

The current status of the critically endangered Caerulean Paradise-flycatcher *Eutrichomyias rowleyi* on Sangihe, North Sulawesi

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Summary: The Caerulean Paradise-flycatcher *Eutrichomyias rowleyi* is one of eight endemic birds on Sangihe. Its remaining population is only known from primary forest in valleys between 390–674 m above sea level on Mount Sahendaruman. IUCN has categorized the species as Critically Endangered. The rediscovery of 19 individuals in 1998 sparked new hope of their continued survival. We conducted population surveys in 15 valleys on Mount Sahendaruman during May–June 2014. Our estimated population size of 34–150 individuals suggests that there has not been any significant increase. The small area of remaining primary forest on the mountain (519 ha) is assumed to be the main limiting factor on population growth. The conversion of forest into plantation remains the main threat to this species, alongside changes of forest floristic composition, with introduced plants pushing into its habitat. Participatory agreements on area management that were formulated in 2005, including zoning system, should be revitalized and replicated for other villages to conserve the species.

Ringkasan: Seriwang Sangihe *Eutrichomyias rowleyi* merupakan satu dari delapan jenis burung endemik Sangihe. Populasinya diketahui hanya tersisa di lembah-lembah hutan primer pada ketinggian 390–674 m dpl di Pegunungan Sahendaruman. IUCN telah mengkategorikan sebagai jenis kritis. Perjumpaan kembali jenis ini pada Oktober 1998 sebanyak 19 individu memberi harapan baru kelestarian mereka. Hasil survey populasi yang kami lakukan di Pegunungan Sahendaruman dalam 15 transek pada Mei–Juni 2014, tidak menunjukkan peningkatan populasi yang signifikan (34–150 individu). Luasan kecil hutan primer di pegunungan ini (519 ha) diduga menjadi faktor pembatas utama pertumbuhan populasinya. Hilangnya tutupan hutan tetap menjadi ancaman utama jenis ini, di samping perubahan komposisi hutan dengan tanaman-tanaman introduksi yang terus mendesak ke habitat utama seriwang sangihe. Kesepakatan partisipatoris mengenai pengelolaan area yang diformulasikan tahun 2005, termasuk sistem zonasinya, diharapkan dapat dikuatkan kembali serta direplikasi ke desa lain sebagai usaha melestarikan jenis ini.

Introduction

The Caerulean Paradise-flycatcher *Eutrichomyias rowleyi* (Plates 1) constitutes a monotypic genus of flycatchers (Moeliker & Sharpe 2016), and is one of eight bird species endemic to the island of Sangihe, north of Sulawesi. It is currently known only from Mount Sahendaruman on the south side of the island (Coates & Bishop 1997; BirdLife International 2001, 2014a). The type specimen was collected from Tabukan, Sangihe, and described by A.B. Meyer in 1878 (White & Bruce 1986). In May–June 1985 F.G. Rozendaal searched for, but failed to find, the species at Mount Sahendaruman (Rozendaal & Lambert 1999). In 1986 K.D. Bishop searched for the species during three days in the secondary forest of Mount Awu, on the north side of the island, and also failed to find any paradise-flycatcher (Whitten *et al.* 1987a).



Plate 1. Caerulean Paradise-flycatchers on Mount Sahendaruman, Sangihe.

A decade later an ornithological expedition party from the University of York, led by J. Riley, spent 15 days during 1995–1996 searching for the species on Mount Awu, without success. F.R. Lambert also failed to find the species there in 1996. Finally in August 1998, Riley and his team discovered two individuals on Mount Sahendaruman, and from October to December 1999 located a total of 19 individuals in five valleys of the mountain. Their observations also shed light on the types of habitat frequented by this paradise-flycatcher (Riley & Wardill 2001).

Five years after Riley's last sighting, another survey of the Caerulean Paradise-flycatcher was carried out by a team from BirdLife Indonesia through their Conservation of Key Forests in the Sangihe–Talaud Islands programme. During October–November 2004 and March–April 2006, the team had 13 sightings of birds in secondary forest/mixed cultivation and primary/old secondary forests in the valleys of Mount Sahendaruman, and estimated a total population of 23 individuals (Mamengko 2006). BirdLife Indonesia staff carried out monitoring of the species again in May–July 2009, and encountered 22 paradise-flycatchers in the valley's primary forest (Rosyadi 2009). Since the rediscovery of the species in 1998, the species has frequently been seen by birdwatchers on Mount Sahendaruman. However, no sightings have been made on Mount Awu (Dadoali *pers.com*).

Currently the species is classified as Critically Endangered using 2014 IUCN criteria because it has a tiny range and population, both of which are likely to have undergone major and continuing declines owing to extensive habitat loss (BirdLife International 2014a). This species was found almost exclusively in the sub-canopy and understorey (to ground level) of primary tropical hill rainforest on steep slopes in deep, damp valleys with small rocky streams, at altitudes of 425–650 m above sea level, though was occasionally observed in old secondary growth, dominated by *Cyathea* sp., *Piper* sp., and *Homalanthus* sp. at the forest edge below one deep valley (BirdLife International 2001).

Mamengko & Mole (2006) estimated that only 519 ha of primary forest and 229 ha of secondary forest remained on Mount Sahendaruman, almost all within the 3,594 ha of theoretically protected forest or *Hutan Lindung* (Fig.1). Mount Sahendaruman is among the most significant biodiversity sites in the world, hosting eight endemic bird species,

four of which are Critically Endangered (BirdLife International 2014a, 2014b, 2015a-g). Together with the Talaud Islands, Sangihe is an Endemic Bird Area (EBA) (Stattersfield *et al.* 1998; BirdLife International 2014d) and one of the 33 Important Bird and Biodiversity Areas (IBA) in the Sulawesi region (Sujatnika *et al.* 1995; Chan *et al.* 2004; BirdLife International 2016). This area has been designated as an Alliance for Zero Extinction site (American Bird Conservancy 2013) and an IBA in Danger (BirdLife International 2014b, 2014c). Furthermore, the Profile of Wallacean Ecosystems has included Mount Sahendaruman as a Key Biodiversity Area for which conservation action is a priority (Burung Indonesia 2014).

Since there has been no thorough survey of the Caerulean Paradise-flycatcher since 2009, our study aimed to estimate its current population and the status of its habitat on Mount Sahendaruman, as well as to determine if the species occurred on Mount Awu.

Methods

The survey was conducted over 21 days between 28 May and 7 July 2014 in valleys on the horseshoe-shaped caldera of Mount Sahendaruman, Sangihe Islands District, North Sulawesi Province. Surveys were carried out at seven camps, three of which were on the inner slopes of the horseshoe and four on the outer slopes of the horseshoe (Fig. 1). The camp locations were chosen on the basis of the known habitat requirements of the species. Based on examination of satellite images and on-ground observations, two or three transect lines were made in potentially suitable habitat near each camp (Table 1), and tracked using a GPS Garmin 60CSx. This resulted in 15 transects, each in a different valley. The total length of each transect and valley were later calculated using Google Earth software (Google Inc. 2013) to avoid inaccuracies caused by weak satellite signals and irregular walking paths.

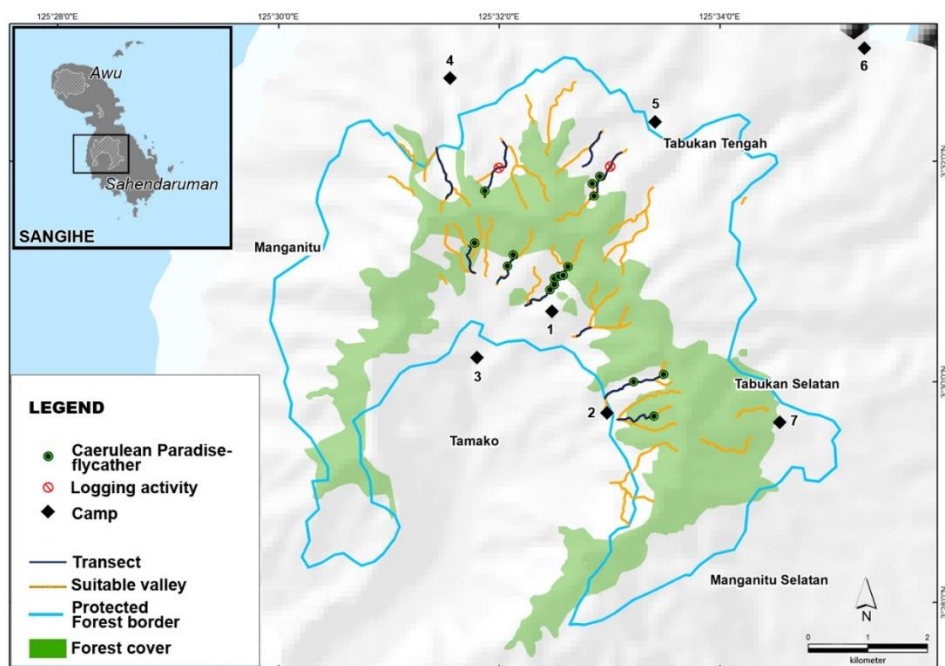


Figure 1. Map of survey locations, transects and point counts of Caerulean Paradise-flycatcher on Mount Sahendaruman, May–July 2014.

Table 1. Characteristics of the 15 survey transects and Caerulean Paradise-flycatcher sightings on Mount Sahendaruman, May–July 2014.

Camp	Village	Transect	Highest no. birds	Date of observation	Range of altitudes (m asl)
1	Ulung Peliang	1	11	28–31 May	352–560
1	Ulung Peliang	2	0	28–31 May	351–569
2	Lelipang	3	4	2–4 June	412–674
2	Lelipang	4	3	2–4 June	416–584
3	Ulung Peliang	5	5	6–8 June	265–511
3	Ulung Peliang	6	2	6–8 June	293–440
3	Ulung Peliang	7	0	6–8 June	306–513
4	Hiung	8	1	21–23 June	300–670
4	Hiung	9	0	21–23 June	357–628
5	Pelelangeng	10	8	25–27 June	334–526
5	Pelelangeng	11	0	25–27 June	323–532
6	Kulur 2	12	0	1–3 July	38–162
6	Kulur 2	13	0	1–3 July	233–407
7	Malamenggu	14	0	5–7 July	623–743
7	Malamenggu	15	0	5–7 July	694–835

We used line transects, combined with point counts, to maximise our opportunities of sighting the species. Due to the noise made by rivers, the species was rarely detected by its calls. Each transect was 1–2 km in length, with point counts at 200 m intervals. Observations were carried out each morning (06:00–10:00 hrs) and afternoon (14:00–17:00 hrs) to give a total of 505 field-hours. A total of 165 point counts were made along the 15 transects. The 11.7 km of transects ranged in elevation from 38 to 835 m asl. Surveys were conducted by two teams simultaneously sampling different transects. The observers walked slowly ($c.1 \text{ km h}^{-1}$) along the assigned transect, and stopped for 10 min at each point to do intensive searches. If sightings occurred while walking the transect or at the count points, the geographic position, elevation, time, type of habitat, number of individuals, and plumage were recorded. Attention was paid to the direction in which each bird flew in order to ascertain whether it was different from the previous bird seen. Each transect was walked twice or three times to provide replicate counts. Possible cases of double counting within each sample were removed.

For each transect, only one count (of two or three counts) with the highest number of birds was used for further population analysis, regardless of whether the counts came from different sampling times or not. The minimum population size was derived from the sum of these counts over all transects. The encounter rate was then calculated by summing the highest numbers of individuals on each transect, then dividing the resultant value by the total length of transects sampled. The maximum population size was extrapolated by multiplying the encounter rate by the estimated total length of potentially suitable habitat of paradise-flycatchers. Transect surveys were also conducted along the ridges above each of the seven valleys, but these were not counted included in the above data analysis.

A brief assessment of the habitat condition was carried out on every line transect. At each survey point, we recorded the species of ten nearest trees with a diameter of more than 10 cm, and visually estimated the canopy cover (%) within in radius of 15 m.

Potential and current threats were identified both on transects and around the forest of Mount Sahendaruman.

Rapid surveys were also carried out in seven valleys with apparently suitable habitat on Mount Awu. Altitudes ranging from 68 to 1,140 m asl were sampled within seven days in September 2014. The surveyed valleys were on the western, northern and eastern sides of the mountain where forests were present.

Results

The total length of transects sampled was 7.6 km, while the length of suitable habitat was estimated as 33.54 km. The encounter rate of Caerulean Paradise-flycatchers was 4.46 individuals km⁻¹ in suitable habitat. Using the observed number of individuals as the minimum range of the population, and the potential number as the maximum range, we estimate that the population on Mount Sahendaruman comprises between 34 and 150 individuals.

Even though observations were made at elevations ranging from 38 to 835 m asl, all 34 individuals were seen between 431 and 674 m asl. Twenty-two individuals were seen in primary forest (64.7%) and 12 individuals in secondary forests (35.3%). Their preference towards primary forest was also supported by the finding that all individuals were seen in areas with more than 51% canopy cover. More individuals were encountered inside the horseshoe-shaped caldera (25 individuals) than outside (9), and only one pair was seen on the ridges, while the vast majority of birds were inside valleys (Table 2).

Table 2. Several characteristics of sighting locations of Caerulean Paradise-flycatchers on Mount Sahendaruman, May–July 2014.

Environmental characteristics		Number of flycatchers encountered	Percentage (%)
Forest type	Primary	22	64.7
	Secondary	12	35.3
Position relative to caldera	Inside	25	73.5
	Outside	9	26.5
Elevation (m asl)	400–499	9	26.5
	500–599	19	55.9
	600–699	6	17.7
Canopy cover (%)	0–25	0	0
	26–50	0	0
	51–75	13	56.5
	76–100	10	43.5
Valley or ridge	Valley	32	94.1
	Ridge	2	5.9

The primary forest of Mount Sahendaruman was generally dominated, in order of abundance, by *Kleinhovia hospita* (Sterculiaceae), *Endocomia macroma* (Myristicaceae), *Myristica cf. fatua* (Myristicaceae), ‘kengkendang-mahengang’, and *Dendrocnide aff. amplissima* (Urticaceae). The secondary forest was dominated by ‘kentumbe’, ‘melengku’, *Endocomia macroma* (Myristicaceae), *Dendrocnide aff. amplissima* (Urticaceae) and ‘pesang’. Some of the transects or point counts are within community

plantations planted with clove *Syzigium aromaticum* (Myrtaceae), nutmeg *Myristica fragrans* (Myristicaceae) and coconut palms *Cocos nucifera* (Arecaceae). However, during this survey, no sightings of paradise-flycatcher were made in plantations.

Sightings of paradise-flycatchers were generally made in valleys (1-8 m wide) with a permanent river or creek on the bottom (1-4 m wide) with intermittent flow and featured large rocks. The valleys were bordered on both sides by steep slopes. Most paradise-flycatchers were seen in areas where dense canopy cover extended unbroken from one side of the river to the other. On Mount Awu, all surveyed locations consisted of secondary forest and plantations of clove, nutmeg and coconut. No paradise-flycatchers were seen or heard in any of the seven surveyed valleys.

Discussion

Population estimates and habitat preferences

Population surveys of Caerulean Paradise-flycatchers over the last two decades indicate little change in the total population size (Table 3). The number of birds encountered was surprisingly similar, with an average of 21 ± 2 , in previous surveys. This study assumed that the abundance of paradise-flycatchers is more dependent on the number and the length of suitable valleys, as opposed to the area of the forest. Even if the area of primary forests surveyed was extended, the population of paradise-flycatchers may not increase if suitable valleys are not present.

Table 3. Population survey of Caerulean Paradise-flycatcher on Mount Sahendaruman, Sangihe.

Year of survey	Elevation range of sightings (m asl)	No. birds seen	Population/density estimates
1998 ¹	475-625	19	19-135 individuals
2004-2006 ²	390-620	23	<ul style="list-style-type: none"> • Secondary: 0.03-0.68 ha⁻¹ • Primary: 0.13-1.19 ha⁻¹
2009 ³	437-670	22	30-106 individuals
2014 ⁴	431-674	34	34-150 individuals

¹Riley & Wardill 2001 and Riley 2002; ²Mamengko 2006; ³Rosyadi 2009; ⁴this study.

We did not use the Variable Circular Plot (VCP) method as was done by Mamengko (2006) and Rosyadi (2009), as we consider this method to be less effective for this species because of their specific habitat requirements. We believe that population estimates extrapolated from surveys based on area, such as VCP, can be misleading because not all primary forest is suitable habitat for the Paradise-flycatcher.

Like Riley & Wardill (2001), we used the actual number of individuals seen as the basis for our estimate of the minimum population size. However, our method for estimating the maximum population size differs from that of Riley & Wardill (2001) because these authors multiplied the maximum encounter rate in any one valley by the number of valleys with suitable habitat, regardless of the length of the valley. We argue that long valleys are likely to have more birds than short valleys, assuming similar densities in all valleys.

In the surveys by Riley & Wardill (2001), the proportion of sightings of Caerulean Paradise-flycatchers in primary forest was 85%, whereas in Rosyadi's (2009) survey, all records (100%) were in primary forest. Surveys by Mamengko (2006) provided very similar results to this survey, as 69% of their sightings were in primary forest (vs. 65% in

the present study). All surveys suggest that paradise-flycatchers consistently favour primary forest, and our study indicates that sites with moderate canopy cover (51–75%) are used as much as sites with high canopy cover (76–100%) (Table 2).

The four surveys consistently show that the species occupies elevations from c. 400 to c. 700 m asl. We did not observe any paradise-flycatchers below 400 m in the valley, even where primary forest was present. We encountered them on the ridge top on only one occasion (Table 2). As this encounter occurred in the afternoon at 16:47 hrs it is possible that the birds were intending to roost there. These two individuals perched silently on a branch, c.2 m from the ground, for at least 5 min, then flew into one of the valleys when disturbed by the observer.

Threats and conservation

The major threat to Caerulean Paradise-flycatchers is deforestation in the Mount Sahendaruman area. During the last decade plantations spread closer to the primary forests. We observed the cutting of forest for new plantations in six of the surveyed villages. Within the remnant primary forests, there was evidence of logging activities taking place in the surveyed valleys for new *kebun* and people have planted nutmeg, clove, and *Falcataria* sp. inside the forest (Fig. 1). Landcover has also changed from secondary forest to *kebun* in the eastern, outer most part of Mount Sahendaruman. Our local guide claimed to have seen paradise-flycatchers in those valleys in the past (Dadoali *pers.comm*), but they were not seen in them during this survey. There is no evidence of paradise-flycatchers being captured by the people at Mount Sahendaruman.

Although surveys over the last 20 years suggest a stable population for the Caerulean Paradise-flycatcher, the maximum population of 150 individuals in a forest area of no larger than 519 ha remains precarious and justifies their classification as Critically Endangered. Thirty forested valleys on Mount Sahendaruman remain as the main habitat of this species, but a decrease in the number of suitable valleys due to logging and clearing for plantations will almost certainly cause a decrease in the number of paradise-flycatchers over time. Although paradise-flycatchers were seen in secondary forests on several occasions, these areas were contiguous with primary forests. Conversion of either primary or secondary forests to cultivation will, without doubt, lead to further decline of its small population. Indeed, Mount Awu apparently supported paradise-flycatchers as recently as 1978 (White & Bruce), but due to cutting of the forest, they almost certainly no longer occur there.

Mount Sahendaruman is designated as a Protection Forest (*Hutan Lindung*), although the forested area occupies only 14.6% of the total area. Conservation of the paradise-flycatcher depends on protecting the remaining valley habitats, and increasing the forest cover on deforested valleys. Joint management of Sahendaruman forests by local people, local government and other stakeholders needs to be intensified. In 2005 BirdLife Indonesia formulated agreements in the form of Regents' Decrees and village regulations concerning the zoning and management of the area, but gradually over time they ceased to be implemented due to subsequent changes in regional leaders and regulations. These agreements need to be evaluated and, if necessary, modified and re-activated. A participatory management approach is more likely to be effective than changing the status of the area to nature reserve or wildlife reserve as recommended by Rozendaal & Lambert (1999). Such a change of protection status may induce conflict over land tenure between government and local people. Effective management of Mount

Sahendaruman in the future should not only maintain the population of paradise-flycatchers but also other species endemic to Sangihe.

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