Distribution and abundance of threatened and heavily traded birds in the mountains of western Java

STUART J. MARSDEN[1,] ACHMAD RIDHA JUNAID[2], FAJAR KAPRAWI[2], FARIS MULADI[2] GANJAR CAHYO APRIANTO[2], S. (BAS) VAN BALEN[3]; RIA SARYANTHI[2], NIGEL J. COLLAR[4] & CHRISTIAN DEVENISH[1,5]

[1] Department of Natural Sciences, Manchester Metropolitan University, Manchester, M1 5GD, UK

[2] Burung Indonesia, Bogor, Indonesia.

[3] Basilornis Consults, Muntendampad 15, 6835 BE Arnhem, The Netherlands.

[4] BirdLife International, David Attenborough Building, Pembroke Street, Cambridge CB2 3QZ, UK

[5] Current address: NatureMetrics, Surrey Research Park, Guildford, GU2 7HJ, UK

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Abstract

There is serious concern for the future of a wide range of birds in Java and elsewhere in Indonesia due to both loss of habitat and trapping for the cagebird trade (the so-called 'Asian Songbird Crisis'). Despite this concern, few data on presence and abundance of key species exist. We provide such data on 184 bird species from two years of biodiversity surveys from 37 sites on twelve mountains in West and Central Java. Many of these species are heavily traded, endemic, and globally threatened. Several of the threatened endemics, notably Javan Trogon and Javan Cochoa, were often recorded, in terms of both geographical spread and numerical abundance. Rufous-fronted Laughingthrush, Spotted Crocias and Orange-spotted Bulbul, believed to be threatened by trapping for the songbird trade, appear to remain fairly widespread. By contrast, Brown-cheeked Bulbul, Chestnut-backed (Javan) Scimitar-babbler, Javan Oriole, and especially Javan Blue-flycatcher, recorded on just a single occasion, and Javan Green Magpie which we failed to record with certainty, now appear to be extremely rare. Our encounter rates, while not pinned to specific mountains for security reasons, represent an important baseline against which future changes in abundance can be gauged.

Introduction

For the world's most populous island, with around 149 million inhabitants, and despite a long occupation by Europeans with a strong tradition of natural history, Java in Indonesia is remarkably poorly known ornithologically. Unlike its larger island neighbours Sumatra and Borneo, it has no modern checklist of birds, and the only recent field guide (Eaton *et al*. 2021) and bird atlas (Winnasis *et al.* 2020) also serve much of the rest of Indonesia. However, the biodiversity of Java is of considerable importance: although the island forms part of the Greater Sunda biogeographical region ('Sundaland') and shares many species with the Thai-Malay Peninsula, Sumatra and Borneo, it is also a centre of endemism in its own right (Stattersfield *et al*. 1998); indeed, greater taxonomic scrutiny in the 21st century has shown this endemism to be far more pronounced than was previously apparent (del Hoyo & Collar 2014, 2016, Eaton *et al*. 2021). Much of Java is montane, concentrated in the tropical forests flanking the island's many volcanoes; but owing to the declining west–east rainfall gradient across the island the highest endemism and overall biodiversity are concentrated in the west (Whitten *et al*. 1997).

Researchers wishing to study—and birdwatchers wishing simply to see—the birds endemic to montane western Java almost invariably visit the twin peaks of Mts Gede and Pangrango which, being only 25 km south-east of Bogor, form easily the most accessible and much the best-known site (Andrew 1985). A consequence of this is that knowledge of the avifaunas of other forested volcanoes in the region has remained rudimentary. For example, the Rufous-fronted Laughingthrush *Garrulax rufifrons* is known from 15 volcanoes but, as documented in Collar & van Balen (2013), only Gede-Pangrango held records from the present century, while half of the other 14 involved records made in or before 1930. Similarly, the Javan Green Magpie *Cissa thalassina* has only been recorded in the 21st century at four of its 18 known sites (van Balen *et al*.

2013). The absence of recent information on these two species at so many sites, and indeed on the extent and condition of their habitat there, has rendered it problematic to assess their IUCN Red List status or to identify the most appropriate conservation measures; and the same difficulty affects all other species occupying a similar range.

Preliminary to fieldwork to address this issue, an analysis of satellite images of 19 volcanoes in West Java attempted to assess, as best as possible, the extent of remaining montane forest on their slopes (Higginbottom *et al*. 2019). This indicated that much of the most accessible lower-altitude montane forest has already disappeared and only some 5,200 km^2 of montane forest remains, often as fragmented isolates, although official protection has slowed deforestation rates in recent decades (Higginbottom *et al.* 2019). However, a further problem in assessing the conservation status and needs of the bird species in these forests is the intense pressure on Java's songbirds exerted by the cagebird and song competition industries (Marshall *et al*. 2020). So great is the concern over the fate of the Rufous-fronted Laughingthrush and Javan Green Magpie that they have become the precautionary subject of intensive (and expensive) captive-breeding initiatives (Collar *et al*. 2012, Owen *et al*. 2014), despite the possibility that populations might survive in some of the forests where no surveys have been undertaken in 50 years or more. Equally, if such populations survive but are in poor condition or simply remain unknown, the opportunity may be lost to put in place measures to secure them for the long term. Moreover, a further value in a modern inventory of these forests is their potential for reintroductions of captive-bred birds, if (a) the sites prove to be in good condition but 'empty', having lost the species in question to trapping, and (b) they can be better protected under new management systems.

There are, however, also concerns for the loss of numbers in once extremely common species—white-eyes, leafbirds, shrikes, bushlarks and even sunbirds and weavers—and the ecosystem services, such as seed dispersal and pollination, that they provide (e. g. Barros *et al*. 2019). While evidence of declines due to excessive trapping is clear in species on the brink of extinction (e.g. van Balen & Collar 2021), in Java, as elsewhere, much less is known about the scale of declines in commoner species, largely due to a lack of baseline historical data (e. g. Hughes 2017). This knowledge gap is slowly being filled in Java's lowlands by initiatives such as the *BigMonth2020* citizen science event and the Indonesian Bird Atlas (Squires *et al*. 2021) and targeted repeat surveys of individual species (van Balen *et al*. 2022). For Java's montane birds, knowledge is far more rudimentary and restricted to notes of visiting birdwatchers or records from consultants.

We undertook a two-year bird survey across eleven West (plus one western Central) Javan mountains aimed at identifying areas for enhanced biodiversity protection; mammals and certain amphibians were also surveyed (see, e.g., Devenish *et al*. 2021) but will be reported elsewhere. Here we present occurrence data for bird species from 622 km of transects from 37 sites on the twelve mountains, and encounter rate data (groups encountered per hour) aggregated across sites. We do not identify bird records with particular sites or mountains for reasons of security, but these data are available to *bona fide* individuals on request.

Methods

We chose mountain sites based on an evaluation of current knowledge of the fauna and forest status of 20 montane areas in West Java (and Mt. Slamet in Central Java; Marsden

& Collar 2018, unpublished report). Twelve mountains (Figure 1) were chosen for surveys based on their large extents of remaining forest (Higginbottom *et al*. 2019), with the potential to provide habitat for species of conservation interest such as Rufous-fronted Laughingthrush and Javan Green Magpie. At each mountain, we chose sites in consultation with local villagers, in areas accessible to a field team along mountain trails as far into the forest area as possible, but also in proximity to water for the camp sites (Figure 1; map of sites). Table 1 shows information on survey effort across the twelve mountains. To support our analyses, we took habitat recordings at 8-21 10 m radius plots positioned every 200 m along transects lines at each site. At each plot we measured/estimated a range of habitat features, but in this paper, we include assessments of forest type, counts of cut stems to indicate forest disturbance, along with cut trails and signs of trapping (see Appendix S2).

At each site, we walked transects of variable length and duration along trails emanating from our camp, noting bird species, number of individuals per group and time of day. Transects were generally walked during the period 06h00–09h00, at an approximate speed of 1 km hr^{-1}. In all, 295 transects totalling 622 km and 1031 hours' effort were walked across the 37 sites over 127 days between 14/09/2018 and 06/03/2021. The mean length of each transect was 2.1 km, with a mean number of transects per site of 8.0 (min = 4, max = 16) and a mean length per site of 16.8 km. Transects were walked by one or more of 13 experienced recorders, but with three recorders (ARJ: 206 km; GCA: 189 km; and FM: 63 km) contributing nearly 75% of all transect length.

We expressed bird occurrence as the number of transects, sites and mountains in which the species was recorded. Encounter rates were expressed as mean number of encounters with groups or individuals per hour of each transect. These were then

aggregated to site level (including transects on which the species was not recorded) and averaged across all sites, but only where the species was recorded at least once. We present the final figures as mean encounter rate ± standard deviation and a minimum and maximum site-level encounter rate (site absences excluded).

Although comparisons with similarly collected historical data from the mountains of west and central Java are understandably rare, we do make some broad comparisons of our encounter rates for selected species with those made by BvB in 1981 on Mts Gede-Pangrango and Puncak, just to the west of our surveys, and from 1995 at two sites on Mt Slamet (van Balen 1984; van Balen unpubl. data).

In our analyses, we consider predominantly submontane species with IUCN threatened or Near Threatened classifications (BirdLife International 2021), and non-threatened but traded submontane species, including those regularly recorded in market or household surveys (e. g. Marshall *et al*. 2020) and those identified in the priority species list by the IUCN Asian Songbird Trade Specialist Group (ASTSG; www.asiansongbirdtradesg.com). It should be remembered when reviewing the results of these analyses that none of these species is restricted to the mountains covered by this study, being found on at least one other mountain in Java. For security reasons, we do not name any specific mountains or sites in the Results section. Taxonomy follows del Hoyo & Collar (2014, 2016) plus Lim *et al*. (2018) for Sangkar White-eye *Zosterops melanurus* and Gwee *et al*. (2019) for Javan Blue-flycatcher *Cyornis banyumas*.

Results

Altogether, 234 bird species were recorded at any time during the surveys, with 184 of these recorded on the transects themselves. Appendix S1 provides a full list of occurrence and encounter rate data for all species recorded on transects. Encounter rates were positively skewed, with the majority of species occurring on few transects and at low rates (Figure 2a). In fact, only 14 species were recorded at rates above 0.5 encounters per hour, just 0.1 encounters per hour greater than the median value. Only two species (Javan Tesia *Tesia superciliaris* and Pygmy Cupwing *Pnoepyga pusilla*) had rates > 1 encounters per hour. Rates decreased with decreasing site/transect occupancy (Figure 2a) but showed little difference across categories of extinction risk (Figure 2b).

A total of 32 species of elevated conservation concern (2 CR, 5 EN, 9 VU and 16 NT) were recorded, either on transects (26 species) or incidentally (Table 2). Orange-spotted Bulbul *Pycnonotus bimaculatus* was the only species of elevated conservation concern to be recorded on transects on every mountain, being also found on most transects and generally at high encounter rates. The transects were clearly more appropriate for recording some species than certain others such as the nocturnal species; for example, Salvadori's Nightjar *Caprimulgus pulchellus* was encountered incidentally on all twelve mountains but only on five mountains during transect surveys. Surprisingly, the Javan Cochoa *Cochoa azurea*, a retiring, unobtrusive species, was recorded at nearly every site and on all but one mountain, while Javan Trogon *Apalharpactes reinwardtii*, previously known from only three of the mountains sampled prior to our surveys (Collar & van Balen 2002), was recorded at nine of them and in around two-thirds of sites. These two species also had reasonably high and quite consistent (low SD) encounter rates across transects. Two heavily trapped threatened species—Rufous-fronted Laughingthrush (around half of mountains and sites) and Spotted Crocias *Laniellus albonotatus* (around two-thirds of sites/mountains)—proved

189 to occur quite widely. Incidental records of the Critically Endangered Javan Blue-banded
190 Kingfisher *Alcedo euryzona* at single sites on four mountains are notable as there are
191 just a handful of records of the species since the 1930s (Chan & Setiawan 2019).

192 Of the 26 non-threatened but trapped species we considered (Table 3), four stand out as
193 present at few sites, rarely encountered, or both, namely Javan Oriole *Oriolus cruentus*
194 (7 sites on 3 mountains; IUCN Red List category Data Deficient), Chestnut-backed
195 Scimitar-babbler *Pomatorhinus montanus* (6 sites on 4 mountains), and Mountain Serin
196 *Chrysocorythus estherae* and Javan Blue-flycatcher (both single records only). In
197 contrast, Chestnut-bellied Partridge *Arborophila javanica*, Sunda Minivet *Pericrocotus*
198 *miniatus*, Rufous-tailed Fantail *Rhipidura phoenicura*, Chestnut-fronted Shrike-babbler
199 *Pteruthius aenobarbus*, Javan Grey-throated White-eye *Heleia javanica*, Snowy-browed
200 Flycatcher *Ficedula hyperythra*, Indigo Flycatcher *Eumyias indigo*, Little Pied Flycatcher
201 *Ficedula westermanni* and White-flanked Sunbird *Aethopyga eximia* all occurred on over
202 half of transects, at the great majority of sites on nearly all mountains. While these were
203 fairly consistently recorded across transects at sites, two species, Mountain White-eye
204 *Zosterops japonicus* (16 of 37 sites but only 32 of 295 transects) and White-bibbed
205 Babbler *Stachyris thoracica* (20 sites, 35 transects), were found at a reasonable number
206 of sites but only on very few transects, suggesting their local rarity.

207 Table 4 shows comparisons of mean encounter rates (groups per hour) across the
208 surveys. We were able to make reasonable comparisons for eleven species. Of these, we
209 posit that Javan Green Magpie, Chestnut-backed Scimitar-babbler, Javan Fulvetta and
210 Javan Grey-throated White-eye appear to have encounter rates from our study
211 markedly lower than those presented previously.

212 **Discussion**

Java holds high levels of bird endemism, and yet our study represents a rare attempt—another such being van Balen *et al*. (1999)—to gauge abundance systematically in the island's key birds. It also represents the first documented ornithological surveys of many of the mountains in decades. This was a data gap that needed to be filled, given the rates of environmental change on the island and especially the breadth and volume of bird trapping to supply demand for songbirds (Eaton *et al*. 2015, Marshall *et al*. 2020). During over two years of biodiversity surveys, we recorded 234 species, including 32 threatened or Near Threatened taxa. Some species suspected to be scarce were in fact widespread and reasonably often encountered at sites. Species such as Javan Trogon and Javan Cochoa, and, to a certain extent, the traded Rufous-fronted Laughingthrush, were encouragingly well-recorded. There was, however, a larger suite of species that were rarer than anticipated: Crested Jay, White-breasted Babbler, Sangkar White-eye, Javan Oriole, Brown-cheeked Bulbul, White-bellied Fantail *Rhipidura euryura*, Chestnut-backed Scimitar-babbler, Mountain Serin and Javan Blue-flycatcher were all either restricted to a few sites, uncommonly recorded within sites, or both. Crested Jay *Platylophus galericulatus*, recorded at just five sites on four mountains, and White-breasted Babbler *Stachyris grammiceps*, on just three transects on three mountains, were likely rare in our surveys as most effort was above the elevational range of the species (survey effort at just three and seven sites respectively were within the core elevational range of the species: Eaton *et al.* 2021). Javan Oriole is so poorly known that it may never have been that common in Java's mountains (BirdLife International 2021), but trapping for the cagebird trade must surely be a concern for several taxa. For both the traded or threatened species and the common 'Least Concern' birds, our occurrence and encounter rate data represent a first baseline against which future trends in bird abundance can be gauged.

A general frustration in conservation biology is the lack of comparable historical data against which to gauge current population densities, thus preventing population trends from being accurately assessed (e.g. Annorbah et al. 2016). In our case, a literature review revealed no published papers that had used similar encounter rates along transects to survey montane birds in Indonesia, but we did have reasonably comparable counts made in the 1980s and 1990s on the same or nearby mountains. We acknowledge that we must interpret these encounter rates with great caution, for several reasons including survey effort and seasonal differences, but most importantly because we are not comparing the same sites. This said, we do suggest that some potentially interesting patterns emerge. Several species in the current study appear to occur at encounter rates fairly like those from the 1980s and 1990s—the fantails, White-bibbed and Crescent-chested Babblers, Indigo Flycatcher, and notably Rufous-fronted Laughingthrush among them. There is some support for the notion that Orange-spotted Bulbul, Javan Fulvetta *Alcippe pyrrhoptera* (see Appendix 1) and Javan Grey-throated White-eye may have declined, but this is not strong, given the necessary caveats. In contrast, Chestnut-backed Scimitar-babbler does seem to have become scarcer.

Our work produced a number of new localities for species of conservation interest. We found Javan Scops Owl *Otus angelinae* and Brown (or Sunda) Wood Owl *Strix* (*leptogrammica*) *bartelsi* on Mt Slamet for the first time, both formerly known from only a few sites. The relatively large and colourful Javan Trogon was found on Slamet, Cikuray, Limbung, Patuha, Masigit, Tilu, Kencana, Simpang, and Papandayan. The more cryptic Javan Cochoa was recorded at all the above plus Malabar and Guntur. Sunda Grasshopper Warbler *Locustella montis* was found on Slamet and Tilu. White-breasted Babbler, a species known to be present on the foothills of Patuha, Cikuray and Slamet

(van Balen *et al*. 2005), was not recorded at these sites but compensated by turning up at three new sites (Masigit, Kencana, Papandayan) during our surveys. Mountain White-eye was previously recorded only as far west as Papandayan (Mees 1996), but we recorded it at several mountains (Patuha, Masigit, Tilu, Malabar, Kencana and Wayang-Windu) up to 50 km further west. None of the new localities can be considered to reflect recent colonisations; rather they far more likely represent lack of contact in earlier surveys. However, our failure to find White-breasted Babblers at three known sites for the species should be treated as a warning signal: the species may simply have been missed, perhaps because most of our survey efforts was above the elevations where it usually occurs, but it is equally possible that it has steeply declined or disappeared entirely. This is a species that joins understorey mixed flocks in numbers (van Balen *et al.* 2005) and, as such, might be easily caught in mist-nets. We encourage future visiting birdwatchers to determine which of these scenarios is correct.

As with most status assessments of species in tropical forests, the lack of a historical baseline against which to compare current bird abundance (e. g. Hughes 2017) is frustrating. This is especially true of most of the mountains included in our survey, some of which have not been visited by biologists and naturalists for decades (as inferred from the absence of their names in online search engines considering both academic and popular postings). Without such a baseline, we can at least report on current occurrence and likely abundance, as a core portion of the montane avifauna is both widespread across mountains and readily recorded within sites. This includes Sunda Minivet, Rufous-tailed Fantail, Chestnut-fronted Shrike-babbler, several flycatchers and White-flanked Sunbird. The list even includes some Red List species, like Javan Cochoa and Orange-spotted Bulbul, classified as Vulnerable and Near Threatened on account of habitat loss and trapping respectively (BirdLife International 2021). The

abundance of Chestnut-bellied Partridge is encouraging, given the concern for other ground-dwelling galliforms in Java and elsewhere in Indonesia (Boakes *et al*. 2019). It seems likely that, in this part of Java at least, the partridge is no longer targeted for food in numbers by trappers. That components of Java's montane avifauna remain largely intact bodes well for both their populations in coming years, and for ecosystem functioning (e.g. Loreau *et al*. 2001).

In stark contrast, however, we had only a single and unconfirmed record, from one of the team's local guides, of the Critically Endangered Javan Green Magpie, and we must assume that excessive trade has pushed this once reasonably widespread but perhaps never common species (MacKinnon 1988; van Balen *et al*. 2013) to the very brink of extinction. Javan Blue-flycatcher, also suffering from trade pressure (Eaton *et al*. 2015), was recorded just once, although most of our survey effort was above its usual elevational range. Hoogerwerf (1969–1971) described it as 'one of the commonest flycatchers in Java, perhaps more common at moderate elevations than in the lowlands or highlands', while in the 1980s the species was described as 'one of the commoner flycatchers at moderate to high elevations' (MacKinnon 1988). It is now extremely rare in the lowlands (Eaton *et al*. 2021) and was recorded only three times in over 20,000 bird lists in a month-long citizen science event in Java and Bali (Squires *et al*. 2021). This species, about to be recognised as Critically Endangered (BirdLife International pers. com.), clearly warrants urgent searches in forests not covered in our survey. While several babbler species appear to be relatively widespread, the current rarity of Chestnut-backed Scimitar-babbler is a major concern, given its frequency in bird markets (Chng & Eaton 2016; S. Marsden pers. obs.), and especially given that the taxon is likely soon to be treated as a Javan endemic by BirdLife International. This species was, in the 1980s and 1990s, relatively easily recorded in Java's mountains and was

described as ‘a not uncommon bird, found in loose parties’ (MacKinnon 1988). Similarly, the abundance of White-bellied Fantail seems to have declined: around a century ago it was collected in numbers similar to those of the related Rufous-tailed Fantail (M. Bartels 1895–1936 unpubl. data) and both species were considered fairly common by MacKinnon (1988), yet White-bellied was recorded on nearly ten times fewer transects as Rufous-tailed in our fieldwork. It is likely that the latter’s higher elevational preference has served it well in terms of protection against forest alteration, excessive trapping or both. However, these suggestions of abundance declines must be interpreted cautiously, although they certainly are backed up by the perceptions of ornithologists with experience on the island for decades (BvB pers. obs.).

While some of Java’s montane areas, such as Mts Halimun-Salak and Gede-Pangrango, have been formally protected as national parks since the last century (www.protectedplanet.net), the majority of the forested highlands in West and Central Java are under either weaker management or no protection at all (Higginbottom *et al*. 2019). Indeed, the objective of our fieldwork was either to support moves towards gazetting further areas as formal reserves, or to enhance protection in alternative ways. Several mountains have stood out as particularly warranting protection, including Mt Slamet, the furthest east of our sites, along with Masigit, Kencana, and Tilu (Devenish *et al*. 2021). Key taxa driving these judgements included the Endangered Javan Hawk-eagle *Nisaetus bartelsi*, Javan Leopard *Panthera pardus melas* and Javan Gibbon *Hylobates moloch*, which are among the Indonesian governments Priority species for recovery (Mardiastuti et al. 2008), but others such as Critically Endangered Rufous-fronted Laughingthrush should also guide decisions. Arguably, however, there are key birds on all mountains surveyed.

How individual sites are best protected is open to debate, but the Indonesian authorities have recently moved away from the idea of further 'national parks' towards a more integrated form of land management. This, largely but not wholly in partnership with private sector entities, involves land and forest protection combined with income generation in an 'Essential Ecosystem Areas' (EEAs) framework (Sahide *et al*. 2020, Devenish *et al*. 2021). Some of our key species will of course benefit from forest protection and restoration, particularly at the lower sections of mountains which have lost most forest in recent decades (Higginbottom *et al*. 2019). We encountered evidence of bird trapping at all but six of the 38 sites we visited, and all but one site had cut trails that may well have been used for bird trapping (Appendix S2). The survival of a suite of species including Javan Green Magpie, Crested Jay, Javan Blue-flycatcher and Chestnut-backed Scimitar-babbler will depend on efforts over the next decade to (1) reduce demand for songbirds; (2) enforce restrictions on trapping and trading of key species; and (3) work with local communities at individual sites either to protect remaining populations or to create socio-ecological conditions suitable for re-introductions. This last action appears the most feasible at present, and indeed initiatives centred on species such as Javan Green Magpie are underway. A cornerstone of such initiatives must be to identify and create alternative livelihoods to those who currently gain at least part of their income from bird trapping.

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Table 1. The twelve mountain regions visited with dates, altitudes worked and survey effort.

Mountain	No. sites	Dates	Alt. range (m)	Trans	km	hrs
Slamet	5	14/9–16/10/2018	808–2751	52	103	219
Cikuray	2	19/11–5/12/2018	1593–2806	13	23	45
Patuha	2	24/2–6/3/2019	1793–2354	9	16	28
Tilu	3	8/4–6/5/2019	1295–2116	29	72	105
Malabar	2	17/7–29/7/2019	754–2322	15	43	51
Wayang-Windu	1	7/10–9/10/2019	1808–2160	9	16	32
Limbung	3	11/12/19–3/2/2020	994–1782	22	44	73
Masigit	6	13/3–12/10/2020	1100–2047	43	116	175
Kencana	5	28/8–22/9/2020	1091–2116	37	82	132
Simpang	2	8/8–20/8/2020	1044–1594	16	36	54
Papandayan	3	5/12–24/12/2020	1982–2321	22	37	54
Guntur	3	10/2–6/3/2021	1377–1933	28	35	65

Table 2. Occurrence per site for 32 bird species of conservation concern. Summary data are given for observations on transects (26 species), including encounter rate + standard deviation, number of transects, sites and mountain regions. Incidental records away from transects are included in the totals inside parenthesis; six species were only observed off transects. Species which are currently heavily trapped are shown in **bold**. IUCN Red List categories are CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened. * Species endemic to Java and Bali; † species with subspecies endemic to Java and Bali. Elevational ranges (see Hoogerwerf 1948, Eaton et al. 2021) are m = strictly montane, mainly 1000–3000m, but many start at a lower altitude, s = found at 0–1500m but preferring the higher parts of this zone, l = found at 0–1500m, more inland, higher than sea level, but usually not higher than 800m; all other species are less restricted, but below 1500m.

	Transect (n=295)	Sites (n=37)	Mts (n=12)	ER ± SD (min–max)
Asian Woollyneck *Ciconia episcopus* NT	1	1 (1)	1 (1)	0.06
Javan Hawk-eagle *Nisaetus bartelsi* EN *s	25	11 (21)	7 (9)	0.09 ± 0.06 (0.02–0.20)
Rufous-bellied Eagle *Lophotriorchis kienerii* NT	0	(3)	(3)	
Javan Woodcock *Scolopax saturata* NT m	5	4 (6)	3 (3)	0.07 ± 0.04 (0.03–0.12)
Sumatran Green-pigeon *Treron oxyurus* NT m	1	1(2)	1 (2)	0.03
Yellow-throated Hanging-parrot *Loriculus pusillus* NT * s	36	18 (22)	7 (9)	0.11 ± 0.08 (0.03–0.30)
Javan Scops-owl *Otus angelinae* VU * m	5	3 (18)	2 (10)	0.07 ± 0.10 (0.01–0.18)

516	Salvadori's Nightjar *Caprimulgus pulchellus* NT † m	16	8 (29)	5 (12)	0.09 ± 0.08 (0.02–0.25)
517	Waterfall Swift *Hydrochous gigas* NT m	2	1 (5)	1 (4)	0.11
518	Volcano Swiftlet *Aerodramus vulcanorum* NT* m	0	(5)	(3)	
519	Javan Trogon *Apalharpactes reinwardtii* VU * m	59	24 (27)	9 (10)	0.11 ± 0.07 (0.02–0.25)
520	Javan Blue-banded Kingfisher *Alcedo euryzona* CR*	1	1 (4)	1 (4)	0.02
521	Rhinoceros Hornbill *Buceros rhinoceros* VU †	0	(1)	(1)	
522	Wreathed Hornbill *Rhyticeros undulatus* VU	9	3 (4)	3 (3)	0.13 ± 0.10 (0.02–0.22)
523	Black-banded Barbet *Psilopogon javensis* NT*	5	4 (4)	3 (4)	0.05 ± 0.02 (0.03–0.07)
524	Javan Yellownape *Chrysophlegma mentale* NT * s	41	20 (22)	8 (10)	0.10 ± 0.07 (0.02–0.24)
525	Javan Flameback *Chrysocolaptes strictus* VU* s	4	3 (5)	3 (4)	0.07 ± 0.02 (0.05–0.09)
526	White-rumped Woodpecker *Meiglyptes tristis* EN*	2	2 (2)	2 (2)	0.04 ± 0.01 (0.03–0.05)
527	Javan Broadbill *Eurylaimus javanicus* NT* s	93	23 (25)	9 (9)	0.32 ± 0.24 (0.02–0.80)
528	**Crested Jay** *Platylophus galericulatus* NT †	11	5 (9)	4 (5)	0.11 ± 0.07 (0.04–0.22)

516	**Bar-winged Prinia** *Prinia familiaris* NT	1	1 (7)	1 (4)	0.05
517	**Ruby-throated Bulbul** *Rubigula dispar* VU	1	1 (2)	1 (1)	0.03
518	**Orange-spotted Bulbul** *Pycnonotus bimaculatus* NT m	100	31(32)	12 (12)	0.23 ± 0.30 (0.03–1.50)
519	**Brown-cheeked Bulbul** *Alophoixus bres* EN *	2	1 (1)	1 (1)	0.23
520	White-breasted Babbler *Stachyris grammiceps* NT * l	3	3 (3)	3 (3)	0.09 ± 0.10 (0.02–0.21)
521	**Rufous-fronted Laughingthrush** *Garrulax rufifrons* CR* m	39	14 (14)	6 (6)	0.16 ± 0.20 (0.02–0.60)
522	**Spotted Crocias** *Laniellus albonotatus* NT * m	77	21 (22)	8 (9)	0.27 ± 0.34 (0.03–1.38)
523	**Sangkar White-eye** *Zosterops melanurus* VU s	37	15 (20)	8 (8)	0.13 ± 0.09 (0.03–0.32)
524	Javan Myna *Acridotheres javanicus* VU	0	(4)	(3)	
525	Javan Cochoa *Cochoa azurea* VU * m	100	31 (31)	11 (11)	0.18 ± 0.15 (0.03–0.51)
526	**Greater Green Leafbird** *Chloropsis sonnerati* EN † l	0	(1)	(1)	
527	**Javan Leafbird** *Chloropsis cochinchinensis* EN* s	0	(5)	(4)	

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Table 3. Occurrence and encounter rates for 26 heavily trapped but non-threatened birds across the twelve Javan mountains surveyed. * Species endemic to Java and Bali; † species with subspecies endemic to Java and Bali. See Table 2 for elevational ranges.

	Transect (n=295)	Sites (n=37)	Mts (n=12)	ER ± SD (min–max)
Chestnut-bellied Partridge *Arborophila javanica* *m	205	37	12	0.47 ± 0.23 (0.09–1.02)
Pink-headed Fruit-dove *Ptilinopus porphyreus* m	76	24	9	0.21 ± 0.20 (0.02–0.68)
Dark-backed Imperial-pigeon *Ducula lacernulata* † m	32	11	6	0.11 ± 0.11 (0.02–0.35)
Sunda Minivet *Pericrocotus miniatus* m	173	37	12	0.33 ± 0.22 (0.03–0.92)
Javan Oriole *Oriolus cruentus* * m	11	7	3	0.12 ± 0.08 (0.04–0.28)
Rufous-tailed Fantail *Rhipidura phoenicura* * m	172	36	12	0.33 ± 0.20 (0.03–0.78)
White-bellied Fantail *Rhipidura euryura* *m	23	10	6	0.13 ± 0.10 (0.02–0.35)
Javan Bulbul *Ixos virescens* *m	109	25	9	0.38 ± 0.27 (0.03–0.86)
White-bibbed Babbler *Stachyris thoracica* *m	35	20	9	0.11 ± 0.18 (0.01–0.87)
Chestnut-fronted Shrike-babbler *Pteruthius aenobarbus* †m	156	31	12	0.42 ± 0.29 (0.04–1.07)

516	Chestnut-backed Scimitar-babbler *Pomatorhinus montanus* †m	10	7	4	0.06 ± 0.04 (0.02–0.13)
517	Mountain White-eye *Zosterops japonicus* m	32	16	10	0.08 ± 0.06 (0.03–0.23)
518	Javan Grey-throated White-eye *Heleia javanica* †m	149	33	12	0.43 ± 0.39 (0.04–2.00)
519	Velvet-fronted Nuthatch *Sitta frontalis* †	32	14	8	0.14 ± 0.13 (0.02–0.54)
520	Blue Nuthatch *Sitta azurea* †m	68	26	11	0.12 ± 0.08 (0.02–0.28)
521	Javan Shortwing *Brachypteryx montana* *m	44	18	10	0.13 ± 0.10 (0.03-0.30)
522	Sunda [Javan] Blue Robin *Myiomela diana* †m	47	22	9	0.12 ± 0.11 (0.02–0.45)
523	Snowy-browed Flycatcher *Ficedula hyperythra* m	174	34	12	0.46 ± 0.28 (0.03–1.07)
524	Little Pied Flycatcher *Ficedula westermanni* m	232	36	12	0.85 ± 0.47 (0.08–1.99)
525	Indigo Flycatcher *Eumyias indigo* *m	156	33	12	0.34 ± 0.21 (0.04–0.85)
526	Javan Blue-flycatcher *Cyornis banyumas* †	1	1	1	0.04
527	White-flanked Sunbird *Aethopyga eximia* *m	162	36	12	0.37 ± 0.29 (0.02–1.39)
528	Javan Sunbird *Aethopyga mystacalis* *s	40	15	8	0.24 ± 0.28 (0.01–1.00)

Tawny-breasted Parrotfinch *Erythrura hyperythra* †m	20	10	6	0.09 ± 0.06 (0.02–0.21)
Pin-tailed Parrotfinch *Erythrura prasina* s	4	4	3	0.03 ± 0.02 (0.01–0.05)
Mountain Serin *Chrysocorythus estherae* m	1	1	1	0.03

Table 4. Comparisons of mean encounter rates (bird groups per hour) for selected songbirds between surveys done in the 1980s and 1990s and our study (numbers in parentheses are maximum and minimum at occupied sites). Also shown are dates, altitudes and survey effort (hours of morning fieldwork).

Attribute/Species	Gede-Pangrango 1981	Puncak 1981	Slamet 1995	This study
Dates	2/4–20/7	31/3–22/6	28/6–undated	14/09/18–06/03/21
Hours/days surveying	35.5 / 6	27.7 / 7	10.4 / 3	1031/127
Altitudinal range (m)	1,450–1,700	~1,600	600–2,500	754–2,806
Rufous-tailed Fantail	0.25	0.14	0.96	0.33 (0.03–0.78)
White-bellied Fantail	0.11	0	0.19	0.13 (0.02–0.35)
Javan Green Magpie	0.06	0.07	0	0
Orange-spotted Bulbul	0.17	0.61	0.96	0.23 (0.03–1.50)
White-bibbed Babbler	0.08	0.11	0	0.11 (0.01–0.87)
Chestnut-backed Scimitar-babbler	0.82	0.90	1.05	0.06 (0.02–0.13)
Crescent-chested Babbler	0.23	0.61	2.01	0.90 (0.12–1.84)
Javan Fulvetta	1.49	0.98	1.73	0.76 (0.25–2.90)
Rufous-fronted Laughingthrush	0.42	0.22	0	0.16 (0.02–0.60)
Javan Grey-throated White-eye	0.90	1.48	2.11	0.43 (0.04–2.00)
Indigo Flycatcher	0.20	0.29	0.29	0.34 (0.04–0.85)

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Figure 1. Survey sites (filled circles) in 12 montane areas (differing shades of grey denote clusters of sites nested within individual mountains) located in West and Central Java, Indonesia, showing forest cover (green shading).

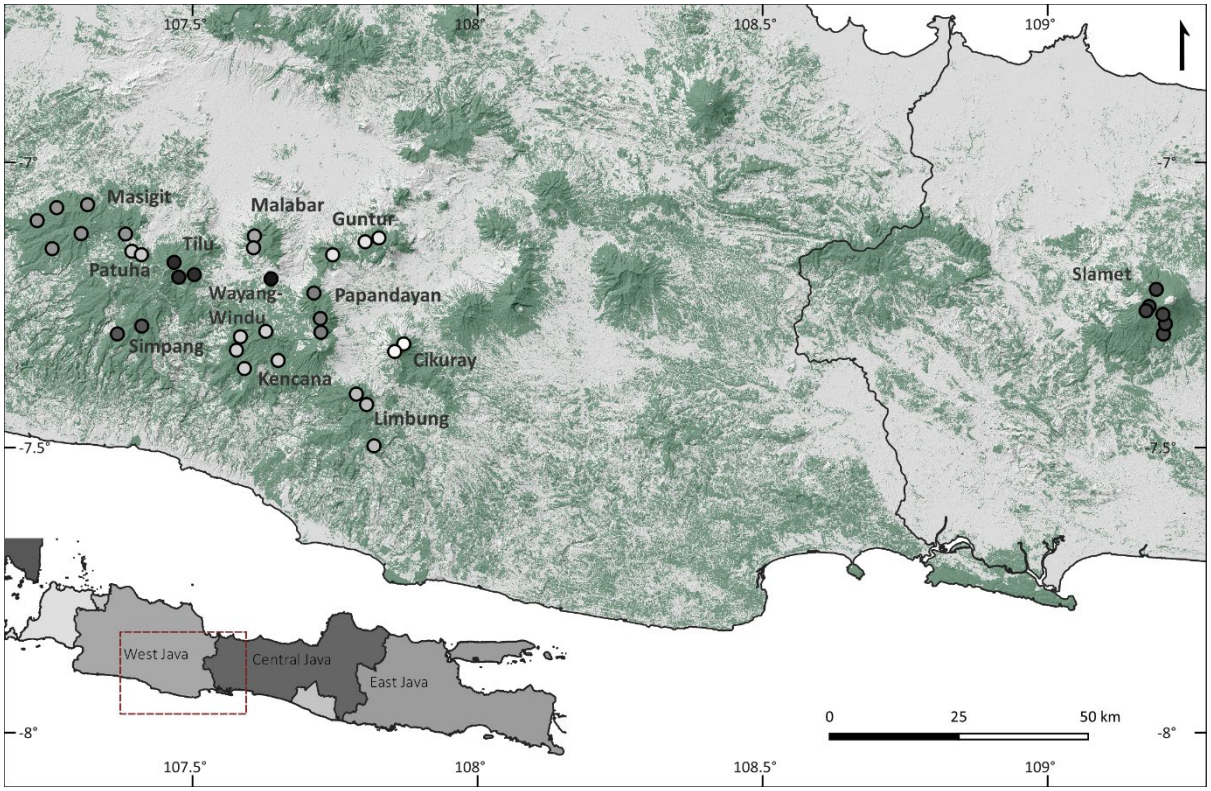
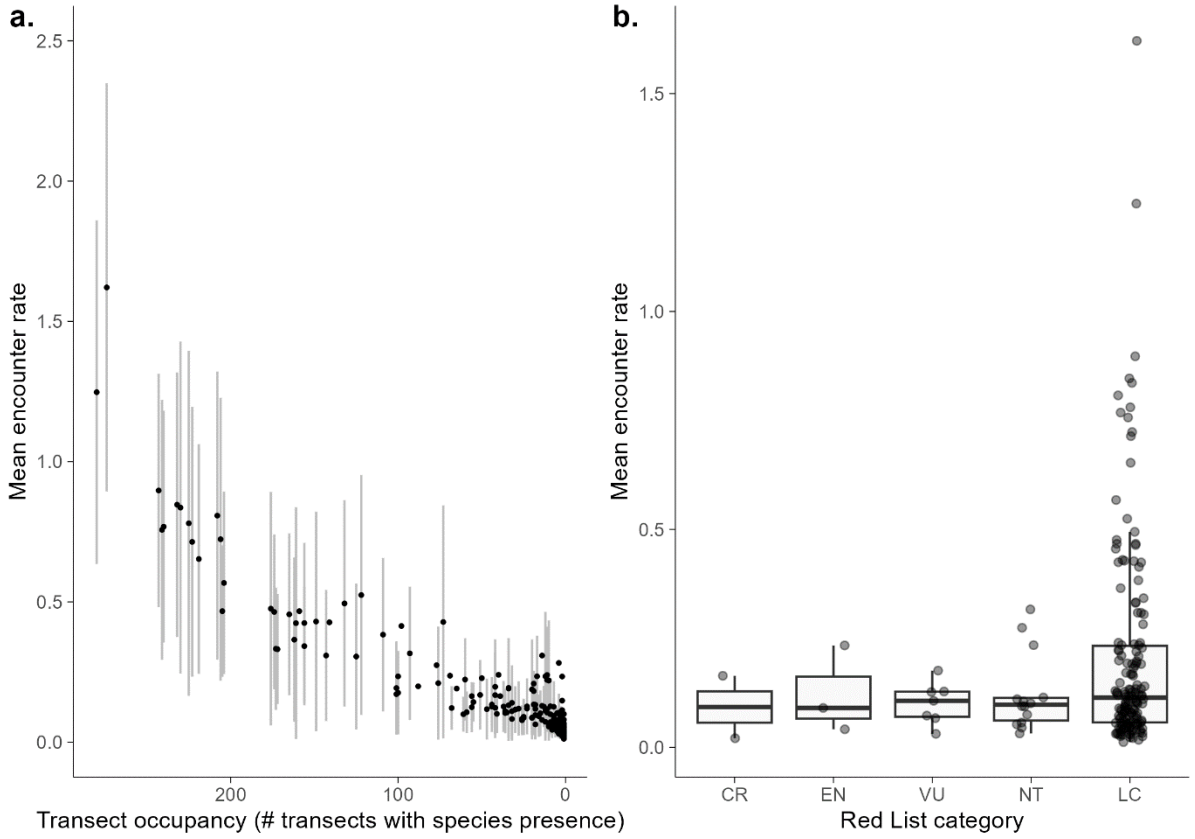


Figure 2. Mean encounter rates (groups per hour) for 184 bird species across 37 sites in 12 western Javan mountain regions. Shown are a) the relationship between transect occupancy (number of transects with species presence) and encounter rates (grey bars show 1 standard deviation); b) median and variability of encounter rates grouped by global red list categories (2021 assessment).



Appendix S1. Full list of bird species recorded on transects across twelve mountains in Java. Also shown are mean, SD, minimum and maximum encounter rates for each species, along with the number of transects, sites and mountains on which they were recorded. We do not identify bird records with particular sites or mountains for reasons of security, but these data are available to *bona fide* individuals on request.

Appendix S2. Characteristics of individual sites surveyed. Shown are number of transects, mean, maximum and minimum altitudes of transects, and main habitat type. No transects were walked at Ketenger 1 at Slamet. Also shown is the number of habitat plots surveyed at sites, and the proportion of these at which bird trapping and cut trails were recorded. Level of habitat disturbance was coded according to proportion of plots at which cut stems were recorded: 0.0–0.2 = Low; 0.2–0.5 = Medium; >0.5 = High.