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1

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

4

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16

17 **Short title:** Threatened birds of West Javan mountains

18

19 **Keywords:** abundance; conservation; Asian Songbird Crisis; endemic; trapping;
20 baseline

21 **Abstract**

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

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43 **Introduction**

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

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

69 2013). The absence of recent information on these two species at so many sites, and
70 indeed on the extent and condition of their habitat there, has rendered it problematic to
71 assess their IUCN Red List status or to identify the most appropriate conservation
72 measures; and the same difficulty affects all other species occupying a similar range.

73 Preliminary to fieldwork to address this issue, an analysis of satellite images of 19
74 volcanoes in West Java attempted to assess, as best as possible, the extent of remaining
75 montane forest on their slopes (Higginbottom *et al.* 2019). This indicated that much of
76 the most accessible lower-altitude montane forest has already disappeared and only
77 some 5,200 km² of montane forest remains, often as fragmented isolates, although
78 official protection has slowed deforestation rates in recent decades (Higginbottom *et al.*
79 2019). However, a further problem in assessing the conservation status and needs of
80 the bird species in these forests is the intense pressure on Java's songbirds exerted by
81 the cagebird and song competition industries (Marshall *et al.* 2020). So great is the
82 concern over the fate of the Rufous-fronted Laughingthrush and Javan Green Magpie
83 that they have become the precautionary subject of intensive (and expensive) captive-
84 breeding initiatives (Collar *et al.* 2012, Owen *et al.* 2014), despite the possibility that
85 populations might survive in some of the forests where no surveys have been
86 undertaken in 50 years or more. Equally, if such populations survive but are in poor
87 condition or simply remain unknown, the opportunity may be lost to put in place
88 measures to secure them for the long term. Moreover, a further value in a modern
89 inventory of these forests is their potential for reintroductions of captive-bred birds, if
90 (a) the sites prove to be in good condition but 'empty', having lost the species in
91 question to trapping, and (b) they can be better protected under new management
92 systems.

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

105 We undertook a two-year bird survey across eleven West (plus one western Central)
106 Javan mountains aimed at identifying areas for enhanced biodiversity protection;
107 mammals and certain amphibians were also surveyed (see, e.g., Devenish *et al.* 2021)
108 but will be reported elsewhere. Here we present occurrence data for bird species from
109 622 km of transects from 37 sites on the twelve mountains, and encounter rate data
110 (groups encountered per hour) aggregated across sites. We do not identify bird records
111 with particular sites or mountains for reasons of security, but these data are available to
112 *bona fide* individuals on request.

113

114 **Methods**

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

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

129 At each site, we walked transects of variable length and duration along trails
130 emanating from our camp, noting bird species, number of individuals per group and
131 time of day. Transects were generally walked during the period 06h00–09h00, at an
132 approximate speed of 1 km hr⁻¹. In all, 295 transects totalling 622 km and 1031 hours'
133 effort were walked across the 37 sites over 127 days between 14/09/2018 and
134 06/03/2021. The mean length of each transect was 2.1 km, with a mean number of
135 transects per site of 8.0 (min = 4, max = 16) and a mean length per site of 16.8 km.
136 Transects were walked by one or more of 13 experienced recorders, but with three
137 recorders (ARJ: 206 km; GCA: 189 km; and FM: 63 km) contributing nearly 75% of all
138 transect length.

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

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

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

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

162

163 **Results**

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

173 A total of 32 species of elevated conservation concern (2 CR, 5 EN, 9 VU and 16 NT)
174 were recorded, either on transects (26 species) or incidentally (Table 2). Orange-
175 spotted Bulbul *Pycnonotus bimauculatus* was the only species of elevated conservation
176 concern to be recorded on transects on every mountain, being also found on most
177 transects and generally at high encounter rates. The transects were clearly more
178 appropriate for recording some species than certain others such as the nocturnal
179 species; for example, Salvadori's Nightjar *Caprimulgus pulchellus* was encountered
180 incidentally on all twelve mountains but only on five mountains during transect
181 surveys. Surprisingly, the Javan Cochoa *Cochoa azurea*, a retiring, unobtrusive species,
182 was recorded at nearly every site and on all but one mountain, while Javan Trogon
183 *Apalharpactes reinwardtii*, previously known from only three of the mountains sampled
184 prior to our surveys (Collar & van Balen 2002), was recorded at nine of them and in
185 around two-thirds of sites. These two species also had reasonably high and quite
186 consistent (low SD) encounter rates across transects. Two heavily trapped threatened
187 species—Rufous-fronted Laughingthrush (around half of mountains and sites) and
188 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**

213 Java holds high levels of bird endemism, and yet our study represents a rare attempt—
214 another such being van Balen *et al.* (1999)—to gauge abundance systematically in the
215 island’s key birds. It also represents the first documented ornithological surveys of
216 many of the mountains in decades. This was a data gap that needed to be filled, given
217 the rates of environmental change on the island and especially the breadth and volume
218 of bird trapping to supply demand for songbirds (Eaton *et al.* 2015, Marshall *et al.*
219 2020). During over two years of biodiversity surveys, we recorded 234 species,
220 including 32 threatened or Near Threatened taxa. Some species suspected to be scarce
221 were in fact widespread and reasonably often encountered at sites. Species such as
222 Javan Trogon and Javan Cochoa, and, to a certain extent, the traded Rufous-fronted
223 Laughingthrush, were encouragingly well-recorded. There was, however, a larger suite
224 of species that were rarer than anticipated: Crested Jay, White-breasted Babbler,
225 Sangkar White-eye, Javan Oriole, Brown-cheeked Bulbul, White-bellied Fantail
226 *Rhipidura euryura*, Chestnut-backed Scimitar-babbler, Mountain Serin and Javan Blue-
227 flycatcher were all either restricted to a few sites, uncommonly recorded within sites, or
228 both. Crested Jay *Platylophus galericulatus*, recorded at just five sites on four mountains,
229 and White-breasted Babbler *Stachyris grammiceps*, on just three transects on three
230 mountains, were likely rare in our surveys as most effort was above the elevational
231 range of the species (survey effort at just three and seven sites respectively were within
232 the core elevational range of the species: Eaton *et al.* 2021). Javan Oriole is so poorly
233 known that it may never have been that common in Java’s mountains (BirdLife
234 International 2021), but trapping for the cagebird trade must surely be a concern for
235 several taxa. For both the traded or threatened species and the common ‘Least Concern’
236 birds, our occurrence and encounter rate data represent a first baseline against which
237 future trends in bird abundance can be gauged.

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

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

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

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

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

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

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

323 While some of Java’s montane areas, such as Mts Halimun-Salak and Gede-Pangrango,
324 have been formally protected as national parks since the last century
325 (www.protectedplanet.net), the majority of the forested highlands in West and Central
326 Java are under either weaker management or no protection at all (Higginbottom *et al.*
327 2019). Indeed, the objective of our fieldwork was either to support moves towards
328 gazetted further areas as formal reserves, or to enhance protection in alternative ways.
329 Several mountains have stood out as particularly warranting protection, including Mt
330 Slamet, the furthest east of our sites, along with Masigit, Kencana, and Tilu (Devenish *et*
331 *al.* 2021). Key taxa driving these judgements included the Endangered Javan Hawk-
332 eagle *Nisaetus bartelsi*, Javan Leopard *Panthera pardus melas* and Javan Gibbon
333 *Hylobates moloch*, which are among the Indonesian governments Priority species for
334 recovery (Mardiastuti *et al.* 2008), but others such as Critically Endangered Rufous-
335 fronted Laughingthrush should also guide decisions. Arguably, however, there are key
336 birds on all mountains surveyed.

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

356

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

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

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516 Table 2. Occurrence per site for 32 bird species of conservation concern. Summary data are given for observations on transects (26
517 species), including encounter rate + standard deviation, number of transects, sites and mountain regions. Incidental records away from
518 transects are included in the totals inside parenthesis; six species were only observed off transects. Species which are currently heavily
519 trapped are shown in **bold**. IUCN Red List categories are CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near
520 Threatened. * Species endemic to Java and Bali; † species with subspecies endemic to Java and Bali. Elevational ranges (see Hoogerwerf
521 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
522 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
523 other species are less restricted, but below 1500m.

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

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

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

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516 Table 3. Occurrence and encounter rates for 26 heavily trapped but non-threatened birds across the twelve Javan mountains surveyed. *

517 Species endemic to Java and Bali; † species with subspecies endemic to Java and Bali. See Table 2 for elevational ranges.

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

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

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

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516 Table 4. Comparisons of mean encounter rates (bird groups per hour) for selected songbirds between surveys done in the 1980s and
 517 1990s and our study (numbers in parentheses are maximum and minimum at occupied sites). Also shown are dates, altitudes and
 518 survey effort (hours of morning fieldwork).

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520	Attribute/Species	Gede-Pangrango 1981	Puncak 1981	Slamet 1995	This study
521	Dates	2/4–20/7	31/3–22/6	28/6–undated	14/09/18–06/03/21
522					
523	Hours/days surveying	35.5 / 6	27.7 / 7	10.4 / 3	1031/127
524	Altitudinal range (m)	1,450–1,700	~1,600	600–2,500	754–2,806
525	Rufous-tailed Fantail	0.25	0.14	0.96	0.33 (0.03–0.78)
526	White-bellied Fantail	0.11	0	0.19	0.13 (0.02–0.35)
527	Javan Green Magpie	0.06	0.07	0	0
528	Orange-spotted Bulbul	0.17	0.61	0.96	0.23 (0.03–1.50)
529	White-bibbed Babbler	0.08	0.11	0	0.11 (0.01–0.87)
530	Chestnut-backed Scimitar-babbler	0.82	0.90	1.05	0.06 (0.02–0.13)
531	Crescent-chested Babbler	0.23	0.61	2.01	0.90 (0.12–1.84)
532	Javan Fulvetta	1.49	0.98	1.73	0.76 (0.25–2.90)
533	Rufous-fronted Laughingthrush	0.42	0.22	0	0.16 (0.02–0.60)
534	Javan Grey-throated White-eye	0.90	1.48	2.11	0.43 (0.04–2.00)
535	Indigo Flycatcher	0.20	0.29	0.29	0.34 (0.04–0.85)

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).

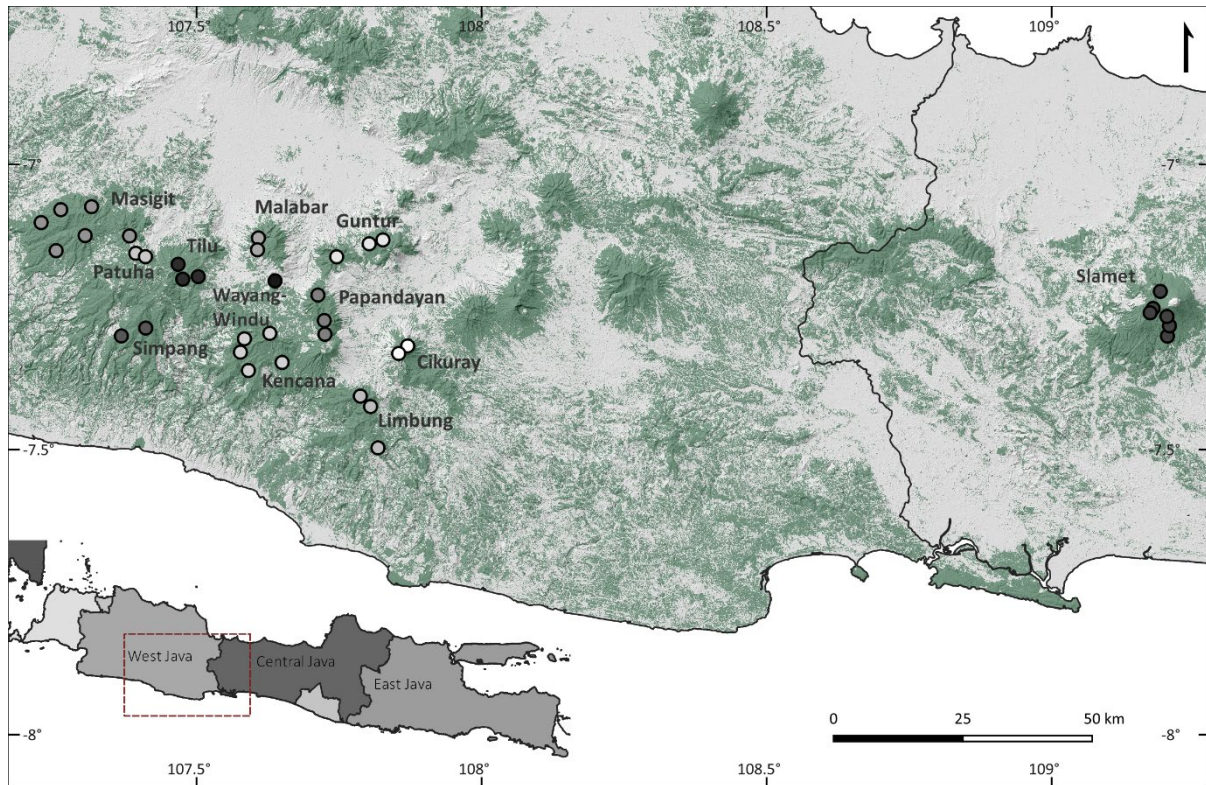
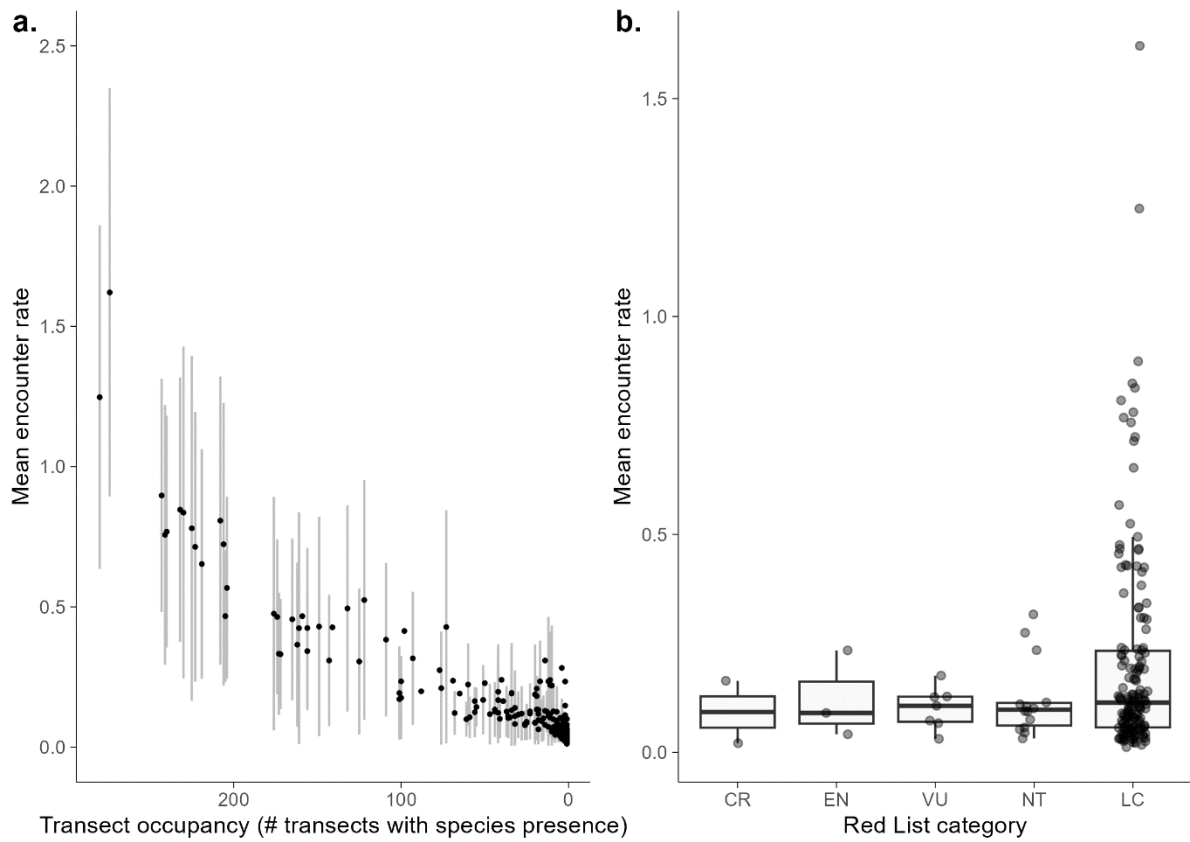


Figure 2. Mean encounter rates (groups per hour) for 184 bird species across 37 sites in 12 western Javan mountain regions. Shown are a) the relationship between transect occupancy (number of transects with species presence) and encounter rates (grey bars show 1 standard deviation); b) median and variability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