserve should be dedicated to the eagle as Indonesia's national bird, just as the Komodo National Park is to the Komodo dragon *Varanus komodoensis*. Strengthening protection for a further 10 forest areas in Central Java is desirable for the long-term conservation of the species's habitat (Nijman and Sözer 1996). Control around all current reserves holding Javan Hawk-eagles should be increased by clearly marking boundaries, by education of local communities, and by a consistent, firm policy towards destructive intrusion (Mooney 1997); at least an increase in patrolling would be extremely beneficial (V. Nijman *in litt.* 1999). The following sites need to be considered for the establishment of reserves, extension of reserve area or other appropriate measure to ensure long-term natural forest conservation (FAO 1981–1982, Sujatnika and Jepson 1995, SvB): Gunung Asepun, which only retains a small recreation forest and no proposals exist; Gunung Karang, which has no current proposals for a nature reserve; Gunung Salak, which consists of protection forest between 1,000 and 2,211 m; Pegunungan Pembarisan, which has a proposed 130 km² nature reserve of hill forest between 300 and 1,351 m; Dieng Mountains, which have a proposed 250 km² wildlife reserve between 1,000 and 2,565 m; Gunung Slamet, which has a proposed 150 km² nature reserve between 1,000 and 3,418 m, including the tiny 2 ha reserve of Guci (FAO 1981–1982); Gunung Muria, which has a proposed 120 km² nature reserve between 600 and 1,600 m; Gunung Merapi, which has a proposed 150 km² recreation forest at 1,000–3,142 m (this would include a large amount of good forest on the eastern slopes, if not destroyed in the recent eruption: see Threats); Gunung Liman-Wilis, which has a proposed 450 km² wildlife reserve between 600 and 2,563 m, including the small reserve of Gunung Picis; Gunung Kawi/Kelud, which has a proposed 500 km² nature reserve between 300 and 2,886 m; Teluk Lenggoso (Lebakharjo), which has a proposed 160 km² nature reserve of lowland forest; Gunung Raung, for which a 600 km² nature reserve between 600 and 3,332 m is proposed; Maelang, for which a 700 km² nature reserve between 100 and 2,800 m is proposed; Gunung Bromo Tengger Semeru National Park, which requires expansion; and Gunung Simpang, which is a 150 km² protection forest (Sujatnika verbally 2000) on the southern slopes of Gunung Patuha, between 600 and 1,600 m (YPAL *in litt.* 1999).

Habitat improvement Rapid evaluation of production forests is needed to determine their relative value for eagles and how best to manage parts of them as protection forest using patches of natural forest and protection of nesting trees and their surroundings (N. Rov per R. Saryanthi *in litt.* 2000). The restoration of suboptimal habitat to the point where it can support eagles needs at least to be investigated. Plantations might in due course be modified through the use of corridors along watercourses (often part of good forest management practice) and elsewhere (Mooney 1997). The introduction of wooded buffer zones in protected areas, which are constantly losing their boundaries (even when well marked) to encroachment, might help conserve eagle habitat while providing for local needs (V. Nijman *in litt.* 1999).

Trade control It has been argued that a special PKA Bird Market Unit, well trained in wildlife identification and highly motivated, should be formed to visit bird markets at random and confiscate protected birds; and that repeat offenders should be prosecuted (Mooney 1997). Although the fact that PKA has to pay the costs of a prosecution before the trial begins has been judged a great disincentive (V. Nijman *in litt.* 1999), confiscation alone, if PKA were persistent, would probably be sufficient to undermine the market (R. F. A. Grimmett *in litt.* 2000); and although a good holding facility might be thought requisite for any programme of confiscations (V. Nijman *in litt.* 1999), birds should simply be released as soon as possible into the nearest suitable habitat, otherwise long-term holding operations

runs the risk of becoming a laundering mechanism (R. F. A. Grimmett *in litt.* 2000). There should certainly be a strict limit on the number of bird parks and zoos in Indonesia allowed to keep and exhibit the eagle (van Balen 1996a), but confiscated birds might be placed with some of them. These birds should be registered with PHPA as property of the state, and displayed with information about the eagle as the national bird (belonging to the visitor, not the zoo), as a target of forest conservation, and as illegal private property.

Publicity and education The launch of implementation phases in the Recovery Plan should be sources of publicity for the species. There is a plan to link Norwegian and Indonesian television for a film (N. Rov *per* R. Saryanthi *in litt.* 2000). The use of zoos as education platforms for the eagle is mentioned under the preceding heading. Local education campaigns around important reserves with eagles should seek to generate local pride and vigilance.

Biological research Despite some important work in the past decade, there has been no detailed study of the foods, breeding success and population dynamics of the species in different areas, seasons and habitats, so that it remains scientifically unproven which populations are, in fact, viable; there is also a need to clarify the ecology of the species in the relatively dry seasonal forests in the east of its range. Understanding such factors as food—the proportions at different seasons—and population dynamics—that is, the patterns of growth, longevity and mortality in populations in different circumstances—is essential to identifying the most appropriate management regimes. Targets itemised by van Balen (1996a) are: (1) home range size and optimal habitat studies, for better population estimates and baseline monitoring; (2) dispersal, to determine genetic isolation; and (3) breeding ecology and juvenile mortality, to determine recruitment rates. Data on population demography and dynamics might best be generated via postgraduate programmes with NGO support (Mooney 1997). Radio telemetry will help determine sizes of and overlap between home ranges, and adult survival; satellite-tracking would determine juvenile survival, dispersal patterns and distances, and reveal levels of genetic interchange (Mooney 1997, N. Rov *per* R. Saryanthi *in litt.* 2000). Monitoring (e.g. using counts of displaying birds) should establish indices of abundance between areas and times rather than attempting absolute values (Mooney 1997). All protected areas with a management unit should conduct surveys to identify nests, and then allocate resources to monitor and guard them (van Balen 1996a). (Despite the foregoing, site conservation remains the primary measure now needed, and no postponement of such activity should occur on the pretext of the need for further biological research.)

Survey and monitoring Confirmation of the eagle's presence is needed at Segara Anakan/Nusa Kambangan. All sites of significance for its conservation need to be registered in BirdLife's forthcoming Important Bird Area programme for Indonesia.

Captive breeding and rehabilitation In May 1996 a "Population and habitat viability assessment" was conducted on the species (Manansang *et al.* 1996). Despite a BirdLife statement pointing out five action points, none of which referred to or required captive management (P. Jepson *in* Manansang *et al.* 1996:131), this assessment made several assumptions (e.g. that there are three separate populations, in West, Central and East Java, that the number of birds counted at a site represents the number of birds present, and that the "survival [of individuals] in captivity is nearly guaranteed") which duly led to the recommendation to establish a captive breeding programme requiring a minimum of 20 pairs at two sites, with the highest initial priority being placed on sexing captive birds by laparoscopy (Manansang *et al.* 1996). Apart from noting that this laparoscopy caused the deaths of at least four of eight Javan Hawk-eagles examined (V. Nijman verbally 2000), which is scarcely consistent with the notion that captivity nearly guarantees survival, it needs to be stressed that captive breeding is currently irrelevant to the conservation of the eagle (see Sözer *et al.* 1998:21).

REMARKS (1) The Javan Hawk-eagle is one of a group of rainforest raptors in the genus *Spizaetus* in South-East Asia. Although given taxonomic standing in 1924 (Stresemann 1924),

because of the rarity of specimens in collections and the variability in plumages of *Spizaetus* eagles with age it was not recognised as a full species endemic to Java until 1953 (Amadon 1953; see also Finsch 1908, Nijman and Sözer 1998). It probably forms a superspecies with (i.e. is most closely related to) *S. alboniger*, *S. lanceolatus*, *S. nipalensis* and *S. philippensis* (Stresemann and Amadon 1979). (2) Van Balen *et al.* (1999a) excluded certain published and unpublished records of this species, which is easily confused with several other raptors on Java (see Nijman and Sözer 1998, van Balen *et al.* 1999b). The records they excluded are also excluded here; however, there are other records included here which have not been subject to scrutiny or independent consideration. (3) Gunung Masigit and Gunung Masigit-Kareumbi Hunting Park, although both in West Java, are two entirely different localities. (4) Gunung Melati was treated as a subsite of Gunung Tangkuban Perahu by van Balen *et al.* (1999a), but it is better treated as a separate entity. (5) Panaruban was treated as a site on Gunung Tangkuban Perahu by van Balen *et al.* (1999a); it is clear that Tangkuban Perahu and Burangrang are very close together. (6) Darajat was treated as a separate entity from Gunung Papandayan by Setiadi *et al.* (1999).