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# Distribution and conservation of the Javan Hawk-eagle *Spizaetus bartelsi*

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## Summary

The Javan Hawk-eagle *Spizaetus bartelsi* is endemic to the island of Java. Severe habitat fragmentation and small population size, aggravated by illegal hunting have put this rainforest species on the list of threatened bird species. Intensive searching since 1986 resulted in the discovery of a large number of localities additional to the historic ones. All known locality records of Javan Hawk-eagle have been scrutinized and are listed in the present paper. Confirmed post-1980 records are from 24 forest fragments of varying sizes: 10 (including 28 discrete localities) in west, seven (including 14 discrete localities) in central and seven (including 20 discrete localities) in east Java. The configuration of available habitat in forest clusters is evaluated. The co-existence with other threatened bird taxa, and the need for further field surveys and studies of the Javan Hawk-eagle are discussed.

## Ringkasan

Elang Jawa *Spizaetus bartelsi* adalah sejenis burung pemangsa yang endemik di Pulau Jawa. Penghuni hutan lebat ini dimasukkan ke Daftar Burung yang Terancam Punah karena populasinya yang kecil dan habitatnya yang makin sedikit. Survai-survai intensif sejak tahun 1986 menghasilkan sejumlah lokasi baru sebagai tambahan dari lokasi penemuan yang sudah diketahui sejak dahulu. Semua lokasi Elang Jawa diperiksa dan didaftarkan oleh kami. Semua lokasi pasca-1980 yang dapat kami pastikan berasal dari 24 blok hutan yang bervariasi ukurannya: 10 areal (termasuk 28 lokasi) di Jawa Barat, 7 areal (termasuk 14 lokasi) di Jawa Tengah dan 7 areal (termasuk 20 lokasi) di Jawa Timur. Pengelompokan dan penyusunan kantung-kantung hutan habitat Elang Jawa akan kami evaluasi. Keberadaan jenis-jenis burung lain yang terancam punah, dan perlunya survei-survei lanjutan serta studi lapangan mengenai berbagai aspek biologi Elang Jawa akan kami diskusikan.

## Introduction

The Java Hawk-eagle *Spizaetus bartelsi* is a little-known eagle, endemic to the scattered rainforests of Java. Continuing deterioration of Java's forests is bringing this and many other forest birds closer to extinction. On account of loss, degradation and fragmentation of natural forests, and its small population size, the Javan Hawk-eagle has been given the IUCN status Endangered (Collar *et al.* 1994).

Java is important for global bird preservation; both in terms of species richness,

level of endemism and degree of threat the island scores highly. Indonesia is one of the World's centres of global bird endemism (ICBP 1992). The forests on Java (and Bali) have been recognized as one of two Javan Endemic Bird Areas (EBAs), i.e. an area with two or more restricted-range species occurring in it, the other being the Javan coastal zone (Sujatnika *et al.* 1995). The Java and Bali forest EBA is listed as "critical" in the conservation priority listing of Endemic Bird Areas. It contains 38 restricted-range species, 25 species being confined to it (Sujatnika *et al.* 1995). Java and Bali furthermore harbour 19 threatened bird species, while one, Javan Lapwing *Vanellus macropterus* is almost certainly already extinct (Collar *et al.* 1994).

In setting priorities for bird conservation, both the Endemic Bird Area approach and the threatened species approach are in practice through the identification of Important Bird Areas (IBAs), i.e. sites supporting (a) globally threatened species, (b) restricted-range species, (c) important congregations of seabirds and/or waterfowl, or (d) bird communities characteristic of and restricted to avifaunal zones or biomes which lack EBAs (see Evans 1994). As the top avian predator in the Javan forest ecosystem, Javan Hawk-eagles can be used as an indicator species for relatively undisturbed environments. By virtue of its endemicity, its habitat and breeding requirements, and its conservation status, the Javan Hawk-eagle is an important species in identifying IBAs.

International attention to the plight of the eagle was more or less instigated by the species nomination as Indonesia's flagship species for rare animals (Widyastuti 1993). Indonesian authorities (Indonesian Institute of Sciences; Ministry of Forestry; Ministry of State for the Environment) and non-governmental organizations have been assisted in separate initiatives in their efforts to save the eagle and conduct cooperative research projects by the Norwegian research institute NINA (N. Røv and J.O. Gjershaug verbally), the Japanese Society for Research of the Golden Eagle (T. Yamazaki verbally), Environment Australia (N. Mooney verbally) and the predominantly North American IUCN/CBSG (Manansang *et al.* 1997). Many local survey reports have appeared, some of which were specialized Javan Hawk-eagle surveys, but too often without substantiation of the field sightings. For the conservation of the species management and gazettement of reserves it is of utmost importance that the distribution and ecological range of this eagle is adequately mapped. Therefore this report seeks to make a comprehensive inventory of existing Javan Hawk-eagle habitat by assembling and scrutinizing all existing reports.

## Methods

The best method to assess the presence of Javan Hawk-eagle is to find vantage points, i.e. on hill tops, along ridges, in forest openings and along forest edges, and search the sky and canopy on days with fine weather. Especially in the late morning, typically between 09h00 and 12h00, birds can be seen soaring and displaying in these places. Calls are another clue to their presence and with some practice they can be recognized with confidence (Nijman and Sözer 1998).

Field observations were made in the framework of a general study on forest birds on Java in 1980–1981 and 1984–1997 (SvB); and during specialized surveys in March–September 1994 (VN, RS), June–July 1995 (VN, SvB), August–Sep-

tember 1997 (VN), May–June 1998 (RS), and September 1998–January 1999 (VN). Additional data come from museum specimens stored in the Leiden (RMNH, The Netherlands), Bogor (MZB, Indonesia) and Washington, D.C. (USNM, U.S.A.) museums; and from published as well as unpublished field observations of Javan Hawk-eagles. Published records from Cirebon (Kuroda 1936) and Baluran NP (K.D. Bishop in Robson 1988) have been omitted by us because of inadequate descriptions of the observed birds and/or evident confusion with other raptor species. Highly unlikely observations, such as four pairs on the 528-ha offshore island of Sanghiang (Sunda Strait), or one pair at the artificial lake of Kedungombo (C Java), with no forest in the wide surroundings (Manansang *et al.* 1997), have been discarded. Less doubtful localities were evaluated after descriptions had been solicited from the observers. Especially the possible confusion with resembling crested species such as Rufous-bellied Eagle *Hieraaetus kieneri* and Crested Honey-buzzard *Pernis ptilorhynchus* (see van Balen *et al.* 1999) had to be ruled out. In other cases the expertise and reliability of the observer alone was considered sufficient to warrant inclusion.

## Results

### *Localities*

In the following paragraphs all localities are listed from where Javan Hawk-eagles have been recorded since the beginning of this century. Indicated protection status of the areas follows MacKinnon *et al.* (1982), which is found on maps produced by RePPProT (1990) and, largely unaltered, adopted by Whitten *et al.* (1996). In Figure 1 all localities records are mapped.

### *West Java*

1. *Ujung Kulon National Park* Despite intensive ornithological surveys, until recently almost exclusively undertaken in the 30,000-ha peninsula comprising this reserve, no Javan Hawk-eagles were seen (Hoogerwerf 1948, 1969–1971, SvB unpublished data 1986–1989). In June 1994 during a brief survey a single adult was seen flying over forest in the northern part of the isthmus that connects the peninsula to the mainland part (Mt Honje) of the park (RS). In August–September 1997 N. Røv *et al.* (in Sözer *et al.* 1998) recorded two neighbouring pairs on Mt Honje. Ujung Kulon NP embraces more than 75,000 ha area of old secondary lowland forest, with primary forest in the higher parts. The peninsula and isthmus are relatively secure from logging and encroachment, but the mainland part is threatened by surrounding cultivation.

2. *Mt Aseupan* A single adult was seen in June 1991 (P. Heath *in litt.* 1992) and a single bird in September 1997 in the lowland forest above the Curug Gendang waterfalls above Carita Beach (VN). The area belongs to a 95-ha tourist resort but is adjacent to a larger, heavily disturbed lowland forest of several thousand hectares rising up to 1,174 m.

Unconfirmed sightings were made in 1995 in the Rawa Danau Nature Reserve, *c.* 7 km to the north (Manansang *et al.* 1997).

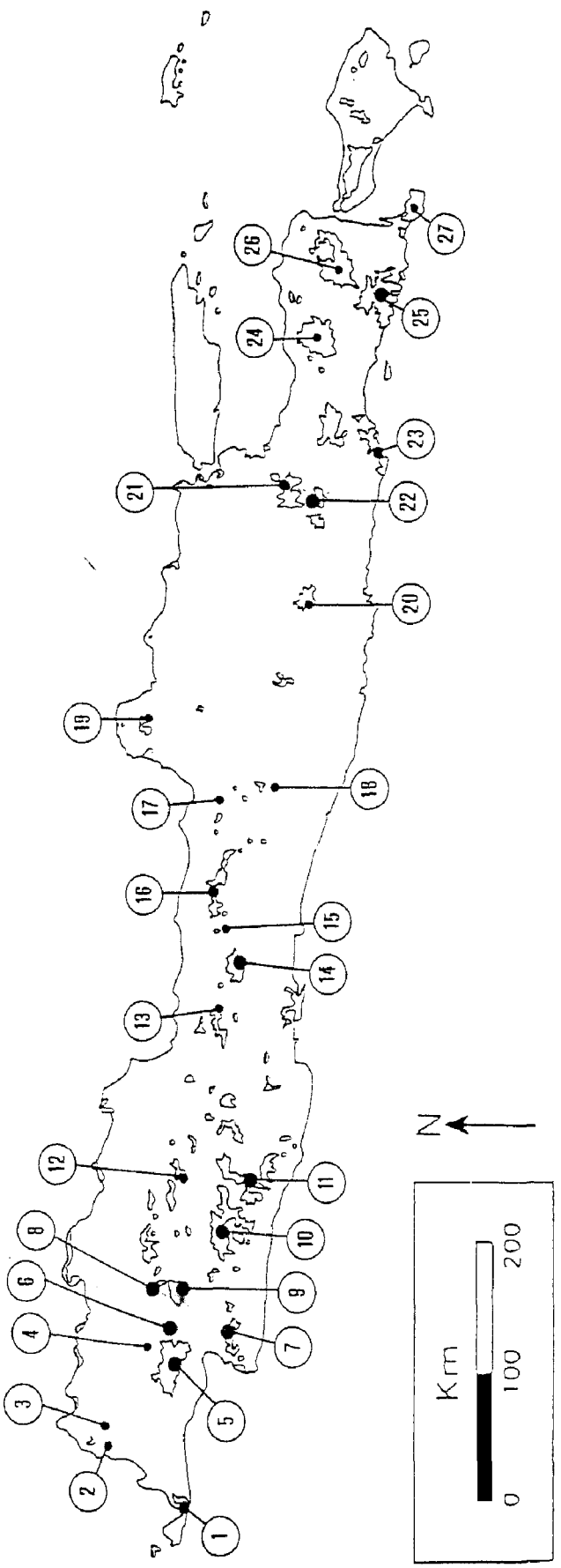


Figure 1. Localities of Javan Hawk-eagle in Java. Numbers refer to those in the text. Remaining forest areas have been outlined. Small dots: 1–2 records; medium dots: 3–5 records; large dots: >5 records.

3. *Mt Karang* Robinson and Kloss (1924) did not collect the species from this area, where they stayed two weeks in April 1920. During a four-day survey in April 1995 a juvenile was seen on the southern slope and an adult on the eastern slope (SvB). Mt Karang (1,778 m) is a protection forest of *c.* 3,000 ha managed commercially by the forestry department; rainforest below 1,000 m has been converted entirely to mahogany plantations, orchards, paddy fields and village gardens. The area has formed an isolated forest complex since at least the beginning of this century.

4. *Gobang* G.F. Mees (1946–1949, unpubl. data, *in litt.* 1995) reported repeated observation of a single (most likely the same) juvenile bird in February and August 1948; the bird frequented a ladang and forest edge on Gunung Pengangkang, where presently no extensive rain forest is extant.

5. *Mt Halimun* Although this area was visited twice by M. Bartels in 1922–1925, first sightings from this area date from as recently as the mid-1980s. Since then Javan Hawk-eagles have been seen regularly at various localities, i.e., around the Nirmala tea estate where subadults and adults were seen soaring during various visits between 1986 and 1989 (e.g. Thiollay and Meyburg 1988, van Balen 1991); Cikotok, with sightings in 1994–1995 (D. Liley verbally, SvB); and six territorial pairs within a linear distance of *c.* 10 km at Ciptarasa in the south-west corner of the mountain (N. Røv *et al.* in Sözer *et al.* 1998). The area covers lowland and hill forest from 500 to 1,929 m and is largely enclosed in the 40,000 ha of Mt Halimun NP, although especially in the western part important lowland forests are present outside the park boundaries (Whitten *et al.* 1996). Encroachments from surrounding agriculture and large tea estate enclaves, illicit logging, hunting and illegal gold mining form major threats to the forest (FAO 1978).

6. *Mt Salak* Javan Hawk-eagle was seen once at the Ciomas tea estate on the northern slopes by Hoogerwerf (1948). In the mid-1980s P. Andrew (*in litt.* 1992) saw the eagle on the southern slopes. Hernowo (1997) reported a single adult in March 1996 at Awibengkok on the south-west slope of the mountain. Immatures were seen in April 1981 above Cidahu on the southeast slope, and in October 1986 above Gunung Bunder (Pasirreungit) on the northern slope (SvB). In September–October 1987 single immatures seen above Sukamantri on the north-east slope (SvB); at the same general locality breeding was reported in 1997 at Loji where a fledgling was seen near its nest; at Bobojong where an active nest was under observation from July until October; and at Citiis a single bird seen in November 1997 (Hapsoro *et al.* in Sözer *et al.* 1998). Mt Salak is a volcano 2,211 m high, well vegetated above 1,000 m. Encroachment by agriculture and various projects (geothermal generator, development for tourism) impinge on its integrity. The forest has the status of protection forest.

7. *Jampang* Four birds were collected in Cibutun, Sukamaju and Jampang Kulon by Bartels in 1927–1928. A single immature was seen perched in a tree overlooking the valley south-east of Pelabuhanratu in April 1983 (P. Andrew *in litt.* 1995). More recent records are from Ciracap, where an old nest was reported in July 1997; and Cigaru where a bird was seen in September 1997 (Hapsoro *et al.*

in Sözer *et al.* 1998). Forest in this area has the status of protection forest and is broken into several small blocks and a larger one in a rugged area of this scarcely populated region. In the flat peripheries of this area the Cibanteng Nature Reserve and the adjacent Cikepuh Wildlife Reserve (together little more than 8,500 ha) are established; from here no Javan Hawk-eagle records are known. Unconfirmed sightings were made in 1991 in the tiny Sukawayana Nature Reserve on the coast west of Pelabuhanratu (Manansang *et al.* 1997).

*8. Megamendung and Puncak* During regular surveys in 1981–1998 single birds were observed at Megamendung and Telaga Warna (Ciloto) (van Balen 1988, A. Supriatna, unpubl. data 1997–1998). Single juvenile birds were seen in October 1986 and December 1991 on Mt Pancar (Meyburg *et al.* 1989, SvB). Breeding was noted at Cibulau, both in June–September 1997 and December 1997 (T. Yamazaki, A. Supriatna and I. Setiawan verbally; SvB, VN). The Telaga Warna area forms a 350-ha nature reserve, but the remaining part of the area is greatly threatened by encroachment of tea estates and holiday resorts. Mt Pancar is a somewhat isolated hill, 800 m high, with moderately disturbed forest above 600 m.

*9. Mts Gede and Pangrango* First record from the area is a female collected on Mt Gede by E. Prillwitz in August 1898 (Amadon 1953). The type locality of the Javan Hawk-eagle is found on the south-west slope of the complex, above Pasir Datar, where subsequently another six specimens and one egg were collected by M. Bartels and his sons (specimens in RMNH). Another nest was recorded in the first half of this century, *c.* 25 km east of the mountain complex, near Gunung Masigit (H. Bartels verbally 1995), but no extensive forest survives here nowadays. On the northern slopes a single bird was collected in the Gunung Mas tea estate in 1922 (specimen in MZB). Above Cisarua on the north-western slope a single bird was seen in June 1994 (Sözer *et al.* 1998). From the area above Cibodas on the north-eastern slope Javan Hawk-eagles were reported by a large number of visiting birdwatchers (e.g. Delsman 1926, Hoogerwerf 1950, Andrew 1985); here an active nest was found in 1992 (van Balen *et al.* 1994). Another active nest was under observation in 1994 at Pasir Pogor on the western slope (Nijman *et al.* in press). A pair with their young was seen in July–August 1986 above Selabintana on the southern slope (Meyburg *et al.* 1989). Although virtually the entire area is within the 15,000-ha Gunung Gede Pangrango National Park, ranging from 500 to 3,019 m, encroachment from surrounding agriculture, hunting, and the effects of *c.* 30,000 visitors annually impose continuous threats.

*10. Mts Patuha and Tilu* Specimens originating from Ciwidey (single juvenile in May 1928; shot on a tennis lawn), Gambung on Mt Tilu (three juveniles in 1908–1931), Lake Pangkalan (single male in 1922) and Pangalengan (single male in 1933) are stored in RMNH and MZB. Bartels (1931) mentioned the occurrence of two pairs on the southern slopes of Mt Patuha above Koleberes in 1927–1929. Apart from an unconfirmed sighting at Gunung Halu in the west (T. Sibuea verbally), no subsequent observations have been made of the eagle, but its survival is very likely as forest cover is still extensive. A number of nature reserves exist in the area, the most important of which are Mt Tilu (8,000 ha) and Mt

Simpang (15,000 ha); one nature reserve has been proposed: Mt Masigit (23,000 ha), ranging from 1000 to 2,078 m.

*11. Mt Papandayan and Kawah Kamojang* A juvenile caught under a house at Cikajang (Garut), was erroneously identified by Sody (1920) as Changeable Hawk-eagle *Spizaetus cirrhatus* (see Becking 1989). Recent observations are of a single bird in the Kawah Kamojang reserve (H. Kobayashi *in litt.* 1992) and two single immatures above Darajat on Mt Papandayan in September 1987 (SvB). The nature reserves and tourist forests of Mt Papandayan and Kawah Kamojang comprise 844 ha and 8,000 ha of mountain forest, respectively; three wildlife reserves have been proposed: Mt Kencana (25,000 ha), Cimapang (1,500 ha) and Gunung Limbang (20,000 ha), ranging from 300 to 2,182 m.

Unconfirmed sightings were made in 1995 in the Leuweungsancang Nature Reserve along the coast south, and Gunung Sawal Wildlife Reserve, *c.* 35 km to the east (Manansang *et al.* 1997).

*12. Mts Tangkubanperahu and Burangrang* A single male originating from Gunung Melati (Cikondang) is stored in MZB. P. Andrew (*in litt.* 1992) reported Javan Hawk-eagle for Situ Lembang in the mid-1980s. In May 1998 Javan Hawk-eagles were observed at Panaruban on the northern slopes of Mt Burangrang (RS). The forests north of Bandung are heavily fragmented, totalling less than 5,000 ha included in five reserves and tourist forests ranging from 1,400 to 2,076 m. Unconfirmed sightings were in 1995 on Mt Tampomas, 10 km to the east (Manansang *et al.* 1997)

*Central Java*

*13. Pembarisan Mountains* During a two-day visit in July 1994 two Javan Hawk-eagles were heard above the village of Gandoang on the southern slopes of one of the taller mountains in the area, locally known as Mt Segara (Sözer and Nijman 1995b). The area is underexplored, but probably substantial tracts of lowland and hill rain forest remain; *c.* 13,000 ha of this is proposed as a nature reserve. To the south the area is bordered by extensive pine *Pinus merkusii* plantations, while extensive teak *Tectona grandis* forests border the area to the east.

*14. Mt Slamet* Between 1990 and 1998 pairs and juvenile Javan Hawk-eagles were reported from the forest of the tourist resort Pancuran Tujuh (above Baturaden) on the southern slope (Seitre and Seitre 1990, M.D. Linsley verbally 1994, Sözer and Nijman 1995b, I. Setiawan verbally 1998). In June 1994 a displaying pair was seen above a teak-covered hill near Karanganyar, in cultivated land along the main road between Tegal and Purwokerto and several kilometres from small scattered patches of natural forest on the western slope of Mt Slamet. On the north-western slopes several Javan Hawk-eagles were seen in June 1994 above Pekandangan on the north-western slope of the same mountain (Sözer and Nijman 1995b), and a single bird in March 1994 near Guci (M. Linsley *in litt.* 1997). At 3,418 m, Mt Slamet is Java's second-highest mountain. On the wetter southern slopes extensive forest remains down to 700 m, while on the north-

western slope forest remains above the 1,200 m contour. The eastern slope is more cultivated and forest has disappeared below 1,900 m. Currently the forest above 1,000 m on Mt Slamet is a proposed nature reserve of 15,000 ha.

*15. Mts Cupu and Simembut* On the hills of the Cupu and Simembut forest complex, between Mt Slamet and the Dieng Mountains, a single bird was observed in May 1994 in a small fragment of forest (M.D. Linsley *in litt.* 1997). Small fragments of natural forest remain here, at 350–1,000 m, surrounded by either open ground or pine plantations.

*16. Dieng Mountains* Javan Hawk-eagles have been recorded throughout the area: a single adult on the eastern slopes of Mt Prahu in August 1994; adults and juveniles near Linggo during three visits between 1994 and 1999; a single adult near Lebakbarang in December 1998; a single bird near Mt Kemulan in January 1999 (SvB, VN, RS). The mountains north and north-west of the Dieng plateau are still covered with an extensive block of natural forest covering the total range from lowland to montane. On the northern foothills of Mt Lumping above Linggoasri, the forest (partly a former coffee plantation abandoned in the 1930s) extends down to *c.* 300 m, while the eastern slopes of Mt Prahu are forested only above 1,500 m. The forest totals 25,500 ha. Currently the area below 1,000 m is unprotected forest managed by the Indonesian Forestry Service; the area above 1,000 m is protected forest and proposed as a reserve. Main threats to the area are planned logging of the lowland forest near Linggoasri and its conversion to rubber *Hevea brasiliensis*, pine or damar *Agathis dammara* plantations (Nijman and van Balen 1998).

*17. Mt Ungaran* In April–May 1994 M. Linsley (*in litt.* 1997) observed daily a pair of Javan Hawk-eagles above Gonoharjo (Limbangan district) on the north-western slopes of Mt Ungaran. This small isolated volcano near Semarang is covered with good forest only above *c.* 1,500 m; a *c.* 5,500-ha area is proposed as a nature reserve.

*18. Mts Merapi and Merbabu* The southern slopes of Mt Merapi, above Kaliurang, were surveyed for four days in June 1994, and in September 1995; single Javan Hawk-eagles were heard and seen on Mts Plawangan and Turgo (VN). A four-month-old juvenile from the surroundings of Deles on the eastern mountain slopes was kept in a cage at Kaliurang, and Javan Hawk-eagle may still occur at Bebeng in the south-east (Rudyanto verbally 1995). Mt Merapi is one of Java's most active volcanoes. At the beginning of 1994 the southern slopes with the 230 ha Plawangan Turgo nature reserve/recreation park, were still well forested above 900. In November 1994 parts of these were devastated by an eruption, whilst most of the forest on the eastern slopes escaped. The northern slopes have long been deforested whereas the western slopes are constrained by a permanent outflow of lava. On the southern slopes of Mt Merbabu there appears to be no natural forest left; *c.* 15,000 ha of forests on these twin volcanoes are proposed as a nature reserve.

*19. Mt Muriah* The south-eastern and eastern part of this mountain complex, near Colo, was visited for two days in August 1994, and four days in July 1995;

during the second visit an adult and a juvenile were seen at 1,400 m (VN, SvB). The peaks of this dormant volcano on Java's north coast are covered with mostly secondary forest from 600–1,602 m. The lower, central parts of the complex are cultivated. The forests on Mt Muriah are proposed as a nature reserve of 12,000 ha.

*East Java*

20. *Mts Liman and Wilis* The south-eastern part, north-west of Sendang, was surveyed for two days in September 1994 and a five-day visit was paid to the western (east of Ngebel) and northern parts in July 1995. Calls of Javan Hawk-eagle were heard above Sendang on the southern slope of Mt Wilis (Sözer and Nijman 1995a), and in the Gunung Sigogor Nature Reserve (VN, SvB). The mountain complex comprises four summits of which Liman is the higher (2,563 m). Forest fires occur regularly and large parts of the area are covered with shrubs and small trees and sparse fire-climax cemara *Casuarina junghuhniana* forest on the upper slopes. The lower south-eastern slopes of Mt Wilis are still well forested, while elsewhere scattered patches of forest remain amidst secondary forest, regrowth, bushes and plantations. The forests on Mt Wilis are a proposed 25,000-ha large game reserve, whilst two small areas, Gunung Sigogor (190 ha) and Picis (28 ha), have long been gazetted nature reserves.

21. *Mt Arjuno* Wallace (1869) collected in the north-west parts but missed Javan Hawk-eagle, whereas in 1927 a single bird was taken by J.J. Menden on Mt Arjuno (specimen in USNM). In April 1993 a single subadult was seen on Mt Dorowati, a southern foothill (SvB). Six birds – including a pair and immatures – were observed in the Ratu Suryo Grand Forest Park in July 1997 (KSBK Malang, I. Setiawan and N. Mooney in Sözer *et al.* 1998) and in November 1998 (VN). A single juvenile was seen at Trawas in December 1992 in a kapok *Ceiba pentandra* plantation adjacent to lowland forest on the southern slopes of the Mt Penanggungan, a northern foothill of Mt Arjuno (SvB). The Arjuno Lalijiwo Nature Reserve covers 5,000 ha of mainly montane forest ranging from 1,500 to 3,339 m. The Mt Penanggungan is a 1,653-m high mountain covered with disturbed forest from *c.* 600 m to its summit.

22. *Mts Kawi and Kelud* In April 1993 single birds and pairs were seen above Dadapan and Coban Manten on the western and north-eastern slopes, respectively, of Mt Kawi (SvB). Subsequently an adult was seen in September 1997 above Coban Rondo on the northern slope (VN). The Mt Kawi area is presently a mosaic of partly regenerating former coffee plantations and partly degraded lowland, hill and montane forest in varying degrees of disturbance (Smiet 1992). The 50,000 ha Gunung Kawi Kelud (300–2,806 m) area is a proposed nature reserve.

23. *Bantur and Lebakharjo* No specialized ornithological surveys had been made in these areas until October 1989 when, during a four-day survey, a juvenile was seen in the forest edge near the village of Lebakharjo (SvB). In September 1997

two adults were observed soaring above the Balekambang Recreation Forest, south of Bantur (VN). The Lebakharjo (also known as Teluk Lenggosono) and Bantur forests, respectively covering 13,000 and 5,000 ha, have been gazetted as proposed reserves (Bekkering and Kucera 1990, Whitten *et al.* 1996). Only a few hundred hectares of forest near Balekambang receive protection as a recreation forest. Wood-cutting and hunting form major threats (MacKinnon *et al.* 1982), while plans have been put forward for forest plantations and/or rattan estates. The area is separated by plantations, secondary forests and a few roads from the 57,000 ha Bromo Tengger Semeru National Park.

24. *Yang Highland* Kooiman (1940, 1941) described a mounted juvenile bird in possession of the reserve manager. A possible sighting was made of a single bird near the Taman Hidup lake on the west slope in July 1989 (SvB). The Yang Highlands are partially enclosed in the 14,145 ha Yang Plateau Wildlife Reserve. Threats to the area include poaching, burning of the grasslands and use of the area for military exercises (MacKinnon *et al.* 1982). The Yang Highlands, i.e. the wildlife reserve and the surrounding podocarp forest (mostly under the jurisdiction of the Indonesian Forestry Service), have great potential as a national park if especially the higher parts are properly managed (Whitten *et al.* 1996).

25. *Meru Betiri National Park* Javan Hawk-eagle has been recorded regularly from at least four different localities (i.e. Sumbersari, Permisan, Teluk Hijau and Sukamade) in the eastern half of the park since the mid-1970s (H. Bartels verbally 1984, Thiollay and Meyburg 1988, Meyburg *et al.* 1989, van Balen 1991, J. Tobias and L. Phelps *in litt.* 1994). In December 1989 an immature was seen above secondary forest west of Kalibaru, between the southern foothills of Mt Raung and the northern boundary of the park (SvB). The 50,000 ha lowland forest ranging from sea-level to 1,223 m has the status of national park; it is the last area in which the Javan tiger persisted (MacKinnon *et al.* 1982). The former coffee plantation enclave is presently being abandoned, but encroachment in particular from the north keep threatening the integrity of this important area. The national park is separated from the Ijen Highlands by a relatively narrow area of plantations, secondary forest and a road.

26. *Mt Raung and Ijen Highland* Kooiman (1940) mentions a live bird captured by Mr H. Lucht on the Ijen plateau. In June 1990, a juvenile and an adult were seen above Lijen on the eastern slope. In July 1990, on the south-western foothills of the adjacent Mt Raung, an immature bird was seen in a narrow stretch of hill forest (SvB). The area is only partly protected by the 2,560-ha nature reserve of Kawah Ijen Merapi Ungup-ungup, and by three tiny reserves. More important reserves are proposed for Mt Raung (60,000 ha; north-east of Meru Betiri), and Maelang (70,000 ha; south-west of Baluran National Park).

27. *Alas Purwo National Park* During an eight-day visit in May 1990 a juvenile and adult bird were seen at Pasirputih (Sembulungan) in the north, and a single bird was heard near Sadengan in the central part (van Balen 1991). During an eight-month period in 1997, M. Grantham (*in litt.* 1998) saw one subadult in the open forest at Sadengan in November. Alas Purwo (also referred to locally as

Blambangan, or Banyuwangi Selatan) is a 62,000-ha lowland forest reserve ranging from sea-level to 360 m in the drier part of Java. Wood-cutting forms the major threat to the habitat.

*Forest clusters*

Figure 1 shows that the distribution of Javan Hawk-eagle across Java is mainly concentrated in eight major blocks of forest, each at least covering 20,000 ha. Unhampered dispersal within these blocks is expected on the basis of distance between forest fragments, topography and land use of the area. These forest clusters are:

i. Mts Halimun and Salak (total: 50,000 ha);
ii. Mts Gede and Pangrango, Megamendung and Puncak (total: 20,000 ha)
iii. Mountain range south of Bandung (total: 90,000 ha)
iv. Mt Slamet through Mts Cupu and Simembut to the Dieng Mountains (total: 40,000 ha)
v. Mts Liman and Wilis (25,000 ha)
vi. Mts Arjuno Kawi and Kelud (total: 50,000 ha)
vii. Bantur, Lebakharjo and Mt Semeru (total: 38,000 ha)
viii. Meru Betiri, Ijen highlands, Mt Raung and Maeland (total: 180,000 ha)

These forest clusters are of the utmost importance for the survival of the different populations of Javan Hawk-eagle. The observations of adult and immature Javan Hawk-eagles between a number of these forest patches suggest that dispersal is possible. They cover large areas over a wide altitudinal range, and are laid out across the entire length of the island.

## Discussion and conclusion

According to Kuroda (1936) the Javan Hawk-eagle breeds in the wooded hills of West Java. Also Brown and Amadon (1968) consider the species to be restricted to the wooded hills of West Java, although Kooiman (1940) had reported the species to be present in the Ijen and Yang highlands in the East Javan province. Typical habitat of the Javan Hawk-eagle was described by Thiollay and Meyburg (1988) and Meyburg *et al.* (1989) as wet tropical rainforest. Later surveys indicated the occurrence of the eagle and possible breeding pairs in much drier forest types in East Java, e.g. Alas Purwo (van Balen 1991). In total less than 10% of the original natural forest remains: 19% of the original hill forest, 54% of the mountain forest and only 2% of the lowland forest (MacKinnon *et al.* 1982, van Balen 1988). The latter forest type is now almost exclusively found along the southern coast of the island.

During the present study, without exception the eagles were encountered in hilly terrain. Its characterization as a slope specialist (Wells 1985) fits well with its general absence from the largely flat lowlands of Ujung Kulon, Cikepuh and most likely the northern plains (although here very little forest is extant to attest). The only record from the northern plains, Gobang, originates from a formerly forested hill.

Immature, dispersing birds have been seen in a variety of disturbed areas,

including a tennis lawn, kapok plantations, forest edges, secondary forests, much in line with what has been seen in the closely related Blyth's Hawk-eagle *Spizaetus alboniger* (Medway and Wells 1976). Adults are occasionally seen in disturbed habitats as well, but generally only when more undisturbed natural forest types are in the vicinity.

*Conservation area network*

An extensive network of conservation areas has been established, with important forest clusters included in the Mt Halimun, Mts Gede Pangrango and Meru Betiri National Parks. However, not all areas are adequately protected and a number of national parks suffer much from hunting and encroachment along the forest edges.

Protected areas in Indonesia can be divided into (1) sanctuary reserves, (2) nature conservation areas, and (3) protection forest (after MacKinnon 1982, Whitten *et al.* 1996):

(1) *a* Strict nature reserve (*cagar alam*): generally small undisturbed fragile habitats of high conservation importance, strictly protected and allowed to develop naturally. *b* Wildlife sanctuary (*suaka margasatwa*): medium or large areas of relatively undisturbed stable habitats of moderate to high conservation importance, where habitat management may be conducted. *c* Hunting reserve (*taman buru*): medium or large (semi-)natural habitats with game hunting potential.

(2) *a* National park (*taman nasional*): large, relatively undisturbed area, with high conservation importance, managed through a zoning system to facilitate research, education, tourism, etc. *b* Grand forest park (*taman hutan raya*): area intended to provide a variety of indigenous and/or introduced plants and animals for research, education, tourism, etc. *c* Recreation park (*taman wisata*): small area mainly intended for recreation and tourism purposes.

(3) Protection forest (*hutan lindung*): forested lands on steep, high, erodible lands where forest cover is essential to protect important catchment areas, but where conservation priorities are not so high as to justify reserve status.

Although Java is seriously deforested, the opportunity still exists to create a number of large new forest reserves. On Java a number of forest clusters cover potentially suitable forest areas between 20,000 ha (Mts Gede and Pangrango, and Puncak and Megamendung) and 180,000 ha (Meru Betiri, Ijen Highlands, Mt Raung and Maelang). For the continued existence of Javan Hawk-eagle it is therefore crucial to concentrate on the conservation of these forest areas. Some of the forest clusters consist of national parks or nature reserves and are (at least on paper) adequately protected. Other clusters, however, consist mainly of non-conservation areas and are therefore more susceptible to degradation. These are: (1) mountains south of Bandung, (2) Mt Slamet and Dieng Mountains, (3) Mts Kawi-Kelud-Arjuno, (4) Bantur and Lebakharjo, and (5) Ijen Highlands and Mt Raung. All these five forest clusters are proposed as conservation forest (MacKinnon *et al.* 1982, RePPProt 1990) and their gazettement is overdue. Efforts to preserve the species should be concerted to maintain or improve the integrity of these blocks through the consolidation of existing forest corridors, "stepping stones" or extensively used buffer zones, and existing reserves should be safeguarded against further fragmentation.

Table 1. Forest areas containing Javan Hawk-eagles

| Block | Size[a] ($km^2$) | Status[b] | Survey intensity[c] | Number of recent localities | Altitudinal range observations | Other threatened species[d] |
|---|---|---|---|---|---|---|
| *West Java* | | | | | | |
| 1 Ujung Kulon | 125 | NP | xxx | 2 | 10–?300 | 1,2,3,4,7 |
| 2 Mt Aseupan | 30 | PF | xxx | 1 | 100 | 7 |
| 3 Mt Karang | 30 | PF | x | 2 | 1,000–1,200 | [8] |
| 5 Mt Halimun | 400 | NP | xxx | 3 | 900–1,200 | 5,6,7,[8] |
| 6 Mt Salak | 100 | PF | xxx | 5 | 1,000–1,200 | 5,6,7,[8] |
| 7 Jampang | 100 | NR/WS | x | 3 | ? | 7,8] |
| 8 Megamendung & Puncak | 60 | NR/PF | xxx | 4 | 6,00–1,600 | 7,[8] |
| 9 Mts Gede/Pangrango | 140 | NP | xxx | 4 | 1,100–1,700 | 5,6,7,8 |
| 10 Mts Patuha/Tilu | 460 | PF | x | ?1 | [600–1000] | 7 |
| 11 Mt Papandayan & Kawah Kamojang | 550 | PF/NR | xxx | 2 | 2,000 | 7,[8] |
| 12 Mts Tangkuban Perahu/ Burangrang | 100 | PF/NR | x | 2 | 950 | 5,6,7,[8] |
| *Central Java* | | | | | | |
| 13 Pembarisan Mts | 130 | PF | x | 1 | 470–600 | — |
| 14 Mt Slamet | 150 | PF | xx | 4 | 700–2,200 | 6,7 |
| 15 Mts Cupu/Simembut | ? | PF | x | 1 | 700–1,00 | — |
| 16 Dieng Mts | 250 | PF | xxx | 4 | 600–1,775 | 7 |
| 17 Mt Ungaran | 50 | PF | x | 1 | 700–1,000 | 7 |
| 18 Mt Merapi/Merbabu | 80 | PF | xxx | 2 | 1,150–1,300 | — |
| 19 Mt Muriah | 100 | PF | xx | 1 | 1,400 | [3],[8] |
| *East Java* | | | | | | |
| 20 Mts Liman/Wilis | 250 | PF | xx | 3 | 1,100–1,300 | — |
| 21 Mt Arjuno | 250 | PF/GFP/NR | xxx | 3 | 400–1,050 | [3],[8] |
| 22 Mts Kawi/Kelud | 250 | PF | xxx | 4 | 1,100–2,200 | 3 |
| 23 Bantur & Lebakharjo | 180 | PF | x | 1 | 100 | 3,7 |
| 24 Yang Highlands | 140 | PF/WS | xx | ?1 | 2,000 | 3 |
| 25 Meru Betiri | 500 | NP | xxx | 5 | 0–100 | 3,8 |
| 26 Mt Raung & Ijen Highland | 700 | PF/NR | xx | 2 | 825–900 | 3, 5,[8] |
| 27 Alas Purwo | 160 | NP | xxx | 2 | 0–360 | 2,3 |

[a]Approximate size of Javan Hawk-eagle habitat.
[b]Status: NP, National Park; GFP, Grand Forest Park; NR, Nature Reserve; WS, Wildlife Sanctuary; PF, Protection Forest.
[c]Survey intensity, x, <5 survey days; xx. 5–10 survey days; xxx, >10 survey days.
[d]Other threatened species: 1, Milky Stork *Mycteria cinerea*; 2, Lesser Adjutant *Leptoptilos javanicus*; 3, Green Peafowl *Pavo muticus*; 4, Sunda Coucal *Centropus nigrorufus*; 5, Javan Scops-owl *Otus angelinae*; 6, Javan Cochoa *Cochoa azurea*; 7, White-breasted Babbler *Stachyris grammiceps*; 8, Java Sparrow *Padda oryzivora*. Sources: van Balen 1997, pers. obs., van Balen *et al.* 1995, Becking 1994, Hoogerwerf 1948, M. Linsley *in litt.* 1998, skin collection in Leiden and Bogor museums.
Data in brackets [ ] are before 1980 only.

### *Important Bird Areas programme*

BirdLife International in cooperation with the Indonesian Ministry of Forestry has created a network of birdwatching clubs throughout Java. Most of these clubs are engaged in the Important Bird Area (IBA) programme, the main aim of which is the assessing and monitoring of areas important for bird conservation. Excluding the old observations at Gobang, where no forest is extant, Javan Hawk-eagles have been recorded in 26 forest areas throughout Java. In only seven areas no

Table 2. Natural areas in Java (>10,000 ha), supposedly with Javan Hawk-eagle populations and needing (additional) surveys

| Locality | Gazetted area ( ha) | Status |
|---|---|---|
| *West Java* | | |
| Mt Pangasaman | 34,000 | Proposed game reserve |
| Mt Kencana | 25,000 | Proposed wildlife sanctuary |
| Mt Limbang | 20,000 | Proposed wildlife sanctuary |
| Mt Simpang | 12,000 | Strict nature reserve |
| Masigit Karumbi | 12,420 | Hunting reserve |
| Waduk Gede/Jati Gede | 10,500 | Proposed nature reserve |
| *Central Java* | | |
| Mt Lawu | 21,000 | Proposed nature reserve |

other threatened species (see Collar *et al.* 1994) have been recently recorded (Table 1). One of these areas (Mts Cupu and Simembut) was not visited by us, and two (Pembarisan Mountains and Mt Karang) were only visited over 2–4 days. In 10 of the 26 areas supporting populations of Javan Hawk-eagles, two to four other threatened bird species have been recorded. Three of the threatened species have habitat requirements similar to the Javan Hawk-eagle or overlap almost completely in their range, i.e. the White-breasted Babbler *Stachyris grammiceps*, and the strictly submontane Javan Scops-owl *Otus angelinae* and Javan Cochoa *Cochoa azurea*. All other threatened bird species (three of wetland/coastal, and three open woodland/forest edge) occupy very different habitats. However, if we look at the subspecies level, many more threatened taxa are found cooccurring with the eagle, notably those species that are represented by distinct but rare races endemic to the Javan lowland and hill forest (van Balen 1988, Whitten *et al.* 1996).

*Field surveys and studies*

A number of surveys were carried out during 1986–1997, and resulted in the (re)discovery of Javan Hawk-eagle at a number of historical and new sites (Thiollay and Meyburg 1988, van Balen 1991, van Balen and Meyburg 1994, Sözer and Nijman 1995a). Figure 1 shows the extent of remaining forest with existing records indicated. In some extensive areas with suitable habitat only few (e.g. Mt Raung and Ijen Highlands) or no (e.g. Bromo Tengger Semeru National Park) Javan Hawk-eagles have been recorded as they are still seriously under-surveyed (see Table 1). Additional areas that need surveys are listed in Table 2.

In the framework of the IBA programme priority should be given to the correct identification of eagles and mapping of under-surveyed eagle habitat. Main aims for future in-depth research should be: (1) the assessment of home range sizes; (2) the study of demography and recruitment; (3) the study of dispersal behaviour of both adult and juvenile birds; and (4) further study on habitat requirements for different age classes.

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