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A NEW SPECIES OF HAWK-OWL *NINOX* FROM NORTH SULAWESI, INDONESIA

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ABSTRACT.—A distinctive new species of hawk-owl, *Ninox ios,* is described from a specimen collected in 1985 in forest at 1120 m in Bogani Nani Wartabone (then Dumoga-Bone) National Park, North Sulawesi, Indonesia. It was previously identified as a rufous morph of the Ochre-bellied Hawk-Owl, *N. ochracea. Ninox ios* is small, predominantly bright chestnut, and lacks facial patterning; it has pink orbital skin, yellow irides, triangular whitish scapular spots, a finely banded and relatively long tail, unusually short, slender tarsi that are feathered for most of their length, and weak claws. Its relationships within the genus *Ninox* are unclear; it differs in several morphological characters from all other species. Because *Ninox ios* is only known from one specimen, its distribution and conservation status are unknown; nothing is known of its ecology, but it probably occurs primarily at higher elevations than *N. ochracea. Received 14 Dec. 1998, accepted 5 May 1999.*

For many years two endemic species of the genus *Ninox* were thought to occur on the central Indonesian island of Sulawesi. Of these, the Speckled Hawk-Owl (*Ninox punctulata*) primarily inhabits disturbed lowland habitats throughout the island (White and Bruce 1986), and is morphologically quite different from other endemic Indonesian *Ninox.* The poorly known Ochre-bellied Hawk-Owl [*N. ochracea* (= *perversa*)] of the lowland rainforests in North and Central Sulawesi (White and Bruce 1986) is a small, fairly typical member of its genus (Frontispiece). Because there had been no indication that a third species might occur, it was a surprise when in 1985 F. G. Rozendaal netted an almost entirely bright rufous *Ninox* (Frontispiece) in Bogani Nani Wartabone (then Dumoga-Bone) National Park, North Sulawesi, Indonesia (Fig. 1). He concluded that this individual represented "a previously undescribed rufous phase" of *N. ochracea* (Rozendaal and Dekker 1989), and this treatment was followed by Coates and Bishop (1997).

While working on small owls at the National Museum of Natural History/Naturalis, Leiden (NNM, formerly Rijksmuseum van Natuurlijke Historie, RMNH) in June and October 1998, I chanced to see the rufous Sulawesi specimen, which had been registered as RMNH 84701 but had not yet been incorporated into the main collection following its purchase by NNM. On the second occasion I noted that it differed in several morphological features from *Ninox ochracea,* in addition to

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FRONTISPIECE. Cinnabar Hawk-Owl (*Ninox ios,* upper two) compared with Ochre-bellied Hawk-Owl (*N. ochracea,* lower left), and Buru race of Moluccan Hawk-Owl (*N. squamipila hantu,* lower right). Original watercolor painting by Ian Lewington.

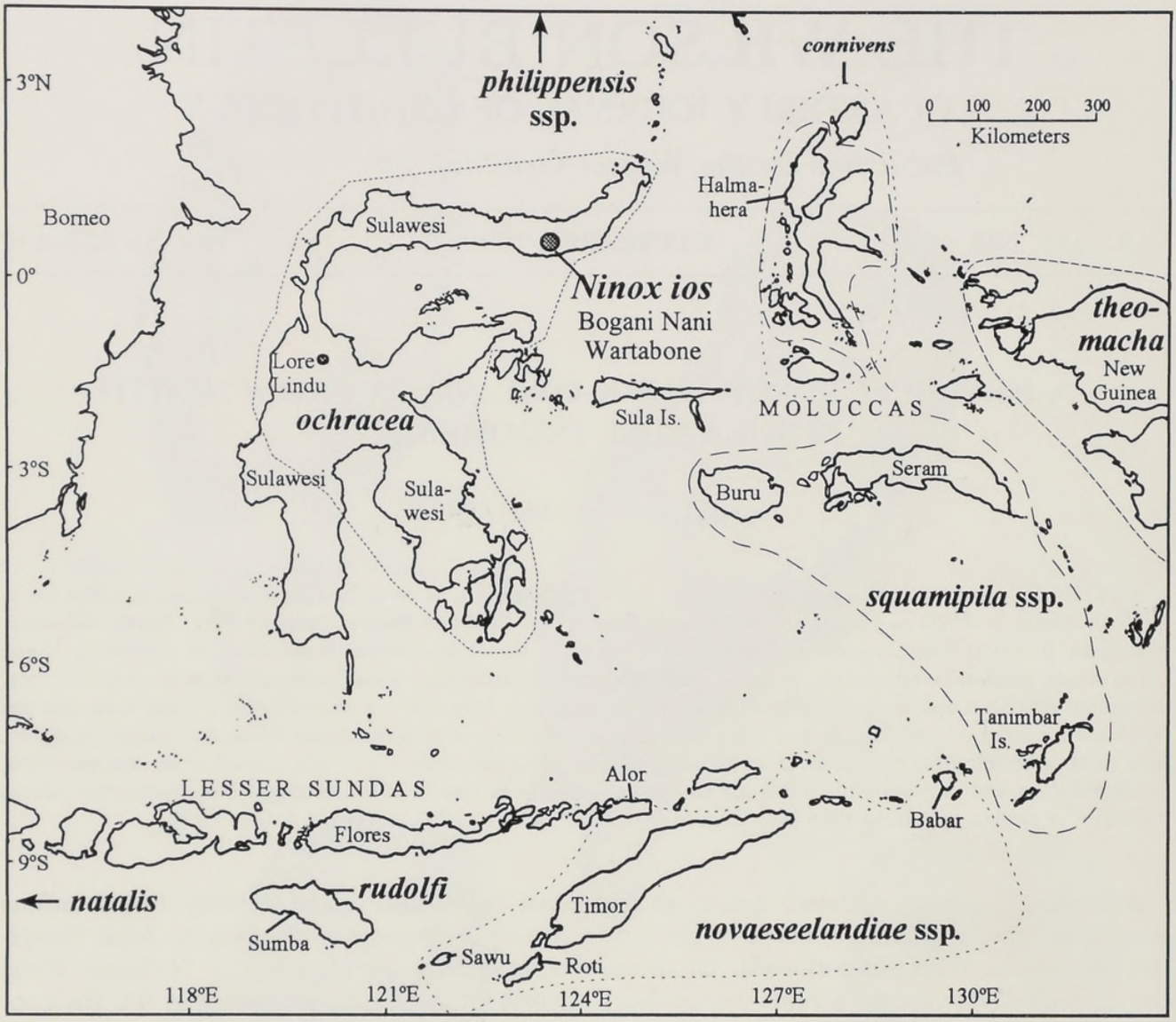

FIG. 1. Map of Wallacea showing collection locality of the holotype of the Cinnabar Hawk-Owl (*Ninox ios*), other locations mentioned in the text, and approximate ranges within the region of other species of *Ninox* and subspecies of *W. scutulata*, which occurs throughout the region.

the obvious color differences. Subsequent mensural analyses of series of all species of *Ninox* have confirmed the distinctness of the rufous Sulawesi specimen (an adult in good condition) in many characters. Although several *Ninox* species from other areas are typically rufous, morphism (and thus true rufous morphs) appears to be unknown for any *Ninox,* and in any case most of the differences are structural and thus would not be related to morph. Despite the fact that only one rufous specimen is known thus far from Sulawesi, there is no reason to believe that any of its several novel character states are aberrant, and there can be no reasonable doubt that it represents a new species.

CINNABAR HAWK-OWL *Ninox ios* sp. nov.

Holotype.—RMNH 84701, adult male (Frontispiece), according to the label collected in a forested valley at 1120 m at Clark's camp (Hill 1440), east-central Bogani Nani Wartabone National Park, North Sulawesi, Indonesia (ca 0° 40′ N, 123° 0′ E) by F. G. and C. M. Rozendaal the night of 5–6 April 1985 (the label date of 7 April presumably indicates date of death). Label data: "Completely ossified skull", "weight 78 g".

Diagnosis.—A small, lightly built, nearly uniformly rich chestnut hawk-owl with a relatively long tail and narrow pointed wings, lax feathering, no facial pattern, mostly feathered

short slender tarsi, and rufous, narrowly dark-barred wings and tail.

Compared with all flying states of *Ninox ochracea* [n = 20 (three of which are fully grown juveniles); 6 males, 4 females, 10 unsexed], *N. ios* is much smaller in most dimensions (Table 1, Fig. 2), but has a relatively longer tail and rictal bristles. Its wing, while shorter than that of *N. ochracea,* is narrower and more pointed (Fig. 3). *Ninox ios* has a much shorter, shallower bill and smaller nares than *N. ochracea.* It has short, slender tarsi that are mostly feathered on both surfaces, whereas *N. ochracea* has longer, stout tarsi that are largely unfeathered on the anterior (acrotarsal) side and are virtually unfeathered on the posterior (plantar) side, with numerous stiff bristles over the unfeathered areas. The new species has relatively sparse, fine rufous bristles on the extreme lower tarsi and on its slender toes (although the bristles are heavier and longer on the hallux), while *N. ochracea* has more profuse, heavier, mostly pale bristles (which are usually longer but sometimes worn down to stubs) on the tops and sides of its stouter toes. *Ninox ios* has much smaller, more slender claws that are dark for most of their length (vs large and mostly pale in *N. ochracea*). The holotype of *N. ios* had pink orbital skin (vs blackish in *N. ochracea*) and yellow eyes, as does *N. ochracea* according to Stresemann (1940), who based this statement on G. Heinrich's specimens [although Meyer and Wiglesworth (1898) mentioned a brown-eyed *N. ochracea*]. The base of the bill and the cere of *N. ios* appear entirely pale (vs the basal two-thirds conspicuously dark in specimens of *N. ochracea*).

In plumage, *N. ios* differs conspicuously from both adults and juveniles of *N. ochracea* in its overall bright rufous coloration (vs dark brown and yellow-ocher). Unlike all flying stages of *N. ochracea,* it lacks facial patterning, including the whitish supercilia typical of most of its relatives, and also lacks white markings in the wing coverts and flight feathers. Less obvious distinctions from *N. ochracea* include its more triangular (vs squarer tipped) whitish scapular spots, its mainly rufescent rictal bristles (vs blackish with white bases), its more narrowly barred rectrices, its vaguely dark-scalloped lower underparts (vs plain ocher or somewhat brown-streaked), and the patterning of its breast feathers, which have a light rufous (vs dark brown) area surrounding the whitish shafts.

The Philippine Hawk-Owl (*Ninox philippensis*) superspecies (sensu Dickinson et al. 1991, but see Collar and Rasmussen 1998) is composed of several dark brown to brown-and-ocher forms that are either barred or streaked below. None of the taxa included in *N. philippensis* can be described as warmer-toned than rufescent brown. All have much heavier claws and relatively shorter tails (Fig. 2A) than *N. ios,* from which they also differ in wing shape (Fig. 3). One form, *N.* [*philippensis*] *mindorensis* (see Frontispiece), is somewhat similar in overall size and tarsal feathering to *N. ios* than is any other taxon, including *N. ochracea* (Fig. 2C), but not in plumage or the above-mentioned shape characters.

All taxa of the paraphyletic Moluccan Hawk-Owl (*Ninox squamipila*; split provisionally into at least three species by Norman et al. 1998) are considerably larger and heavier-legged than *N. ios,* and all differ from it additionally in having whitish-barred underparts and scapulars. Despite the above differences, *Ninox s. hantu* (Frontispiece) of Buru superficially resembles the much smaller *N. ios* because of its overall rufescence and reduced barring below, as well as its obscure facial pattern and finely barred tail. The Sumba Hawk-Owl (*N. rudolfi*) is large and strikingly different, with a heavily spotted crown, barred underparts, and broadly banded and speckled upperparts. The widespread and variable Brown Hawk-Owl (*Ninox scutulata*) is also a much larger species, with a broadly banded tail and large, heavily feathered tarsi. It is dark brown above with the underparts heavily streaked, or nearly solid dark brown in *N. s. obscura* of the Andamans. The nominate race of the Andaman Hawk-Owl (*N. a. affinis*) is smaller than *N. scutulata,* to which it is otherwise quite similar, while the larger Nicobar race (*N. a. isolata*) is even more like some races of *N. scutulata.*

The highly varied subspecies (including a new one described from Roti Island, southwest of Timor, Lesser Sundas; Johnstone and Darnell 1997) usually grouped in the Southern Boobook (*Ninox novaeseelandiae*) as well as the Manus Hawk-Owl (*N. meeki*) are also

TABLE 1. Mean ± SD, *n* for measurements (mm) of species of *Ninox* close in size to *N. ios* (much larger taxa are not included). Ranges are given in parentheses for *Ninox ochracea*. Shortfalls of each primary were measured from the wingpoint, P1 shortfall being the distance from the outermost primary tip to the tip of the longest primary of folded wing, etc. Tarsal feathering was measured from the tip of the most distal plumaceous feather to the joint of the phalanges 1–2 of digit three.

Character	*ios*	*ochracea*	*philippensis* superspecies		
			mindorensis	*philippensis*	*spilocephalus*
Culmen length (from skull)	17.9	23.5 ± 1.5, 17 (20.6–25.7)	20.7 ± 1.0, 25	21.6 ± 1.2, 76	23.1 ± 1.1, 40
Auricular length	22.6	21.1 ± 2.7, 19 (16.5–25.7)	23.5 ± 3.5, 27	26.7 ± 3.7, 69	29.2 ± 3.9, 42
Rictal bristle length	23.9	19.6 ± 2.1, 16 (14.0–22.4)	19.9 ± 1.9, 26	21.3 ± 2.0, 68	22.3 ± 2.2, 40
Wing length	172	185.2 ± 5.8, 19 (176–195)	164.0 ± 5.2, 27	171.5 ± 6.7, 70	170.4 ± 6.3, 38
P1 shortfall	53	53.0 ± 4.0, 18 (47–60)	52.7 ± 4.1, 26	51.6 ± 3.1, 67	52.9 ± 4.7, 32
P2 shortfall	16	20.2 ± 3.8, 15 (15–29)	22.4 ± 2.1, 26	21.8 ± 4.8, 65	21.6 ± 3.5, 33
P3 shortfall	2	4.3 ± 1.9, 17 (2–9)	7.1 ± 1.7, 25	6.0 ± 1.9, 62	6.3 ± 2.6, 33
P4 shortfall	0	0.3 ± 0.8, 17 (0–3)	1.4 ± 1.2, 26	0.4 ± 0.7, 61	0.6 ± 0.9, 32
P5 shortfall	2	1.4 ± 1.4, 15 (0–4.3)	0.3 ± 0.8, 26	0.4 ± 0.9, 59	0.4 ± 0.7, 34
P6 shortfall	11	7.9 ± 2.0, 17 (5–11.4)	4.6 ± 2.1, 26	5.6 ± 2.1, 57	5.7 ± 2.1, 30
P7 shortfall	21	19.0 ± 2.6, 16 (15–22)	13.2 ± 2.6, 26	15.4 ± 2.3, 53	15.0 ± 3.0, 30
P8 shortfall	33	31.7 ± 2.6, 16 (28.9–38)	23.1 ± 2.7, 25	25.1 ± 2.8, 50	24.9 ± 2.6, 29
P9 shortfall	39	41.7 ± 2.7, 16 (38–46)	31.4 ± 2.8, 24	33.6 ± 3.2, 50	33.8 ± 2.4, 29
P10 shortfall	47	49.1 ± 2.9, 16 (43–55)	38.6 ± 3.3, 23	40.9 ± 3.8, 49	42.3 ± 2.8, 29
Tail length	97	98.3 ± 6.1, 17 (88.6–109)	82.9 ± 3.9, 27	80.9 ± 4.5, 75	76.1 ± 5.2, 36
Tarsus length	22.6	29.6 ± 1.4, 18 (26.5–32)	29.2 ± 2.3, 26	29.8 ± 2.2, 77	29.8 ± 1.6, 40
Minimum tarsus width	3.0	3.8 ± 0.3, 16 (3.4–4.6)	3.6 ± 0.2, 25	3.7 ± 0.3, 60	3.8 ± 0.3, 35
Midclaw length	9.8	11.3 ± 0.5, 16 (10.3–12.7)	11.2 ± 0.7, 26	11.6 ± 0.7, 78	11.6 ± 0.8, 40
Unfeathered tarsus	11.6	17.8 ± 3.0, 19 (13.6–24.3)	13.0 ± 1.9, 25	15.2 ± 2.3, 65	16.1 ± 2.2, 36

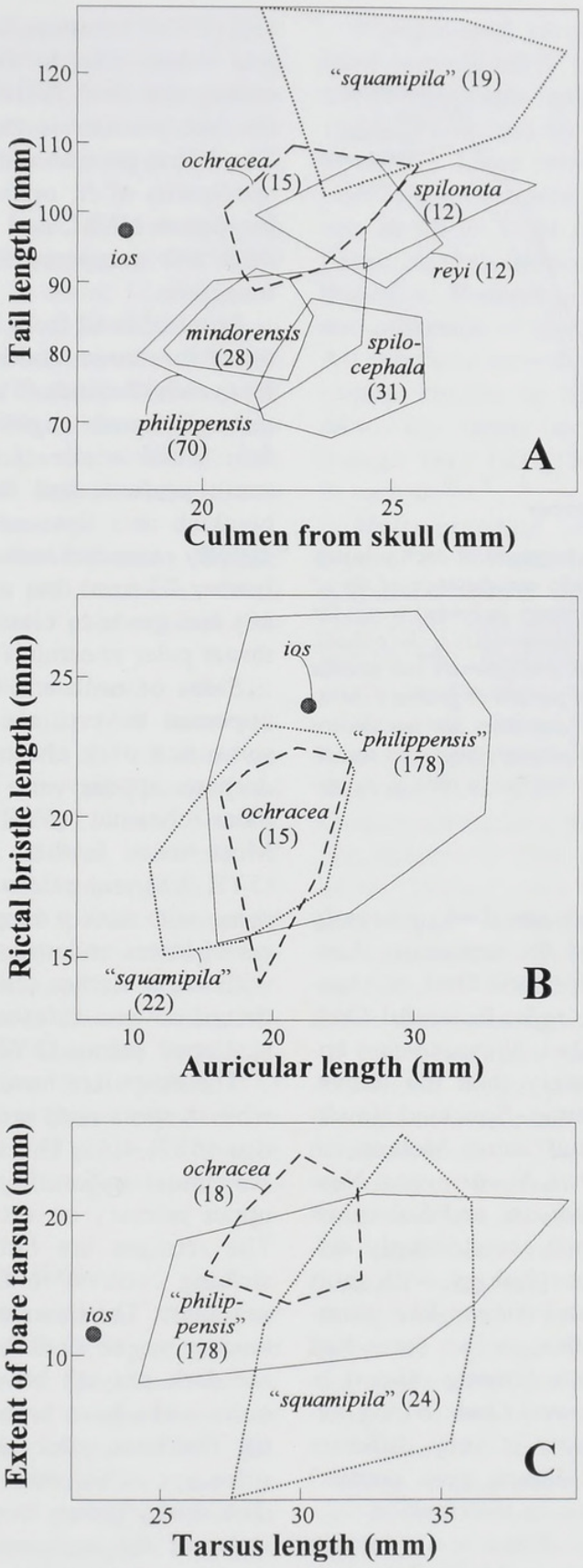

FIG. 2. Bivariate scatter plots (measurements in mm) for *Ninox ios* (filled circles), *N. ochracea*, *N. "squamipila"* (sensu White and Bruce 1986), and *N. philippensis* (sensu Dickinson et al. 1991): A. culmen vs tail length; B. auricular vs rictal bristle length; and C. tarsus length vs extent of unfeathered tarsus. For A, the main Philippine taxon groups are treated separately, while for B and C they are combined.

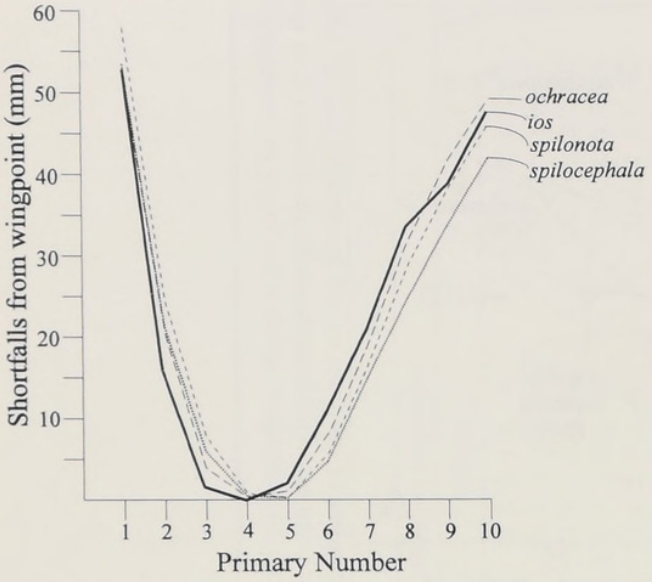

FIG. 3. Shortfalls from wingpoint of each primary (P1 = outer primary; shortfalls are distance of tip of each primary from longest primary in folded wing) for *Ninox ios, N. ochracea, N.* [*philippensis*] *spilocephala,* and *N.* [*p.*] *spilonota. Ninox p. philippensis* and similar races are virtually identical in pattern of primary shortfalls to *N.* [*p.*] *spilocephala* and thus are not shown separately, while all bar-bellied populations in the *N. philippensis* superspecies are similar to race *N. p. spilonota.*

larger than *N. ios* and are streaked or heavily blotched below. None of the remaining Australasian taxa (Papuan Boobook Owl, *N. theomacha*; Rufous Owl, *N. rufa*; Powerful Owl, *N. strenua*; or Barking Owl, *N. connivens*) approach *N. ios* more closely than the above. The other Sulawesi endemic, Speckled Hawk-Owl *(N. punctulata*), and some Melanesian taxa (Bismarck Hawk-Owl, *N. variegata*; New Britain Hawk-Owl, *N. odiosa*; and Solomons Hawk-Owl, *N. jacquinoti*) are strikingly different in plumage and morphology, with short tails, very heavy tarsi, and *Athene*-like plumage pattern and toe bristles; in fact some had been placed in that genus (among others) in the past. The White-browed Owl (*Ninox superciliaris*) of Madagascar is very different from other *Ninox* (H. F. James, pers. comm.) as would be predicted by its distribution.

Distribution.—To date *Ninox ios* is known only from the type locality in North Sulawesi, Indonesia. It might occur at similar elevations elsewhere in the Minahasa Peninsula of North Sulawesi.

Description of the holotype.—Color matching was done under natural light using Munsell (1977) notation, in which the first number and letters refer to the hue, the number preceding the slash is the value or lightness, and the last number is the chroma or saturation. The holotype was directly compared with 11 specimens of *N. ochracea* (including the holotype) at NNM, and a series of photographs of it was compared to specimens from other museums.

Front of head from base of bill through center of forecrown and including supercilia, uniform rich chestnut (5YR 5/8); center of crown through mantle slightly darker (close to 5YR 4/6); rictal bristles fairly long (maximum 24 mm), profuse, and dark chestnut, somewhat blackish near tips; auriculars with fairly long distally extended barbs (total length of longest feather 23 mm) that are paler basally (5YR 5/10) and grade to black near the tips; chin and throat paler chestnut (5YR 6/8) than forehead.

Sides of neck and breast, back, rump, and uppertail coverts are all approximately the same rich dark chestnut (5YR 4/8). The underparts appear very lightly dappled, slightly paler chestnut (5YR 5/8) than upperparts. Most breast feathers have pale shaft streaks (5YR 7/8) and pale rufous surrounding areas, some with darker dappling at sides, and feathers of lower underparts are mostly pale rufous with vague darker scalloping (2.5YR 5/8); undertail coverts rufescent whitish with the tips scalloped rufous (5YR 6/8).

The scapulars have large mostly triangular whitish spots with broad dark chevron-shaped tips (5YR 4/4). The upper secondary coverts are almost uniformly rufous (5YR 6/8) and the upper primary coverts are darker (5YR 4/2). The remiges are faded, pale, and worn, in striking contrast to the fresh, richly colored scapulars. The inner webs of the primaries and narrow vague dark bands of the outer webs are dark grayish brown (5YR 4/4); only the outer webs have broader light bands (5YR 7/6). The base color of the secondaries is dull rufescent ochraceous (7.5YR 6/8), with fine dark dusky brown bars (7.5YR 4/4). The inner webs of the undersurfaces of the inner primaries and secondaries are basally pale rufous (7.5 YR 8/6), as are the uppersurfaces of the inner webs of the inner secondaries, which contrast strongly with the dark bands. The underwing coverts are solid pale rufous (7.5YR 7/8). The uppertail surface has pale bands of

dull rufous (5YR 5/6) that are narrow basally and wider distally, and about 12 narrow very dark brown bands (5YR 3/2) that fade out toward the tip. There are no definite bands for the terminal 20 mm. The rectrices are heavily worn and faded.

The short, slender tarsi are completely feathered with short pale cinnamon (7.5YR 7/6) pennaceous feathers to about 12 mm anteriorly (measured from joint of digits 1–2 of middle toe) and posteriorly to about 6 mm (measured from base of hallux). The toes appear to have been slender, with sparse, short rufous bristles on the tops and sides of each toe. The claws are small, delicate, and mostly blackish but with pale bases.

The soft part colors recorded on the original label are: eyes "bright yellow; pink orbital skin", bill "ivory", feet "pale whitish-yellow".

Measurements of the holotype (by author).—Culmen (from skull) 17.9 mm; culmen (from distal edge of cere) 10.7 mm; tarsus 22.6 mm; wing 172 mm; tail 97 mm. Total length of prepared specimen 220 mm. See Table 1 for measurements of other characters of the holotype and those of other species.

Etymology.—This new species is named *Ninox ios* (Greek for rust) for its striking overall coloration. The specific epithet is here used as a noun in apposition to *Ninox,* which, although usually treated as feminine, is a portmanteau combining *Nisus* and *Noctua.* The common name "cinnabar" also refers to its predominant color, which is similar to that of mercuric sulfide before prolonged exposure to light.

DISCUSSION

Voice.—Not definitely known. Rozendaal (Rozendaal and Dekker 1989:97) mentioned "disyllabic calls ascribed to [*N. ochracea*] recorded at Clark's camp and on the summit of G.[unung] Muajat during April 1985." Ekstrom and coworkers (1998:39) reported "an unknown owl *Ninox* sp." giving a series of dry hoots rising and falling in pitch in dense evergreen valley forest near the eastern boundary of Lore Lindu National Park, at about 1300 m, in the northern part of central Sulawesi (J. Tobias, pers. comm.). Either of these reports might refer to *Ninox ios* but confirming field data are required.

Habitat and elevation.—Most researchers have considered *N. ochracea* to be restricted to the lowlands below 800 m (Stresemann 1939, White and Bruce 1986, Stattersfield et al. 1998). More recently, Coates and Bishop (1997) gave the elevational range of *N. ochracea* as up to 1780 m, but this was probably based on the questionable vocal records mentioned in Rozendaal and Dekker (1989) and the collection of the type of *N. ios* at 1120 m. All montane records of *N. ochracea* therefore require review in light of this new species. *Ninox ios* clearly occurs in sympatry with, although very likely at higher elevations than, *N. ochracea.*

Molt, breeding, and ecology.—The holotype of *N. ios* clearly had recently molted its scapulars, which were bright and fresh and contrasted strikingly with the relatively dull tertials and other flight feathers. The feathers on the crown appeared to be worn, while those of the back appeared fresh. Only 10 rectrices were present. Active molt of the flight feathers was not detected, but avoid damaging the unique specimen a thorough examination was not attempted. The size of the label drawing of the largest testis (which measures 6 × 4 mm) suggests a bird not completely reproductively quiescent. Because nothing is known of the habits of *N. ios,* it is possible only to speculate that its morphology (which recalls that of owlet-nightjars Aegothelidae) suggests the likelihood of its preying largely upon soft-bodied invertebrates caught in flight.

Systematics.—The affinities of *Ninox ios* are unclear; it shows many morphological differences from all other species, particularly in its small size, relatively long tail, narrow pointed wing, and weak tarsi and claws. Although membership in the polytypic *N. philippensis* superspecies might seem geographically plausible, the pattern of primary feather lengths shown by *N. ios* is closer to that of *N. ochracea* than to any form of *N. philippensis.* Phylogenetic analyses will be required to understand the relationships of *N. ios.*

Conservation.—As only one specimen is known, it appears likely that *Ninox ios* has a limited range and/or is rare. However, nocturnal birds are frequently overlooked. Also, most scientific bird collecting in Sulawesi took place before mist-nets were widely available, and at lower elevations. Ascertaining its

vocalizations and calling periods will be a prerequisite to carrying out effective surveys, which will be essential to establish the degree of risk faced by this unique new species.

The only other bird species thought to be restricted to North Sulawesi is the poorly known Matinan Flycatcher (*Muscicapa sanfordi*), which has been found only in the Dumoga-Bone and Tentolo-Matinan mountains between 1400 and 1780 m. The fact that a species as distinctive as *Ninox ios* could have escaped description until now clearly underscores the fact that our knowledge of the avifauna of Sulawesi is still in a rudimentary state.

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