

# The rediscovery of Cerulean Paradise-flycatcher *Eutrichomyias rowleyi* on Sangihe, Indonesia

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Cerulean Paradise-flycatcher *Eutrichomyias rowleyi*, endemic to the island of Sangihe, Indonesia, was previously known with certainty from a single specimen collected in 1873. Two inconclusive field sightings of the species were made before the species was rediscovered in October 1998, in primary forest on the Mt Sahendaruman caldera in southern Sangihe. Our work suggests that the paradise-flycatcher is restricted to forested valleys between 475 m and 650 m on Mt Sahendaruman, and that its population numbers at least 19 birds and probably no more than 135 birds. This paper provides details of its distribution and habitat, breeding biology, behaviour and vocalizations, plumage, taxonomic relationships, and conservation status. *Eutrichomyias rowleyi* is classified as Critically Endangered by BirdLife International. The bird's extremely restricted range, its small population size and the continued loss of its forest habitat are considered to be the main threats to its survival.

## INTRODUCTION AND HISTORY

In 1873, a native hunter working for the German naturalist A. B. Meyer collected the type, which still remains the only specimen of Cerulean Paradise-flycatcher *Eutrichomyias rowleyi* from Tabukan on the island of Great Sangi [Sangihe], Indonesia. The bird had bluish upperparts, light pale blue underparts, a

somewhat whitish belly, and bore distinctive, long bristles around the bill (Meyer 1878). Twenty years later, Meyer published a more complete description of the bird and a brief discussion of its taxonomic relationships (Meyer and Wiglesworth 1898). Later, a review of the specimen's morphological peculiarities led to the establishment of the monotypic genus *Eutrichomyias* (Meise 1939).

A number of other naturalists made collections on Sangihe during the late nineteenth century (details in Blasius 1888, Meyer and Wiglesworth 1898), yet no further specimens of the paradise-flycatcher were obtained. Indeed, it was not until 105 years after the type specimen was collected that any field sightings of *E. rowleyi* were claimed.

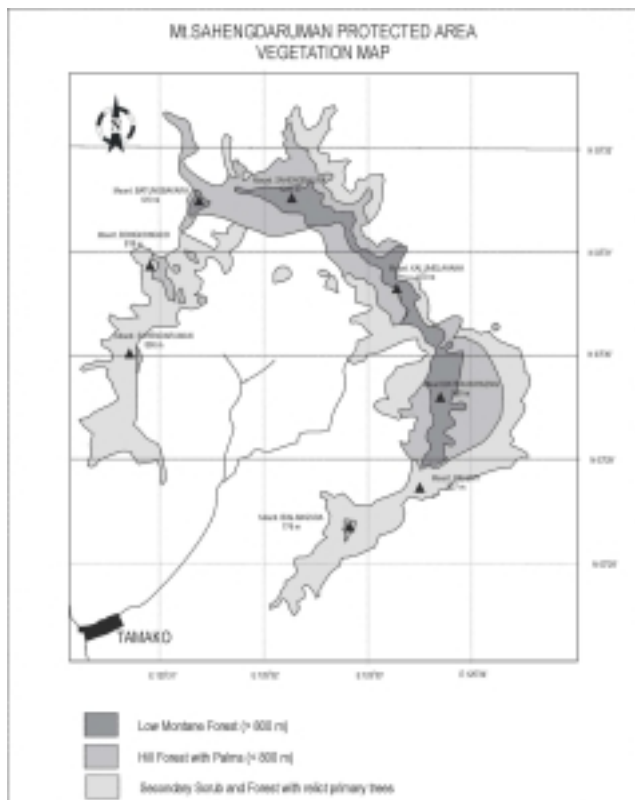
In December 1978, M. D. Bruce observed a single bird on the upper forested slopes of Mt Awu (03°41.40'N 125°26.75'E) in northern Sangihe; the sighting was only first published in 1986 (White and Bruce 1986). Meanwhile, searches by F. G. Rozendaal on Mt Sahendaruman (03°29.90'N 125°30.80'E) in southern Sangihe in May and June 1985 (Rozendaal and Lambert 1999), and K. D. Bishop, who visited the same secondary forest patch on Mt Awu as Bruce in 1986 (Whitten *et al.* 1987), failed to find the paradise-flycatcher.

This led to the presumption of the species's probable extinction (Whitten *et al.* 1987). Other authorities had taken a more optimistic view, stating *E. rowleyi* to be one of the rarest birds in the world (Eck 1980), and it was classified as a Critically Endangered species (Collar *et al.* 1994).

The first author first visited Sangihe in August 1995 as leader of an ornithological expedition from the University of York, England, and on 11 September 1995 a colleague, J. O. H. Small, claimed to have observed a single *E. rowleyi* at Talawid Atas (03°42.66'N 125°24.55'E) on the lower slopes of Mt Awu (Riley 1997a). No further sightings were made at this site, or elsewhere on the island. A survey in August 1996 also failed to find the paradise-flycatcher (F. R. Lambert *in litt.* September 1996) as did our second survey in



Map 1. Location of Sangihe island and place names mentioned in the text.



Map 2. Structural vegetation classification of forest habitat on the Mt. Sahendaruman caldera: based on fieldwork between August–December 1998.

Key:

Vegetation class A: Low montane forest (> 800 m)

Vegetation class B: Hill forest with palms (< 800 m)

Vegetation class C: Secondary scrub and forest with relict forest trees

All boundaries are approximate with a resolution of +/- 200 m.

October–December of the same year (Riley 1997b). We returned to Sangihe in August 1998 and on 2 October 1998 one of our local assistants reported having seen two small, all blue, long-tailed birds. They had been seen feeding in tall trees in a small gully close to the edge of primary forest on Mt Sahendaruman (throughout this paper we use this name to refer to the entire caldera ridge) in southern Sangihe. The following morning, JR descended into the gully and at c. 09h00 saw two birds sallying for insects in the crowns of tall canopy trees (photograph 5) and was able to confirm that they were *E. rowleyi*. Further surveys on the lower forested slopes of Mt Sahendaruman, until late February 1999, revealed the presence of a small, critically endangered population of paradise-flycatchers restricted to five steep forested valleys.

This paper is based on the results of ornithological surveys conducted between 24 August–12 September and 12–25 October 1995, 19 October–18 December 1996, 19 August–20 December 1998, 28 January–1 March 1999, and 7–11 December 1999.

## SANGIHE

Sangihe island is part of the northern volcanic range of North Sulawesi, an area dominated by young and active volcanoes, and lies on a narrow submarine ridge extending from Sulawesi, through Sangihe and the Talaud islands, to the Philippine island of Mindanao. The topography is steep; the north of the island is dominated by Mt Awu (1,340 m), an active volcano, and in the south the extinct volcanic caldera of Mt Sahendaruman rises to a peak of 1,031 m on Mt Sahengbalira (map 1).

Sangihe had largely been deforested by 1920 (Heringa 1921, Whitten *et al.* 1987) and the only extensive area of forest remaining on the island is found at higher altitudes on the steep slopes of Mt Sahendaruman. Between August and December 1998 habitat boundaries were mapped, suggesting that approximately 800 ha of closed canopy forest remain (Hicks and Riley in prep.). The forest in this area extends along the ridge-tops from Mt Bongkongsio (818 m) to Mt Palenti (827 m) with some small outlying patches, for example on the peak of Mt Sahendaruman (806 m). On the steeper south-facing slopes, the forest extends down in places to altitudes of c. 450 m. On the gentler north and eastern-facing slopes forest loss has been far greater, with agricultural land reaching the ridge-top in many places. Only in a few isolated valleys, notably below Mt Batukakiraeng (980 m), does forest extend far from the ridge, down to altitudes of c. 650 m (map 2).

The forest vegetation on Mt Sahendaruman was classified into two structural vegetation classes (map 2). At lower altitudes – to c. 800 m – forest is made up of broadleaf semi-trophophyllous trees, 10–20 m tall, with emergent trees to 35 m. There are abundant lianas and other climbers, and an understory characterized by many palms *Areca* spp., with occasional tree ferns Cyatheaceae and screw palms Pandanaceae. At higher altitudes, above c. 850 m, habitat is dominated by shorter broadleaf semi-trophophyllous trees, 5–10 m tall, with emergent trees to 20 m. There are many climbers and epiphytes, with some dense stands of gingers Zingiberaceae, whilst in some areas, particularly on the ridge-top, screw palms form extensive, single-species canopies.

Most of the island has been converted to a mosaic of plantations, shifting gardens and other agricultural land. Principal tree crops include coconut, clove, nutmeg, breadfruit, durian, and other fruit trees. Within this mosaic, small areas of land are cleared to plant root crops, banana, papaya and chilli. The flatter areas and gentler slopes are already planted with tree crops, leaving only the steeper slopes for such cultivation. Patches of secondary forest and scrub also occur on Mt Awu, around the Mt Sahendaruman forest, and in the centre of the island above Tahuna, and are characterized by *Piper aduncum*, *Trema orientalis*, *Albizia falcataria*, *Homalanthus* spp. and *Ficus cf. minahassae*. The middle slopes of Mt Awu support dense secondary scrub dominated by tree ferns, screw palms, and gingers, whilst above c. 800 m this is replaced by grasses and ferns.

There are currently no strictly protected areas (nature reserve, wildlife reserve, national park) on the island, although there have been several proposals for a c. 5,000 ha conservation area in the vicinity of Mt Sahendaruman

(FAO 1982, Sujatnika and Jepson 1995). A 4,268 ha area centred on Mt Sahendaruman is currently designated Protection Forest *Hutan Lindung* on account of its watershed value and is under the jurisdiction of the Department of Forestry. There are two other areas of Protection Forest on the island: one of 4,884 ha covering the slopes of Mt Awu, and a 1,105 ha area named Mt Otomata in the centre of Sangihe (*Dinas Kehutanan* Manado, unpublished 1998). Of the three areas, only Mt Sahendaruman Protection Forest has any primary forest remaining.

## DISTRIBUTION

Following their rediscovery on 3 October 1998, paradise-flycatchers were observed on 33 occasions over 31 days until the last sighting on 10 December 1999. All but one of the observations were made in five steep forested valleys on the lower slopes of the Sahendaruman caldera (Table 1). Descriptions of the five valleys follow:

Valley 1 – Forested down to an altitude of *c.* 510 m where forest was bordered by coconut plantations and vegetable gardens. Above, the forest rises unbroken to the ridge-top at 850 m.

Valley 2 – Forested from the summit of Mt Sahengbalira down to *c.* 400 m where forest was replaced by clove plantations, secondary scrub and abandoned gardens. Below *c.* 500 m there are some signs of disturbance e.g. tree cutting, and the forest was dominated by trees locally called *Subulre*, with some sago palms and trees locally called *Sahayi*; trees were *c.* 15 m tall and narrow girthed, and undergrowth was sparse. A large stream runs along the valley bottom. This valley is separated from Valley 1 by a steep ridge rising 250 m between the two.

Valley 3 – A narrow, very steep gully, sparsely forested. The ridge-tops and valley sides were dominated by secondary scrub. We made one observation of a single paradise-flycatcher in this scrub.

Valley 4 – A steep river valley surrounded on all sides by extremely steep slopes. The forest was largely undisturbed and extended from the summit of Mt Sahengbalira down to at least 600 m. The lower extent of forest was not ascertained as access to the lower reaches was prevented by a 30 m high waterfall at *c.* 600 m. The valley was bordered on some ridge-tops by well-established secondary forest.

Valley 5 – A narrow gully at the foot of a 10 m high waterfall that was bordered below and on both sides by clove, nutmeg and coconut plantations. The gully was dominated by secondary forest and scrub. Forest appeared to extend upwards from the waterfall to the ridge-top but this could not be confirmed.

Forest in these valleys was noticeably different in character to that on ridge-tops at the same altitude. Trees were larger and taller, with the forest canopy at *c.* 17–25 m, and there were many emergent trees. Common plant species in the mid-storey of the forest – to *c.* 15 m – included the trees *Myristica cf. fatua*, *Ficus cf. minahassae*, *Saurauia* spp., *Gironniera* spp. and *Syzygium* spp., and the palm *Arenga cf. pinnata*. More striking was the lack of vegetation between heights of *c.* 2–5 m; for example the ginger, palms and climbers which characterised the forest elsewhere were largely absent, although *Areca* palms remained frequent. One common plant of the mid-storey, particularly close to streams, was a species of Urticaceae, and a *Leea* spp. shrub was also present. This thin mid-storey encouraged a dense herb layer, with many ferns, lilies (possibly *Dianella* spp.) and succulent perennials e.g. *Pentaphragma* spp.

A further eight valleys were surveyed for paradise-flycatchers but no sightings were made. Two of these sites were at higher altitudes – between 710 m to 850 m – although the forest habitat was judged similar to that in valleys where paradise-flycatchers were observed. The precise upper altitudinal limit of the species's distribution has not yet been ascertained owing to the difficulty of surveying these areas.

Three of the eight valleys were within the paradise-flycatcher's known altitudinal range and represented suitable habitat; however, surveys were hampered by torrential rain and birds may have been overlooked. The remaining valleys were dominated by secondary scrub and thought unlikely to support paradise-flycatchers.

The only sighting of *E. rowleyi* away from these forested valleys was of a single bird seen in secondary scrub on the steep slopes above valley 3. Since over 100 days of fieldwork by the authors between 1995 and 1999 produced no other records away from valleys, we suggest that paradise-flycatchers favour the sheltered habitat in these valleys and forage only occasionally in forest on ridge-tops.

Within the valleys, birds were encountered in both primary (85% of observations) and secondary habitat (15% of observations). There were no records of birds in secondary forest remote from primary habitat. This suggests that *E. rowleyi* favours primary forest in valleys, can forage in secondary habitat that is bordered by

**Table 1.** Summary of observations of *Eutrichomyias rowleyi* in five valleys on Mount Sahendaruman, October 1998-December 1999

Valley	Altitudinal Range	Number of Sightings	Maximum number of paradise-flycatchers	Date maximum recorded
1	525-625m	18	5 - 4 adults, 1 young	3/4 October 1998
2	475-625m	9	4 adults	7 December 1998
3	575-625m	2	5 adults	23 November 1998
4	600-650m	1	3 adults	24 November 1998
5	550-600m	3	2 adults	12 December 1998

primary forest, but is absent from disturbed habitat away from primary forest.

## PREVIOUS RECORDS

Prior to these observations, *E. rowleyi* had been recorded from three separate localities. The first record is that of the type specimen, collected by Meyer's hunters at "Tabukan". No other details about the type locality have been published (Meyer 1878, Meyer and Wiglesworth 1898).

Tabukan is the name of one of the historical kingdoms of Sangihe and the town of Tabukan was the seat of the King until Indonesian independence from the Dutch. After Indonesian independence the kingdom of Tabukan was split into three administrative sub-districts: Tabukan Utara, Tabukan Selatan and Tabukan Tengah. Subsequently, the town of Tabukan became known as Tabukan Lama (literally "Old Tabukan"). JR visited Tabukan Lama (03°40.27'N 125°32.45'E), situated on the east coast of Sangihe, in 1995 and 1996. There is no forest in the vicinity of the town and, according to villagers, land has been dominated by coconut plantations for at least 80 years. It seems unlikely, even if the type specimen originated there, that paradise-flycatchers could survive in such habitat. The three Tabukan districts run along almost the entire east coast of Sangihe and it is impossible, given the lack of information as to the type's provenance, to narrow the collecting locality beyond this. However, a number of bird species from Sangihe also previously known only by one or two specimens are now considered to be restricted to the Mt Sahendaruman forest: Sangihe Shrike-thrush *Colluricincla sanghirensis* (Rozendaal and Lambert 1999), Sangihe White-eye *Zosterops nehrkorni* (Rasmussen *et al.* 2000) and Golden Bulbul *Alophoixus affinis platenae* (Riley 1997b). Such circumstantial evidence might suggest that the type of *E. rowleyi* was also obtained from these forests.

The second record of the paradise-flycatcher was made by M. D. Bruce in December 1978 "in the forested

upper slopes of G. [Mt.] Awu, northern end of Sangihe" but was not published until eight years later (White and Bruce 1986). The bird was observed in "areas above human habitation where apparently suitable habitat was more extensive" but no other details were noted because the significance of the observation was not fully appreciated (M. D. Bruce *in litt.* to J. Riley, May/June 2000). Whilst the observer is confident about the sighting, we feel that the lack of information accompanying this important record makes it impossible to review critically and prefer to treat the sighting as unproven.

In 1986, K. D. Bishop visited the site of Bruce's observation but saw no paradise-flycatchers over a three-day period (Whitten *et al.* 1987). In 1995 and 1996, JR spent a total of 15 days on the slopes of Mt Awu around the villages of Kedang (03°40.11'N 125°28.23'E), Talawid Atas and Kendahe (03°41'N 125°22'E) searching for the paradise-flycatcher. Whilst these surveys led to the observation of a possible paradise-flycatcher at Talawid Atas in 1995, no confirmed sightings were made.

The 1995 sighting was made by J. O. H. Small who claimed to have observed a single *E. rowleyi* in secondary scrub at c. 250 m above the village of Talawid Atas (Riley 1997a). Whilst published as inconclusive, this record should be withdrawn, as a number of features in the description do not agree with our knowledge of *E. rowleyi* (J. O. H. Small *in litt.* to J. Riley, March 2000), and Small has withdrawn other observations made during the same period (Rasmussen *et al.* 2000).

The 1978 and 1995 records were made on the slopes of Mt Awu, and the continued survival of a second population of paradise-flycatchers in northern Sangihe would be of great importance. However, three factors lead us to conclude that, in all probability, Mt Awu does not support such a population. First, there is no forest above c. 800 m and the few small patches of secondary forest are confined to steep valleys on the mountain's lower slopes; in three field trips to Sangihe totalling 12 months, we have yet to locate habitat with the characteristics of that inhabited by paradise-flycatchers

**Table 2.** Summary of valleys potentially occupied by *E. rowleyi* on the Mt Sahendaruman caldera

Mountain <sup>1</sup>	Number of valleys <sup>2</sup>	Valleys with birds present <sup>3</sup>	Valleys with habitat present <sup>4</sup>		Valleys with habitat absent <sup>7</sup>		Maximum valleys occupied <sup>8</sup>	Minimum valleys occupied <sup>9</sup>
			Surveyed <sup>5</sup>	Observed <sup>6</sup>	Surveyed	Observed		
Batukakiraeng	5	0	1	4	0	0	5	0
Kalumelahana	7	0	2	4	0	1	6	0
Sahengbalira	17	5	7	9	0	1	16	5
Batungbakara	7	0	0	0	3	4	0	0
Bongkongsio	8	0	0	0	4	4	0	0
Total	44	5	10	17	7	10	27	5

1 = peak on caldera ridge from which valleys run off.

2 = number of valleys with watercourse separated by c. 250 m.

3 = number of valleys where *E. rowleyi* were observed.

4 = number of valleys with closed canopy forest judged suitable for *E. rowleyi*.

5 = direct observation made in valley.

6 = observation made from ridges near valley.

7 = number of valleys with no habitat judged suitable for *E. rowleyi*.

8 = total number of valleys with closed canopy forest potentially occupied by *E. rowleyi*.

9 = total number of valleys where *E. rowleyi* was observed.

on Mt Sahendaruman. However, until fieldwork is conducted in the secondary scrub and forest at lower altitudes, there remains a remote possibility that paradise-flycatcher habitat will be found. Second, Mt Awu is an active volcano and this may help explain the lack of forest; for example, local people state that a violent eruption in 1966 caused serious damage to houses and vegetation around the mountain. Third, there are no conclusive sightings from northern Sangihe: the two published records have been either inadequately documented or withdrawn altogether. Therefore, whilst the steep, inaccessible terrain on Mt Awu may still hide a population of paradise-flycatchers, the lack of suitable forest, the inadequacy of the published records, and the lack of confirmatory sightings suggest that *E. rowleyi* is now restricted to hill forest in steep valleys between c. 475 m and at least 650 m on Mt Sahendaruman.

## POPULATION

Quantitative surveys using a point count technique produced only two records of *E. rowleyi* from 150-point counts. These data are insufficient to yield a reliable estimate of population density for *E. rowleyi*. Therefore, in this paper, we produce a qualitative assessment of the paradise-flycatcher's population.

In general, we assumed that *E. rowleyi* is restricted to valleys with closed canopy forest around the Mt. Sahendaruman caldera. An initial analysis aimed to identify the total number of valleys around the caldera ridge. Individual valleys were specified as those with watercourses separated by more than c. 250 m from the watercourse in the adjacent valley. Initial identification of valleys was made using a 1:50,000 base map (Peta Rupabumi Indonesia series 1991). This yielded a total of 44 valleys on the caldera's slopes.

Based on direct field surveys or observations from adjacent ridges and the mountain's lower slopes, we assessed whether closed canopy forest was present or absent in each valley. A total of 27 valleys were found to support some closed canopy forest.

No account was taken of *E. rowleyi*'s altitudinal range when assessing habitat availability. Hence, it is possible that valleys thought to contain suitable habitat may lie above the species' upper altitudinal limit. There are, therefore, 27 valleys which could support populations of *E. rowleyi*, the majority located on the slopes below the peaks of Mt. Batukakraeng, Mt. Kalumelahana and Mt. Sahengbalira (Table 2).

The largest flock size recorded in any valley was five birds. To produce a maximum population estimate we assume each of these 27 valleys supports five birds. This leads us to conclude that the maximum population estimate is 135 birds. This is clearly an arbitrary figure and until more is known about the species's ecology and distribution, it is used with caution.

The minimum population is assumed to be the sum of the maximum number of birds seen in each individual valley (Table 1). This is based on the assumption that birds do not move between valleys, a statement evidently supported by concurrent observations of paradise-flycatchers in adjacent valleys (Valleys 1 and 2) on three occasions. Using this method the population of *E. rowleyi*

on the Mt. Sahendaruman caldera is estimated to be between 19 and 135 birds.

## BREEDING BIOLOGY

A number of observations of breeding activity were made and these are summarized below.

### Nests

Two disused nests were found that we strongly suspect to be those of *E. rowleyi*. The first was found on 11 October 1998 in Valley 1 at 625 m. It was located in a 5 m tall understorey tree *Syzygium* spp. and built between the terminal fork of the lowest branch, 2 m off the ground. The second nest was found on 24 November 1998 in Valley 3 at 610 m. The nest was located 2.5 m off the ground in a fork in the outer branch of an unidentified understorey tree. Both nests were cup-shaped and woven around the fork of the branch. Both were constructed from dried palm leaf fibres (possibly *Arenga* sp.) mixed with dried grass fibres and fixed to the tree branch by tougher vine fibres.

The first nest was in a good state of preservation and will be deposited in the Museum Zoologicum Bogoriense, Cibinong, Indonesia. The nest pocket was slightly oval and of the following dimensions: widest diameter 47 mm; narrowest 39 mm, depth to top 40 mm. The second nest was partially disintegrated and was not preserved.

Whilst it is not possible to prove conclusively that these are nests of *E. rowleyi* – no nest construction or attendance was observed – there are a number of factors that support this assumption. Primarily, the size and form of the nests agree closely with those of other members of the Monarchini, being very similar to the nests of the Black-naped Monarch *Hypothymis azurea* in North Sulawesi; both nests are slightly oval in shape, of similar size, woven from dried grass and leaf fibres, and constructed in a suitable fork in an understorey tree (*pers. obs.* JCW, see photograph p. 40 in Kinnaird 1995). Meyer and Wigglesworth (1898: 377) provide the following description of an *H. azurea* nest from Sulawesi: "Cup-shaped, the size of a Chaffinch's [*Fringilla coelebs*], rather loosely built of moss and coarse straw-like strips of dead grasses or wood, ornamented externally with a few large seeds, lined with fine root-fibres. Placed on the twigs of a tree. Height 50 mm, breadth 65 mm, breadth of pocket 52 mm, depth of pocket 38 mm." Since *E. rowleyi* is the sole representative of the Monarchini on Sangihe (Riley and Wardill in prep.) this suggests that these are nests of the paradise-flycatcher. Additionally, the nest discovered on 11 October 1998 was situated within 50 m of trees frequented over the ensuing months by a pair of *E. rowleyi* with young (see below). Finally, a knowledgeable local hunter (who was able to take fieldworkers to see paradise-flycatchers at a new locality in November 1998) claimed that the nest found in Valley 3 was that of *E. rowleyi*.

### Eggs

A small fragment of egg shell discovered directly below the nest in Valley 1 on 11 October 1998, had a white ground colour with fine brick-red flecks. In general,

Monarchini eggs are whitish or buffish marked with brown (Coates and Bishop 1997). Assuming the egg shell came from the nest, its appearance supports the identification of the nest as that of the paradise-flycatcher. The egg-shell fragment will be deposited in the Museum Zoologicum Bogoriense, Cibinong, Indonesia.

### Young Birds

Three observations were made of family groups of *E. rowleyi*. The first, on 3 October 1998, involved two adult birds and a single juvenile in Valley 1 at 625 m. The juvenile bird was noted to be smaller, with a short tail and grey, fluffy underparts. One adult was observed feeding a small invertebrate to the young bird. The second observation was at the same location on 9 December 1998; between 11h00 and 12h30 three birds were seen together – two adults feeding a single immature. The young bird perched, well hidden, in a tree fern in secondary forest immediately adjacent to primary forest. The adults searched for food for c. 45 seconds and on their return the immature responded by opening its gape and flicking its wings; no food items could be identified. Finally, on 6 February 1999 three birds – possibly the same family party – were observed briefly at the same location.

## BEHAVIOUR

The majority of observations of *E. rowleyi* were of birds feeding in small single species groups of 2–5 birds. On two occasions birds were seen in mixed feeding flocks. On 23 November 1998, a single paradise-flycatcher was feeding in close association with a single Sangihe Shrike-thrush and three Sulawesi Cicadabirds *Coracina morio* in secondary scrub dominated by *Piper aduncum* and a Sterculiaceae shrub locally named Kupamanuk. Later the same day, five birds were observed feeding in a loose flock with three Sangihe Shrike-thrushes in Valley 4.

Cerulean Paradise-flycatchers generally feed in the canopy and sub-canopy of c. 15 m tall trees but also descend to low understorey vegetation such as ferns and

rattans. Birds feed in an active manner, often hovering, making looping sallies, and even descending to the ground to recover invertebrates. Flycatching is common but most time is spent snatching and gleaning invertebrates from vegetation. Whilst feeding, they often raise their tails above the horizontal and sometimes spread their tail feathers in the fashion of *Rhipidura* fantails, but less dramatically. The paradise-flycatchers appear to feed mostly on small invertebrates; but the only identified food item was a large c. 7 cm long Orthopteran.

Cerulean Paradise-flycatchers often interact with a small squirrel *Prosciurillus cf. murinus* present in the Mt Sahendaruman forest. Of our 33 observations, nine involved birds following or feeding close to squirrels, apparently attracted to insects disturbed by them. The squirrels (usually alone but occasionally in groups of 2–4 animals) move quickly along canopy branches and vines, pausing to chew at bark or dead wood, presumably to extract invertebrate food. Paradise-flycatchers often approached to within a metre of the squirrel and gleaned for insects from the surrounding foliage. On a number of occasions a paradise-flycatcher was seen to scold or threaten the squirrel if it came too close. *E. rowleyi* was never seen to follow the larger, less active Rosenberg's Squirrel *Prosciurillus rosenbergii*, which is the commonest squirrel species in the forest.

Generally, paradise-flycatchers remained feeding in small areas for considerable periods of time. For example, on 10 December 1999, a pair of paradise-flycatchers was observed flycatching and leaf-gleaning for over two hours in small trees along a 30 m stretch of Valley 2.

## VOCALIZATIONS

A number of calls were recorded – copies have been deposited in BLOWS, National Sound Archive, UK – and three call types were apparent. The most commonly heard vocalizations are the birds' loud contact calls. These are varied and range from a single *tuk* note, uttered irregularly by feeding birds, to a very loud

**Table 3.** Measurements (in mm) of adult *Eutrichomyias rowleyi* mist-netted on 7 December 1998 compared to those of the type specimen (after Meyer 1898 and Meise 1939).

Length measurement	Type specimen (Meyer 1878)	Type specimen (Meise 1939)	Mist-netted bird (JR 1998)
Total length	180	-	-
Bill	13	13	-
Bill tip to forehead	-	17	16
Bill tip to nostril	-	9.5	9.5
Bill width at base	-	9	-
Bill width at nostril	-	-	7.5
Bill depth at nostril	-	-	4
Bill tip to back of skull	-	-	34
Wing	96	95	88 (straightened) 85 (unstraightened)
Tail	92	85	78
Tarsus	21	21	20.5
Hind claw	-	-	6
Rictal bristles (maximum)	-	-	11
Weight (grammes)	-	-	19

*step...step* with the emphasis on the first syllable. The "typical" call, most often heard within feeding groups, is a loud *chew...chew...chew chew chew* or *chrew...chrew...chrew chrew chrew*, which possesses a rasping and grating quality, and with stress on the last three notes. Adults seen feeding young gave this call repeatedly.

A second type of contact call is a loud, descending trill *chreechreechreechree* some five seconds in duration with a rolled *rrr* sound; the trill has a slurred quality. This call was heard once, given by a single bird in a loose feeding flock with two other birds. A third variant is a high, scratchy, fizzing *streeeeeeee* given by feeding birds.

Alarm calls are stridently uttered, sharp notes. One bird, on being flushed by the observer from a distance of two metres, gave a sharp *schweek...schweek*. Two birds coming together whilst chasing the same food item both uttered a sharp, clipped *schwak...schwak*, exposed their gapes and fanned their wings at each other before both resumed feeding. Finally, a series of rapid staccato notes was given by a bird in response to a squirrel.

A wispy whistle consisting of a mixture of thin notes lasting five seconds was given by a single bird on one occasion in October 1998. This may be the birds' song, but confirmation is required from more detailed observations and recordings.

## DESCRIPTION AND MEASUREMENTS

On 7 December 1998 at 12h00, a single adult *E. rowleyi* was caught in a mist-net set *c.* 5 m from the ground on the sides of a steep forested gully at 625 m in Valley 1. Morphometric data, photographs (Photographs 1 and 2, see photograph in Wardill and Riley 1999) and blood samples were taken, and a full description of the bird's plumage made in bright sunlight (see below), before the bird was released, unharmed, approximately three hours later. Owing to the extreme rarity of the species it was decided not to collect a voucher specimen, despite previous calls for such material (White and Bruce 1986).

The capture of this individual allows indirect comparison of measurements and plumage to the type specimen (Table 3, photograph 3 and 4). Measurements and descriptions of the type have been published by Meyer (1878) and Meyer and Wiglesworth (1898), whilst Meise (1939) provides other measurements and a discussion of some key features.

Whilst the wing length:tail length ratio are similar in the two birds (type specimen - 0.894, 1998 bird - 0.886), the wing and tail measurements of the 1998 bird are 8% smaller than those of the type (Meise's measurements). In general, male monarchs (Monarchini) are larger than females (Oberholser 1911) and these measurements may suggest that the type specimen is, as was suggested in the type description, a male, and the 1998 bird an adult female. In addition, the type is a dull greyish blue, which might suggest an immature specimen (P. C. Rasmussen *in litt.* April 2000; see below).

Recent published descriptions and drawings of the paradise-flycatcher have been inaccurate (e.g. plate 4 in Whitten *et al.* 1987, plate 54 in Coates and Bishop 1997). For this reason a detailed plumage description of the

mist-netted bird is given with notes where there are significant differences from published descriptions.

### Soft parts

The iris is dark brown; the eye is relatively large, with an incomplete fleshy white eyering, broken above and bulging in front of and behind the eye; the broad-based bill is black; the gape is yellow; many long rictal bristles issue from the bill base; these rictal bristles are black, except for two either side of the bill which are white and may be freshly grown. The legs are blue-grey, the soles of the feet are grey, and the claws are grey.

The eyering was surprisingly not noted by Meyer (1878) or Meyer and Wiglesworth (1898). However, Meise (1939) noted that this feature was figured by Gould (*Birds of New Guinea* 2 Plate 20, 1882) and, as a footnote to Meise's paper, Stresemann noted that the eyering is poorly preserved on the specimen, perhaps explaining why it was not mentioned by Meyer.

### Underparts

The chin and throat are light grey, paler in the centre of the throat; the upper flanks and breast are grey with a slight blue tinge. The lower flanks and vent are lighter grey. The undertail-coverts are very light grey-white. The centre of the belly is white, whilst the upper belly and lower chest are mottled grey-white with a definite blue tint, forming the suggestion of a breast-band. The thighs are grey, again showing a blue tint.

There was no suggestion of buff around the cloacal region in contrast to that noted by Meyer and Wiglesworth (1898). It is possible that this feature is a result of staining during the collection and preparation of the specimen. The underparts lack the strong blue tones depicted by Nash (in Whitten *et al.* 1987) and Gardner (in Coates and Bishop 1997).

### Upperparts

The back, mantle, rump and uppertail-coverts are cerulean blue. The central tail feathers are almost entirely blue, with the shafts and centres black; the outer tail feathers are black with the distal half of the outer web blue; the undersides of all tail feathers are grey.

### Head

The crown, nape and cheeks are dark cerulean blue, slightly darker than the upperparts. The forehead is a lighter blue, with a slight darkening around the bill. There is a grey wash around the sides of the neck, running up from the sides of the breast.

### Wing

The underwing-coverts are light grey. The greater upperwing-coverts have broad cerulean blue fringes and very dark grey centres; the median and lesser wing-coverts are bright blue, being the brightest part of the wing; the scapulars are blue. The alula is black with a narrow blue fringe. The flight feathers are blackish-grey with the outer webs broadly fringed blue, and the inner webs with narrow white fringes; the blue feather fringes on the outer webs are slightly wider on the secondaries; the tertials are mainly blue with black feather centres. The under surface of all flight feathers are grey, with white inner webs.

### Moult

Primaries 1–4 (counted ascendantly from the outer edge of the wing) were worn and old, primary five was in pin, primary six was half-grown, and the third secondary was still growing but almost complete. All tail feathers were worn; on the right side, the third rectrix from the centre was half-grown.

The immature bird observed on 9 December 1998 had uniform smoky-grey underparts, which were much darker than those of the adult birds and lacked any hint of a blue hue on the breast. Its upperparts and head were dark blue with a strong grey-brown wash. The immature's partial white eyering was thinner and less striking than on adult birds. The gape appeared orange-yellow, with bare parts otherwise resembling those of the adults. In size, the young bird appeared slightly smaller than the adults.

### TAXONOMIC STATUS

Meyer initially placed the paradise-flycatcher in the genus *Zeocephus* (Meyer 1878) but later altered his opinion and included *rowleyi* in *Hypothymis*, noting its similarity to *H. puella* [= *H. azurea puella*] of Sulawesi and postulating that *rowleyi* represented that species on Sangihe (Meyer and Wiglesworth 1898). Oberholser (1911) was unconvinced that *rowleyi* belonged with *Hypothymis* but had not examined the specimen and left the situation unresolved.

Meise (1939) erected the monotypic genus *Eutrichomyias* for the species characterized by a shorter, heavier bill with more steeply arched culmen in comparison to *Hypothymis* monarchs, whilst the nostrils are positioned more to the side of the bill and closer to its base. In addition, the tarsus is more robust and longer than in both *Hypothymis* and *Terpsiphone* (longer than the exposed culmen), and there are differences in the wing formula. The abundant nasal bristles are distinctive (Meise 1939, White and Bruce 1986) and visible in the field.

Meise commented that the closest relative was probably *Hypothymis* (1939 p. 135), but also noted the similarities to *Terpsiphone*. In a footnote to the same paper Stresemann (p. 136) suggested the nearest relative was *Terpsiphone*. White (in White and Bruce 1986) noted "although usually associated with *Hypothymis* in the past, this opinion was evidently based on its blue colour and not on critical examination." and that the species affinities needed further study. Supporting these statements, Watson *et al.* (1986) concluded that *E. rowleyi* is a well differentiated geographical representative of *Terpsiphone*.

Our recent observations complicate the argument. Links to *Terpsiphone* paradise-flycatchers are suggested by the white, fleshy partial eyering of *E. rowleyi*. However, we were immediately struck by their resemblance to *H. azurea* of Sulawesi. Apart from the two species's similar coloration, parallel behavioural traits were noted; both are active species that feed by gleaning and snatching for prey and regularly associate in pairs. Vocalizations of *E. rowleyi* are also most similar to *H. azurea*, both having harsh, strident contact calls. By contrast, Rufous Paradise-flycatcher *Terpsiphone cinnamomea talautensis* observed on Talaud was usually seen singly, was less

active whilst feeding, and is judged to have more melodious vocalizations.

These observations do not conclusively demonstrate the species's affinities, but do suggest that *Eutrichomyias* shows characters of both *Hypothymis* and *Terpsiphone*, although it is perhaps more closely allied to the former.

### CONSERVATION STATUS

*Eutrichomyias rowleyi* was classified as Critically Endangered with extinction owing to a combination of its small, severely fragmented distribution with a decline in the area, extent and quality of habitat (code B1+2ce); small population size with all individuals in a single subpopulation (code C2b) and a small number of mature individuals (code D1) (Collar *et al.* 1994).

The rediscovery of *E. rowleyi* in the Mt Sahendaruman forest and the review of previous records detailed above suggests the species should still be accorded the highest category of threat.

*E. rowleyi* is restricted to c. 800 ha (or 8 km<sup>2</sup>) of forest in southern Sangihe and is only known from small areas – steep valleys – in this forest. The paradise-flycatcher's population is believed to be very small and, whilst the figures should be used with caution, possibly does not exceed 19 birds, with the breeding population smaller, as inferred by observations of immature birds.

At the present time, habitat loss is the main pressure on the species. Clearance of forest and adjacent secondary growth by local farmers is usually small-scale, plots are between 0.5 and 1.5 ha in size, but is concentrated on the forest edge and, of most concern, in valley bottoms. Certain crops are planted preferentially in the damp, sheltered valleys and these areas are sometimes the first to be cleared.

Habitat disturbance brought about by natural resource extraction (Wardill and Riley in prep., Wardill *et al.* 1997) constitutes another threat. Forest products such as rattans, timber, firewood and food plants are collected by local people. The disturbance is generally small-scale but its effects on the forest ecosystem have not been quantified. The disturbance due to forest product extraction may also be exacerbated by the presence of humans within the paradise-flycatchers' habitat.

Of immediate concern is the widespread use of air rifles to hunt birds and small mammals for both food and sport. This hunting appears to be indiscriminate with birds of all sizes shot by hunters; a group of three hunters was observed carrying 20–30 birds after a day's shooting in the Mt Sahendaruman forest in November 1998.

A considerable constraint on future conservation efforts is the lack of basic ecological and behavioural data about *E. rowleyi*. Detailed work to determine accurately the species's range, habitat requirements and population size is crucial. Similarly, the threats to the species have not been adequately quantified and such work should be a high priority. This could be combined with related studies of the threatened *Zosterops nehrkorni* which is also little known and mysteriously rare (Rasmussen *et al.* 2000).

Previous conservation activities on the island has focused on increasing local peoples' awareness of the



forest and its value (Riley 1997b, J. C. Wardill pp. 50–53 in Hurst 1998). Encouragingly, a long-term conservation project building on the work undertaken between 1995 and 1999 is being prepared by BirdLife International – Indonesia Programme.

## DISCUSSION

The rediscovery of *E. rowleyi* is of great significance. Four research projects had visited the Sangihe islands after Whitten *et al.* (1987) concluded that *E. rowleyi* was probably extinct, before a combination of perseverance and luck led to the rediscovery of this enigmatic species.

This highlights again what Collar (1998) – referring to the history of ornithology on Cebu in the Philippines – called the “Romeo Error”: the problem of whether rare species should be treated as extant unless proven extinct or extinct unless proven extant (Diamond 1987). Could the presumed extinction of *E. rowleyi* in 1987 have contributed to the relative neglect of Sangihe by researchers and conservationists alike?

There are similarities between the case of the Cebu Flowerpecker *Dicaeum quadricolor* (Dutson *et al.* 1993, Collar 1998) and Cerulean Paradise-flycatcher. Both species were believed to be extinct, whilst in reality they lingered on in small fragments of primary habitat. We hope that the rediscovery outlined in this paper reinforces the point that serious efforts should be made to find such “lost” species.

Increased awareness of Sangihe’s importance for global biodiversity, and the plight of its endemic birds, was brought about as the result of an investigation into restricted-range bird species by BirdLife International (formerly International Council for Bird Preservation). The distributions of restricted-range species, defined as those with world ranges of less than 50,000 km<sup>2</sup>, were analysed using a Geographical Information System (GIS) and concentrations of two or more species classified as Endemic Bird Areas (EBAs). Twenty-four EBAs were identified in Indonesia, one of them centred on the Sangihe and Talaud archipelagos (ICBP 1992, Sujatnika *et al.* 1995, Stattersfield *et al.* 1998).

The Sangihe-Talaud EBA was thought to support ten restricted-range species, of which five were endemic (Sujatnika *et al.* 1995, Stattersfield *et al.* 1998). Recent research has led to the recognition of five additional endemic species – Sangihe Scops Owl *Otus collari* (Lambert and Rasmussen 1998), *Colluricincla sanghirensis* (Rozendaal and Lambert 1999) and *Zosterops nehrkorni* (Rasmussen *et al.* 2000) on Sangihe, and Talaud Bush-hen *Amaurornis magnirostris* (Lambert 1998b) and Talaud Rail *Gymnocrex talaudensis* (Lambert 1998a) on Talaud – re-enforcing the islands’ importance to conservation. Of particular significance is the fact that five of the six bird species endemic to Sangihe are threatened with extinction – *C. sanghirensis*, *Z. nehrkorni*, *E. rowleyi*, Elegant Sunbird *Aethopyga duyvenbodei* and Sangihe Hanging Parrot *Loriculus catamene* – whilst another species endemic to the Sangihe-Talaud islands, Red-and-blue Lory *Eos histrio*, is probably extinct on Sangihe (Collar *et al.* 1994, Riley 1997b). The first three species in this list are treated as Critically Endangered in the *Threatened birds of Asia* (BirdLife International

2001) and all appear to survive only in small populations restricted to the Mt. Sahendaruman forest.

Now that the biological significance of Sangihe’s Mt Sahendaruman forest is more fully appreciated, it is essential that serious efforts are made to understand the conservation requirements of the birds and other endemic wildlife found there. Further research and conservation activities are urgently needed, especially in the case of the Cerulean Paradise-flycatcher, in order to safeguard the species’s remaining habitat and to increase their chances of long-term survival.

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