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Relative status of two species of migrant sparrowhawks on Java and Bali, Indonesia

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Abstract. Every autumn thousands of sparrowhawks, mainly the Chinese Sparrowhawk (*Accipiter soloensis*) and the Japanese Sparrowhawk (*A. gularis*), migrate from East Asia to western Indonesia. However, the relative abundance of these two species in Indonesia differs between studies, with some reporting Japanese Sparrowhawk being up to ten times more common than Chinese Sparrowhawk, while other studies report the reverse. We assessed the status of these two migrant sparrowhawks on the islands of Java and Bali by comparing four datasets: data from four watch-sites (1992–2004, 108 days, 7698 birds), general surveys (1980–2004, 354 days, 578 birds), museum collections (< 1820–1957, eight collections, 274 birds), and the literature (1902–2004). In the first three datasets, Chinese Sparrowhawk was 2–10 times more numerous than Japanese Sparrowhawk, and data from the literature tended to support this. There were small but significant differences between the two islands, with Japanese Sparrowhawk being slightly more common on Bali than on Java. Systematic study of all available data on the relative abundance of the two species shows there is no evidence that changes in species composition have occurred.

Introduction

The Asian–Australasian bird migration system is one of the least studied migration systems in the world (Lane and Parish 1991). In the 1960s, south-bound raptor migration was first systematically documented in Peninsular Malaysia (Medway and Wells 1976; Wells 1998) and, although it was observed that thousands of raptors migrated to Sumatra, data from Indonesia were completely lacking (e.g. van Marle and Voous 1988). Ash (1984) was the first to describe migration of boreal raptors through western Indonesia. In 1982, on the western part of the island of Bali, he observed 615 individual raptors over a 7-day period; these birds had made a 2.5-km sea crossing, arriving on Bali directly from Java. He recorded two species of sparrowhawk, the Japanese Sparrowhawk (*Accipiter gularis*) and Chinese Sparrowhawk (*A. soloensis*), among the most common species, with a ratio of 1 : 0.44 (n = 489 sparrowhawks) respectively. In 1990, Ash collected data more systematically over a longer period (32 days), counting > 11 000 raptors, of which 8756 were the two sparrowhawks, with a ratio of Japanese to Chinese Sparrowhawks of 1 : 0.12 (Ash 1993). On the basis of these studies, the notion that the Japanese Sparrowhawk is the most common species of migrant raptor in western Indonesia has been universally accepted (e.g. van Marle and Voous 1988; van Balen 1994; Coates and Bishop 1997; MacKinnon *et al*. 1998; Zalles and Bildstein 2000; Ferguson-Lees and Christie 2001).

Ash's studies indicated that large numbers of raptors migrated through western Indonesia and into eastern Indonesia. In the late 1990s, a number of studies were conducted on the migration of raptors in western Indonesia, including Java. In these studies the two migrant sparrowhawks comprised the bulk of the migrants observed, but invariably Chinese Sparrowhawk, not Japanese Sparrowhawk, was the most abundant (Nuraeni and Suparman 2000; Nijman 2001*a*, 2001*b*, 2004*b*; A. Supriatna, personal communication; A. Long, personal communication; I. Z. Mutaqin, in litt.). On the basis of these differences in the ratio of Chinese Sparrowhawk to Japanese Sparrowhawk between Java and Bali, Nijman (2001*a*) hypothesised the existence of an alternative migration route involving large numbers of Japanese Sparrowhawk following small islands on the eastern edge of the Sunda Shelf, and arriving on Bali from a northern direction. Subsequent observations in Bali (Germi 2005) and the island of Bawean (Nijman 2004*a*) do not support this hypothesis.

This poses several questions: which of the two sparrowhawks, Chinese or Japanese Sparrowhawk, is in fact the most common migrant, overwintering or on passage through Java and Bali; are there large inter-island differences; and have

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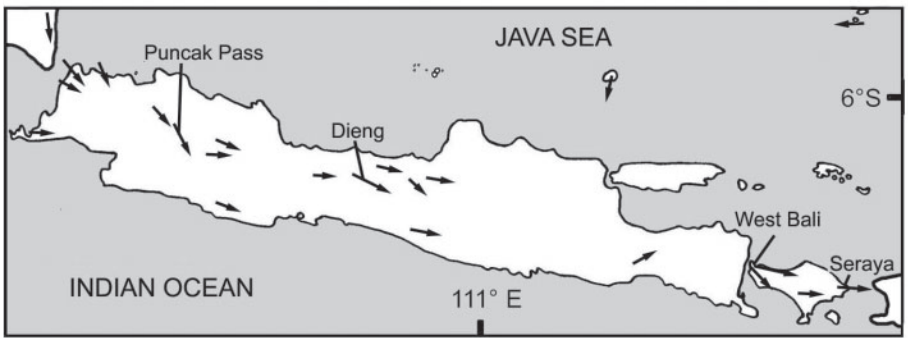

Fig. 1. Java and Bali, Indonesia, with the four watch-sites indicated. The arrows indicate the main direction of migration in the period September – November.

changes in the relative abundance of the two species occurred over the last decades? In order to answer these questions, we systematically compiled data on the occurrence of these two species from the two islands in historic and present times, and discuss our findings in the light of observations of Ash (1984, 1993). Since few data are available on the return, or spring, migration in Indonesia, migration and passage here refer to what is observed during the boreal autumn and winter.

Methods

Data collection

We compiled data on the numbers of Japanese Sparrowhawk and Chinese Sparrowhawk in Java and Bali from three sources: field observations at watch-sites, ornithological surveys, and zoological collections. Independently, and initially unaware of each other's results, we collected systematic data on raptor migration at four watch-sites: the area around Puncak, West Java (S. van Balen, 1996; V. Nijman, 1999, 2001), Dieng Mountains, Central Java (V. Nijman, 1998, 1999, 2001), Bali Barat, West Bali (S. van Balen, 1992; F. Germi, 2004) and Seraya, East Bali (F. Germi, 2004) (Fig. 1; Table 1). Counts lasted ≥ 4 days per site per year and were in the peak migration period (late September – mid-November). In most cases, one or several other ornithologists were present (Table 1). Observation sites were located on ridges, small hills, and in open areas, provided that there were unrestricted views, especially to the west. The sky from where raptors were expected was methodologically scanned with binoculars and telescopes using clouds and distance landmarks as a frame of reference for distance focusing (see Nijman 2001*a*, 2001*b*, 2004*a*; Germi 2005). The two sparrowhawks were distinguished based on a number of diagnostic characters, particularly pattern of underwing, tail barring, and wing-shape, as described by Leader and Carey (1995), Morioka *et al*. (1995) and Ferguson-Lees and Christie (2001).

Second, during general ornithological surveys in various parts of Java and Bali in the period 1980–2004, we collected data on the number of the two sparrowhawks observed during the migration and overwintering period (September – March). This dataset included surveys away from prominent watch-sites, and observations at potential watch-sites <4 days. We grouped sites where we observed the migrant sparrowhawks and which were <50 km apart, in regions (Table 2). Regions are separated from other regions by a sea strait or by distances > 90 km in which we did not observe migrant sparrowhawks or where we did not survey. Total survey duration in regions was 354 days; many more days were spent in the field in areas where the species were not recorded.

Third, we compiled data on the numbers of the two migrant sparrowhawks collected on Java or Bali in eight zoological museums (Amsterdam, Berlin, Bogor, Leiden, London, New York, Singapore, and Washington; see Table 3).

Analysis

Analysis initially focused on our own dataset only. Differences between and within the three datasets (watch-sites, surveys, museum collections) were compared using non-parametric tests (Siegel 1956). Yates' correction for continuity was applied to the χ^2-test where appropriate. We then compared our dataset with that of others. Ash (1984, 1993) does not provide data on the number of sparrowhawks that he could not identify to the species level. He did state, however, that '…the two sparrowhawks … were often difficult to separate when flying high … [and an] unknown proportion of the birds recorded as Japanese sparrowhawk may have been Chinese goshawk, but this figure is probably low, because the ratio of definite Japanese sparrowhawk compared with definite Chinese goshawk are similar to those for the total

Table 1. Migrant sparrowhawks observed during the autumn migration at four watch-sites on Java and Bali, Indonesia, 1992–2004

Watch-site[A]	Year	No. of days	Chinese Sparrowhawk (*A. soloensis*)	Japanese Sparrowhawk (*A. gularis*)	Unidentified sparrowhawks (*Accipiter* spp.)	Observers
Puncak Pass	1996, 1999	18	2025	60	1124	S. van Balen, V. Nijman, R. F. Grimmett, P. Jepson, K. Koyama, F. Lambert, A. Long, S. Nuriaeni, Rudiyanto, R. Saryanthi, U. Suparman
Mt Dieng	1998, 1999, 2001	66	2060	224	1238	V. Nijman, D. Augustina, S. C. F. Luisterburg, P. Lupianingdyah
West Bali	1992, 2004	8	226	64	1783	S. van Balen, F. Germi, V. Mason
Seraya	2004	16	2713	324	2519	F. Germi, P. Asmara, V. Mason
Total		108	7024	672	6664	

[A]For locations of watch-sites see Fig. 1.

Table 2. Regions of general ornithological surveys where migrant accipiters were observed on Java and Bali, Indonesia, 1980–2004
Regions are listed from west to east

Region	No. of days	Chinese Sparrowhawk (*A. soloensis*)	Japanese Sparrowhawk (*A. gularis*)	Observers[A]
JAVA				
Merak–Suralaya	7	5	3	VN, SvB
Bogor–Tajur	86	72	1	VN, SvB
Indramayu	5	1	1	SvB
Dieng–Pekalongan	100	13	8	VN
Meru Betiri–Ijen-Baluran	52	7	3	VN, SvB
BALI				
Bali Barat	84	23	5	SvB
Mt Agung–Batukahu	20	379	57	FG, SvB
Total	354	500	78	

[A]VN = V. Nijman, SvB = S. van Balen, FG = F. Germi.

Japanese sparrowhawk figures compared with Chinese goshawks' (Ash 1993: 4–5). As such, we could not compare numbers directly, but instead had to compare the ratios. Throughout, significance is accepted when $P < 0.05$ in a two-tailed test (Siegel 1956).

Results

Identification

Over the years, the proportion of sparrowhawks that we could reliably identify to the species level at the four watch-sites appeared similar (median 58%, interquartile range 38–65%, $n = 8$) yet was statistically significantly different ($\chi^2 = 4.96$, d.f. = 1, $P < 0.05$). However, the annual proportion of identified sparrowhawks at individual watch-sites during any given year did not differ significantly from the other watch-sites for all years combined (all $\chi^2 < 2.31$, d.f. = 1, $P > 0.05$). About two out of five sparrowhawks could not be identified to the species level, either because the raptors were passing at high altitudes, were in mixed flocks, or the meteorological conditions at the watch-site were poor for observation. A small number of the unidentified sparrowhawks may have been other migratory species, such as Shikra (*A. badius*) or Eurasian Sparrowhawk (*A. nisus*) (though neither have yet been recorded for Java or Bali (MacKinnon *et al.* 1998)) or resident sparrowhawks, such as the similar-sized Besra (*A. virgatus*) or the larger Crested Goshawk (*A. trivirgatus*). In all we were able to identify 8274 individuals to the species level, 7524 of which were Chinese Sparrowhawk and 750 Japanese Sparrowhawk.

Species composition

At all four watch-sites, and during all years that observations were made, the Chinese Sparrowhawk was more common than the Japanese Sparrowhawk (Table 1). The likelihood that this observation is incorrect, and that both species are equally common is very small (binominal test, $N = 8$, x = 0, $P < 0.01$). We did find a small but statistically significant difference in the ratio of Chinese Sparrowhawk to Japanese Sparrowhawk between Java (1 : 0.07) and Bali (1 : 0.13) ($\chi^2 = 63.1$, df = 1, $P < 0.001$).

During the surveys, we consistently encountered more Chinese Sparrowhawk (98 on Java and 402 on Bali) than Japanese Sparrowhawk (16 on Java and 62 on Bali) (Table 2). In six out of seven regions, Chinese Sparrowhawk was more common than Japanese Sparrowhawk, whereas in one region equal numbers of both were recorded. The likelihood that both species are equally common in these regions is small (binominal test, $N = 6$, x = 0, $P < 0.05$). There were no significant differences in the ratio of Chinese Sparrowhawk to Japanese Sparrowhawk between islands (Java 1 : 0.16; Bali 1 : 0.15) ($\chi^2 = 0.03$, df = 1, $P > 0.10$).

Although numbers of Chinese Sparrowhawk and Japanese Sparrowhawk skins in most of the zoological collections were small, in five out of eight collections Chinese Sparrow-

Table 3. Sparrowhawks from Java in the collections of eight zoological museums
Skins were collected in the period <1820–1957

Collection[A]	Chinese Sparrowhawk (*A. soloensis*)	Japanese Sparrowhawk (*A. gularis*)
AMNH	17	5
BMNH	6	2
MZB	1	31
RMNH	132	69
USMN	0	1
ZCR	1	0
ZMA	0	5
ZMB	0	4
Total	157	117

[A]AMNH = American Museum of Natural History, New York, USA; BMNH = Natural History Museum, London, UK; MZB = Museum Zoologicum Bogoriense, Cibinong, Indonesia; RMNH = Naturalis, Leiden, The Netherlands; USMN = Smithsonian Institute, Washington, USA; ZCR = Raffles Museum of Biodiversity Research, Singapore; ZMA = Zoological Museum Amsterdam, The Netherlands; ZMB = Institut für Naturkunde, Hombult Universität, Berlin, Germany.

hawk was more common (Table 3). Overall, in the sample of 274 specimens, the ratio of Chinese Sparrowhawk to Japanese Sparrowhawk was 1 : 0.75. Unfortunately, there were no specimens of either species from Bali in these collections.

In the combined dataset, comprising 8550 identified individuals, the ratio of Chinese Sparrowhawk to Japanese Sparrowhawk was 1 : 0.11, with similar ratios for both islands (1 : 0.09 and 1 : 0.14 for Java and Bali respectively). Overall, Chinese Sparrowhawk is about ten times more common than Japanese Sparrowhawk.

Discussion

Contrary to what is generally perceived (van Marle and Voous 1988; van Balen 1994; Coates and Bishop 1997; MacKinnon *et al*. 1998; Zalles and Bildstein 2000; Ferguson-Lees and Christie 2001), our results indicate that on Java and Bali Chinese Sparrowhawk, and not Japanese Sparrowhawk, is by far the most common sparrowhawk during the autumn migration and overwintering period. Although we have conducted our studies independently from each other and in different years there was a high degree of agreement between our datasets.

On Java, our conclusion is based on the observations from 1980 to 2004 made by different teams of observers, both at watch-sites and during field surveys. Inquiries made to other observers on Java in recent years (e.g. U. Suparman, A. A. Supriatna, and R. Saryanti, personal communications), and scant published data (Nuraeni and Suparman 2000) support the assertion that indeed Chinese Sparrowhawk is by far the more common of the two. M. Argeloo (in Zalles and Bildstein 2000) reported a large flock of 150–200 sparrowhawks tentatively identified as Japanese Sparrowhawk from the Botanical Gardens in Bogor, West Java, in October 1990. Subsequent observations in the period 1998–2003 (R. Saryanti, personal communication; V. Nijman, personal observation) reveal that Chinese Sparrowhawk regularly use the gardens as a stopover site and, with this knowledge and data presented in the current paper, the 1990 observations may well have been Chinese Sparrowhawk (M. Argeloo, personal communication, 2004).

As indicated above, Chinese Sparrowhawk on Java is over-represented in museum specimens collected from the period from < 1820 to 1957. Likewise, various older reports suggest that in the past Chinese Sparrowhawk was indeed the more common of the two sparrowhawks on Java. Bartels (1906) reported that, during the wet season (September–March), Chinese Sparrowhawk was common in the Sukabumi regency of West Java, whereas it was uncommon in West Preanger, West Java (Bartels 1902). In contrast, Japanese Sparrowhawk was a very rare visitor in these regions and has in fact been observed only once (Bartels 1902, 1906). Bartels (1931), reporting on the birds of the Cianjur Regency, West Java, stated that the Chinese Sparrowhawk was a rare migrant, but that Japanese Sparrowhawk was not recorded. In the Bogor Regency, the Chinese Sparrowhawk was reported to be very common during the migration period (Sody 1927); in the teak forests of the central part of Java it was seen 'not much, yet apparently not rare' (Hansen 1922), and 'not numerous, but locally in wandering flocks in rather large numbers' (H.A. Hansen and F.A.T.H. Verbeek, in Sody 1953). Only a single Japanese Sparrowhawk was recorded in the Bogor Regency (Sody 1927); in the Javan teak forest it was possibly of no significance because small in number (Sody 1953). Hoogerwerf (1948) tabulated the birds of 16 Javan localities: Chinese Sparrowhawk was recorded in seven from all over Java and Japanese Sparrowhawk in three in West Java only. Hoogerwerf (1965), based on observations in the period 1931–45, stated that both sparrowhawks were distributed widely on Java, yet Chinese Sparrowhawk was observed frequently, whereas Japanese Sparrowhawk was not commonly recorded. J.H. Becking (personal communication), with years of birding expertise in Java dating back to the 1930s, informed us that Chinese Sparrowhawk has always been more common than Japanese Sparrowhawk. Finally, Wattel (1973) stated that Chinese Sparrowhawk was 'not uncommon' in East Java, but makes no reference to the abundance of Japanese Sparrowhawk.

For Bali, our contention that Chinese Sparrowhawk is by far the most common of the two sparrowhawks is based on observations over the period 1989–2004 made by different teams of observers, both at watch-sites and during field surveys. Mason (1994) stated that during the 1994 migration period of the few identifiable sparrowhawks, there were more Chinese Sparrowhawks. A short study on the migration of raptors in West Bali in October 2001 showed a clear preponderance of Chinese Sparrowhawk (2875 birds) over Japanese Sparrowhawk (249 birds) (Yayasan Kokokan, personal communication, 2003). Most observations of raptor migration on Bali are of birds making land-fall in West Bali. Observational conditions at this watch-site in West Bali are, however, not optimal, as the site is at sea level and most birds pass over at great heights or in the distance to the west. Mason (1994: 6) stated 'Practically all birds flew over at a great height barely, if at all, visible to the naked eye …they were probably flying too high and fast to enable detection against a brilliant blue sky and uncomfortably close to the sun'. Indeed, the two of us that have made observations at this watch-site in West Bali (S. van Balen, F. Germi) have experienced the same conditions. Kerlinger (1989) compared results from simultaneous radar and visual observations, and showed that at distances > 1500 m raptor identification may become problematic even with the aid of binoculars or spotting scopes. (Ash 1993: 8–9) noted that many raptors arriving at West Bali were flying high, and estimated that the birds passed over at altitudes between 1800 m and 4800 m.

With respect to the relative abundance of the two sparrowhawks, data of Ash (1984, 1993) data are a complete reversal of our results. These differences may be apparent (i.e. brought about by different methodologies employed, differences in observation periods, misidentification, or unjust extrapolation from positively identified birds to all birds on passage) or real (i.e. there are large intra-annual differences in species composition). For several reasons supported by the results above, we do not think that there are large difference in species composition between years as both historical and contemporary data are very consistent, except for the data from this one observer at one watch-site (i.e. Ash, in West Bali). Differences in methodologies and observation periods may account for small deviations between years, sites and observers, but is unlikely to lead to a reversal of the results. Furthermore, the migration period is similar for both accipiters with only minor variation in relative abundance. For the 1998–2001 period in Central Java, the most (central 90%) of migration occurred over 31 days and 27 days for Japanese Sparrowhawk and Chinese Sparrowhawk, respectively, and weekly ratios of Japanese Sparrowhawk to Chinese Sparrowhawk ranged from 1 : 1.3 to 1 : 9.5 (Nijman 2004*b*). This leaves open the possibility of misidentification, either by Ash (1984, 1993), others (e.g. Bartels 1902, 1906, 1931; Sody 1927, 1953; Hoogerwerf 1948, 1965; Mason 1994) or ourselves and our co-workers, or that the extrapolation of Ash (1993) from positively identified birds to all birds on passage was unjustified. As already indicated, because of difficulties in separating the sparrowhawks, Ash (1993: 7; in litt., 2005) called for caution when comparing the two species. For the moment, we favour the option that indeed Chinese Sparrowhawk is the most common migrant raptor on Java and Bali, both in the past and at present, and that this is a common migrant, whereas Japanese Sparrowhawk is far less abundant. The small differences in the ratio of the two species between Java and Bali, with Japanese Sparrowhawk being relatively more common on Bali, suggests preferential drop-out of Chinese Sparrowhawk from the migration stream as it progresses eastwards into the Lesser Sunda Islands (this is supported by the many records, after the boreal autumn passage, of Chinese Sparrowhawk in Bali). Unfortunately, few data are available on the species composition of migrant raptors in eastern Indonesia, but our results indicate that Chinese Sparrowhawk may be more common here than previously suggested (e.g. Coates and Bishop 1997). Setting up monitoring schemes at suitable watch-sites in these eastern regions may be a promising avenue for further research.

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References

Ash, J. S. (1984). Bird observations from Bali. *Bulletin of the British Ornithologists' Club* **104**, 24–35.

Ash, J. S. (1993). Raptor migration on Bali, Indonesia. *Forktail* **9**, 3–11.

Bartels, E. (1931). Vogels van Kole Beres. *Natuurkundig Tijdschrift Nederlandsch-Indië* **91**, 308–348.

Bartels, M. (1902). Zur Ornis Javas. *Natuurkundig Tijdschrift Nederlandsch-Indië* **61**, 129–172.

Bartels, M. (1906). Systematische Übersicht meiner Java-Vögel. *Journal für Ornithologie* **54**, 383–407, . doi:10.1007/BF02089279

Coates, B. J., and Bishop, K. D. (1997). 'A Guide to the Birds of Wallacea. Sulawesi, The Moluccas and Lesser Sunda Islands, Indonesia.' (Dove Publications: Alderley, Qld.)

Ferguson-Lees, J., and Christie, D. A. (2001). 'Raptors of the World.' (Christopher Helm: London.)

Germi, F. (2005). Raptor migration in East Bali, Indonesia: observations from a bottleneck watch site. *Forktail* **21**, 93–98.

Hansen, H. A. (1922). Correspondentie. *De Tropische Natuur* **11**, 15–16.

Hoogerwerf, A. (1948). Contribution to the knowledge of the distribution of birds on the island of Java, with remarks on some new birds. *Treubia* **19**, 83–137.

Hoogerwerf, A. (1965). Vogels van Java. Unpublished manuscript lodged at the Department of Birds, Zoological Museum Amsterdam.

Kerlinger, P. (1989). 'Flight Strategies of Migrating Hawks.' (University of Chicago Press: Chicago.)

Lane, B. A., and Parish, D. (1991). A review of the Asian-Australasian bird migration system. In 'Conserving Migratory Birds'. (Ed. T. Salathé.) pp. 291–312. (International Council for Bird Preservation: Cambridge, UK.)

Leader, P. J., and Carey, G. J. (1995). Identification of Japanese Sparrowhawk and Besra. *Hong Kong Bird Report* **1994**, 157–169.

MacKinnon, J. R., Phillips, K., and van Balen, S. (1998). 'Burung-burung di Sumatera, Jawa, Bali dan Kalimantan (termasuk Sabah, Sarawak dan Brunei Darussalam).' [Birds of Sumatra, Java, Bali and Borneo.] Revised Indonesian edition. (Puslitbang Biologi – LIPI: Jakarta, Indonesia.)

Mason, V. (1994). Bird Notes. *Tjerutjuk* **2**(3), 5–6.

Medway, Lord, and Wells, D.R. (1976). 'The Birds of the Malay Peninsula. Vol. V: Conclusion, and Survey of Every Species.' (Witherby and Penerbit Universiti Malaya: Kuala Lumpur, Malaysia.)

Morioka, T., Yamagata, N., Kanouchi, T., and Kawata, T. (1995). 'The Birds of Prey in Japan.' (Bun-ichi Sogo Shuppan: Tokyo.).

Nijman, V. (2001*a*). Autumn migration of raptors on Java, Indonesia: composition, direction and behaviour. *Ibis* **143**, 99–106.

Nijman, V. (2001*b*). Spatial and temporal variation in migrant raptors on Java, Indonesia. *Emu* **101**, 259–263. doi:10.1071/MU00022

Nijman, V. (2004*a*). Survey on the birds of prey and owls (Falconiformes and Strigiformes) on Bawean, Java Sea, with records of three species new to the island. *Raffles Bulletin of Zoology* **52**, 647–651.

Nijman, V. (2004*b*). Timing and magnitude of migrant raptors in Central Java, Indonesia. *Ardea* **92**, 161–168.

Nuraeni, S., and Suparman, U. (2000). Raptor migration at Puncak and Cibulao, West Java, Indonesia – October and November 1999. *Asian Raptor Bulletin* **1**, 7–9.

Siegel, S. (1956). 'Non-parametric Statistics for the Behavioral Sciences.' (McGraw-Hill: Auckland, NZ.)

Sody, H. J. V. (1927). Lijst van Buitenzorg-vogels en – zoogdieren. *Natuurkundig Tijdschrift Nederlandsch-Indië* **87**, 181–204.

Sody, H. J. V. (1953). Vogels van het Javaanse djatibos. *Majalah Ilmu Alam Indonesia* **109**, 125–172.

van Balen, S. (1994). The status and conservation of birds of prey in the Sondaic and Wallacean regions of Indonesia. In 'Raptor Conservation Today'. (Eds B.-U. Meyburg and R. D Chancellor.) pp. 245–254. (World Working Group on Birds of Prey and Owls and Pica Press: Berlin and London.)

van Marle, J. G., and Voous, K. H. (1988). 'The Birds of Sumatra: An Annotated Check-list.' BOU Check-list No. 10. (British Ornithologists' Union: London.)

Wattel, J. (1973). 'Geographical Differentiation in the Genus *Accipiter*.' Publications of the Nuttall Ornithological Club No. 13. (Nuttall Ornithological Club: Cambridge, MA.)

Wells, D. R. (1998). 'The Birds of the Thai-Malay Peninsula. Vol. 1. Non-passerines.' (Academic Press: London.)

Zalles, J. I., and Bildstein, K. L. (Eds) (2000). 'Raptor Watch: A Global Directory of Raptor Migration Sites.' BirdLife Conservation Series 9. (BirdLife International and Hawk Mountain Sanctuary: Cambridge, UK, and Kempton, PA.)

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