

A new subspecies of Red-backed Thrush *Zoothera erythronota kabaena* subsp. nov. (Muscicapidae: Turdidae), from Kabaena island, Indonesia

J. C. ROBINSON-DEAN, K. R. WILLMOTT, M. J. CATTERALL, D. J. KELLY,
A. WHITTINGTON, B. PHALAN, N. M. MARPLES and BOEADI

A new subspecies of Red-backed Thrush *Zoothera erythronota* (Sclater 1859), *Zoothera erythronota kabaena* **subsp. nov.**, is described from Kabaena island in Indonesia. The adult plumage of nine specimens captured at two localities on Kabaena island, and other individuals seen in the field, differs consistently and significantly from that of the nominate subspecies on Sulawesi, which lies 18 km north of Kabaena island. Variation in the nominate subspecies and rationale for the choice of taxonomic rank for this new taxon are discussed. The known vocalisations, ecology, behaviour, distribution and habitat of the taxon are described and its conservation status discussed. *Zoothera erythronota kabaena* is known from forest and forest edge habitats on Kabaena island, where it can be locally common.

INTRODUCTION

Indonesia's Sulawesi region is part of the unique and extremely diverse faunistic region of Wallacea, named after the naturalist and explorer Alfred Russel Wallace, who made the first attempt to understand its biogeographic complexities (Wallace 1860, 1869). Wallacea is noted for its variety of habitats and high levels of endemism; the Sulawesi region alone supports sixteen endemic avian genera and 97 species (ICBP 1992, Coates and Bishop 1997). However, only 3.6% of Wallacea's land area enjoys protected status (McNeely *et al.* 1990), and rapid rates of forest clearance, combined with considerable trapping pressures on many bird, mammal and reptile species, may result in numerous extinctions in the near future if appropriate action is not taken immediately.

Operation Wallacea is a charitable organisation that has been involved since the mid-1990s in ecotourism, social science and biological research projects in the relatively poorly known south-eastern region of Sulawesi. Extensive surveys of the bird fauna of Buton island have been completed by a number of ornithologists working for Operation Wallacea, while other islands, such as '[almost] ornithologically unknown' Kabaena island (White and Bruce 1986: 56), have begun to be explored (Figs. 1-2). In September 1999, a small team of ornithologists (including MJC, DJK, BP and NMM), made some of the first observations of birds on Kabaena island during a visit of four weeks. A number of individuals of a bird taxon similar to Red-backed Thrush *Zoothera erythronota* (Sclater 1859), endemic to the Sulawesi region, were sighted by this team in remnant patches of forest and highly degraded secondary growth near the villages of Rahadopi and Tangkeno, and along the road connecting these two localities (Fig. 2). NMM glimpsed a single bird on 9 September above Tangkeno, and two days later MJC observed a bird feeding on the roadside on the edge of Rahadopi village. Later, near Tangkeno, MJC and volunteers observed another bird

for 15 minutes. Descriptions from these several sightings suggested that the taxon might differ significantly from the nominate subspecies, and resulted in the account of the Kabaena taxon that appears in Clement *et al.* (2000). Attempts to mist-net specimens of the bird resulted in the capture of a single individual at the village of Rahadopi, by DJK, NMM and BP. This individual was a juvenile (Figs. 3e,f; see Discussion) and, while it showed some differences from typical *Z. erythronota*, additional adult specimens were necessary to assess the taxonomic status of this Kabaena population.

Further ornithological fieldwork for Operation Wallacea was conducted in 2000 on Buton, mainland south-eastern Sulawesi and Kabaena, by JR-D (10 weeks, also including Tukangbesi islands) and MJC (3 weeks). This included a variety of habitats, ranging from sea-level to 1,400 m (the latter on Kabaena). One goal of JR-D's work was to mist-net specimens of several potentially distinct taxa reported by earlier expeditions throughout the area, and to assess their taxonomic status, including the *Zoothera* on Kabaena. Ten days were spent in the Tangkeno area of central Kabaena by JR-D, MJC and several volunteers, attempting to locate appropriate sites to capture specimens of the *Zoothera*, and three individuals were mist-netted by JR-D. These specimens confirmed that this was indeed a distinctive taxon, differing consistently in plumage from the nominate subspecies.

Subsequent museum research confirmed that the taxon was definitely undescribed and not represented in museum collections. Given its apparently restricted range, the option of describing the taxon based on available photographs and blood specimens alone was seriously explored. However, after discussion with other ornithologists, including Nigel Collar (BirdLife International, Cambridge) and Robert Prys-Jones (Natural History Museum, Tring), and considering the number of sightings of the taxon at several localities on Kabaena, it was deemed preferable to obtain museum voucher specimens. In 2001, therefore, JR-D returned

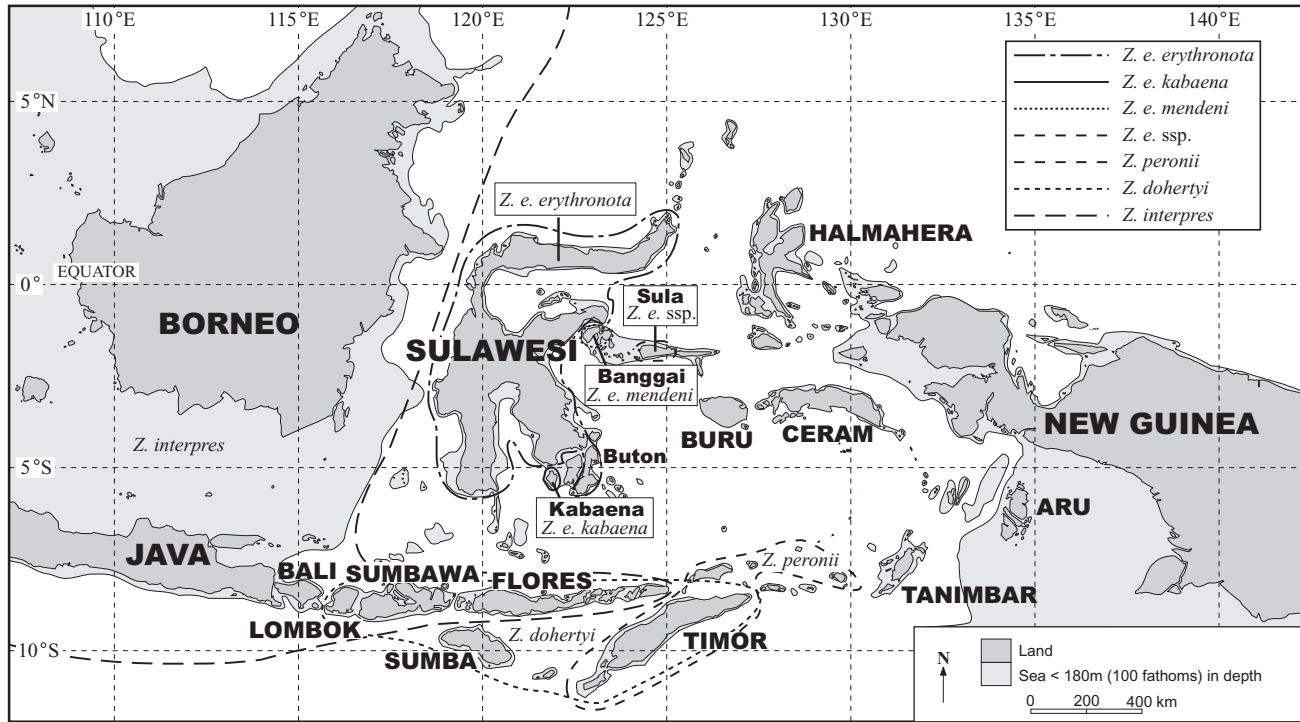


Figure 1. Indo-Malaya, Wallacea and New Guinea. Ranges of related *Zoothera* taxa are shown, based on Coates and Bishop (1997).

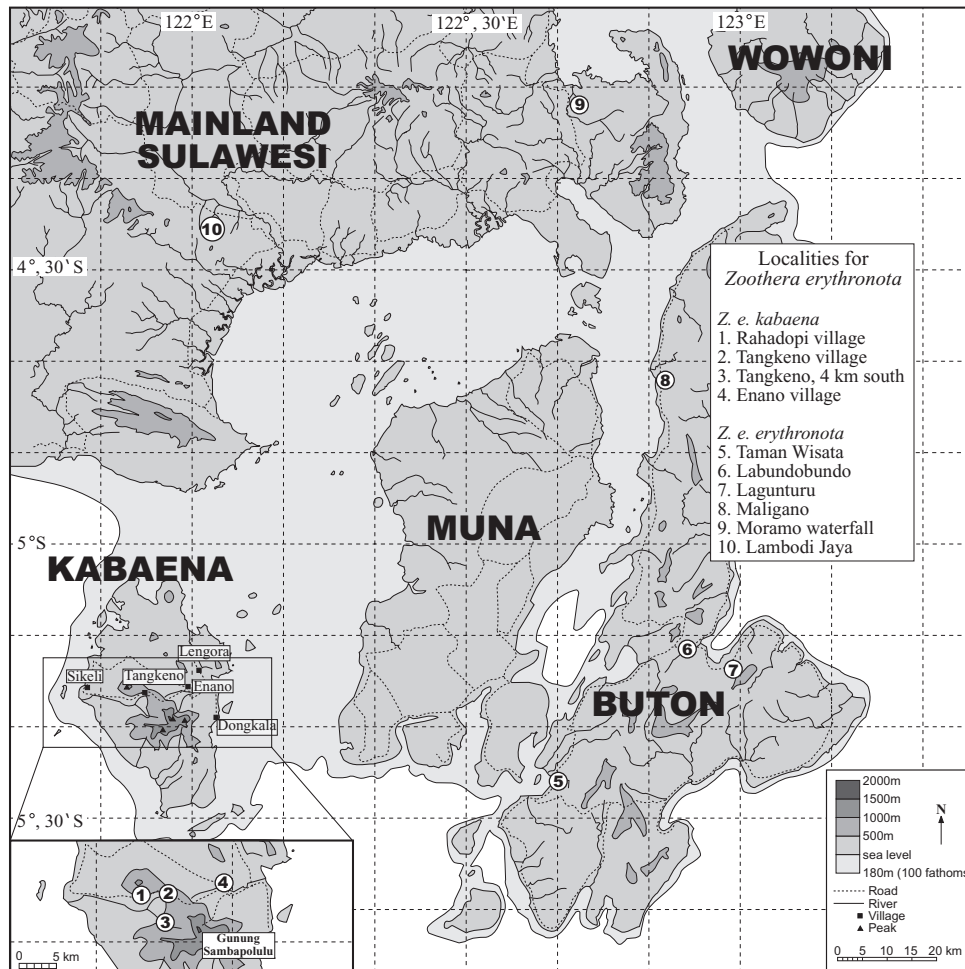


Figure 2. The south-eastern Sulawesi region, showing known localities for *Z. erythronota*. Latitude and longitude data are given in the text for Kabaena localities, but are not available for Buton and mainland localities.

to Kabaena to collect these specimens, joining DJK and volunteers already in the field.

The purpose of this paper is to describe and name this new taxon. We hope that, by so doing, attention will also be drawn to an area which still remains ornithologically very poorly known, and therefore no doubt contains other unique animal and plant taxa.

METHODS

Ornithological surveys of Buton island have been conducted by Operation Wallacea staff (including MJC, DJK, BP, NMM and JR-D) and volunteers since 1995, totalling approximately 24 team-months. In 1999 and 2000, both quantitative and qualitative surveys were conducted on Kabaena, in addition to Buton island, the Tukangbesi islands and mainland south-eastern Sulawesi (2000 only) (Fig. 1). Birds were recorded by sight and call, typically along line transects, from just prior to dawn until the late morning, and again from 14h30 until dusk. Species presence and abundance, along with other ecological data, were recorded.

Because of the records of possibly distinctive *Zoothera* taxa on both Buton and Kabaena islands, special efforts were made to observe and capture specimens of this species for closer examination. The species is naturally very shy and seldom seen since it frequents the forest understorey, so mist-nets were used to trap specimens. All specimens captured by JR-D were obtained after locating apparent territories and flight paths, to guide effective placement of up to three mist-nets (9 m, 12 m and 18 m) at any site, with the lowest shelf at ground level.

During the 1999 and 2000 research visits, detailed notes, photographs and measurements were taken from all captured specimens. Feathers were taken and stored both dry and in DMSO (in 1999) and blood samples were taken from the brachial vein and stored in 97% ethanol (in 2000) or 20% DMSO, 0.25 M EDTA, NaCL sat., pH 8.0 (in 2001) for molecular analysis. Photographs were taken of the head and back, tail, underside (breast, throat, flanks and vent), and upper-

and underside of the extended wings. After processing in the field, specimens were marked (by removing a small section of the inner web of one of the rectrices) and released at the capture site.

In 2001, the two type specimens were collected using three 18 m nets and one 9 m net, and four other captured individuals were examined as in previous visits. The latter four birds were marked and released. The two individuals taken as specimens (one male, one female) were skinned and dried, the sex organs examined and sized, the stomach contents stored in 98% ethanol, and skull ossification noted. The full skeleton of the female was also preserved.

To assess the taxonomic importance of phenotypic variation in *Z. erythronota*, JR-D examined museum specimens of this species (*Z. e. erythronota* and *Z. e. mendeni* (Neuman, n 1939)) and related taxa, including Chestnut-backed Thrush *Zoothera doherityi* (Hartert, 1896) (found in the Lesser Sundas and formerly placed as a subspecies of *Z. erythronota*) and Chestnut-capped Thrush *Zoothera interpres* (Temminck, 1826) (found in the Greater Sundas, Lesser Sunda islands, and Philippines; Fig. 1). The collections visited and acronyms used in the text are as follows: AMNH, American Museum of Natural History, New York, U.S.A.; NHM, Natural History Museum, Tring, U.K.; MZB, Museum Zoologicum Bogoriense, Bogor, Indonesia; NMS, National Museums of Scotland, Edinburgh, U.K.; SMTD, Staatliches Museum für Tierkunde, Dresden, Germany; USNM, National Museum of Natural History, Smithsonian Institution, Washington, U.S.A.; and ZMB, Zoologisches Museum, Humboldt Universität, Berlin, Germany.

DESCRIPTION

Zoothera erythronota kabaena, subsp. nov.

Types

Holotype (Figs. 3a,4): Museum registration # MZB 30.363, male, adult, 4 September 2001, 11h00,

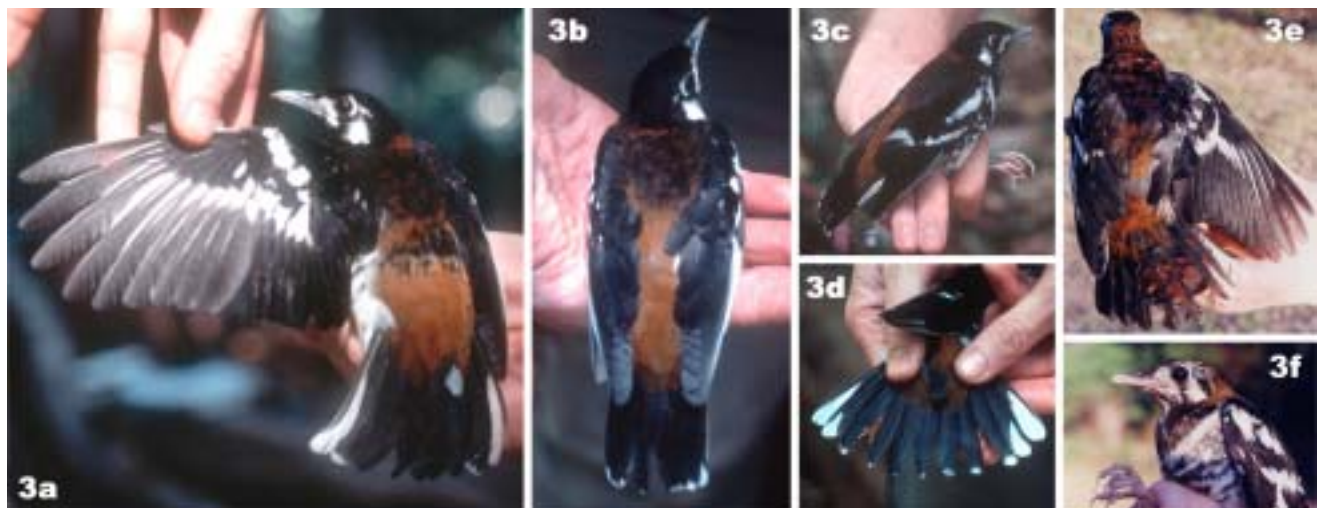


Figure 3. *Zoothera erythronota kabaena*: (a) holotype male, upperside (JR-D); (b) paratype female, upperside (JR-D); (c) paratype female, lateral view (JR-D); (d) paratype female, upperside of tail (JR-D); (e) juvenile (Bird #1) (BP); (f) same juvenile, lateral view (BP).

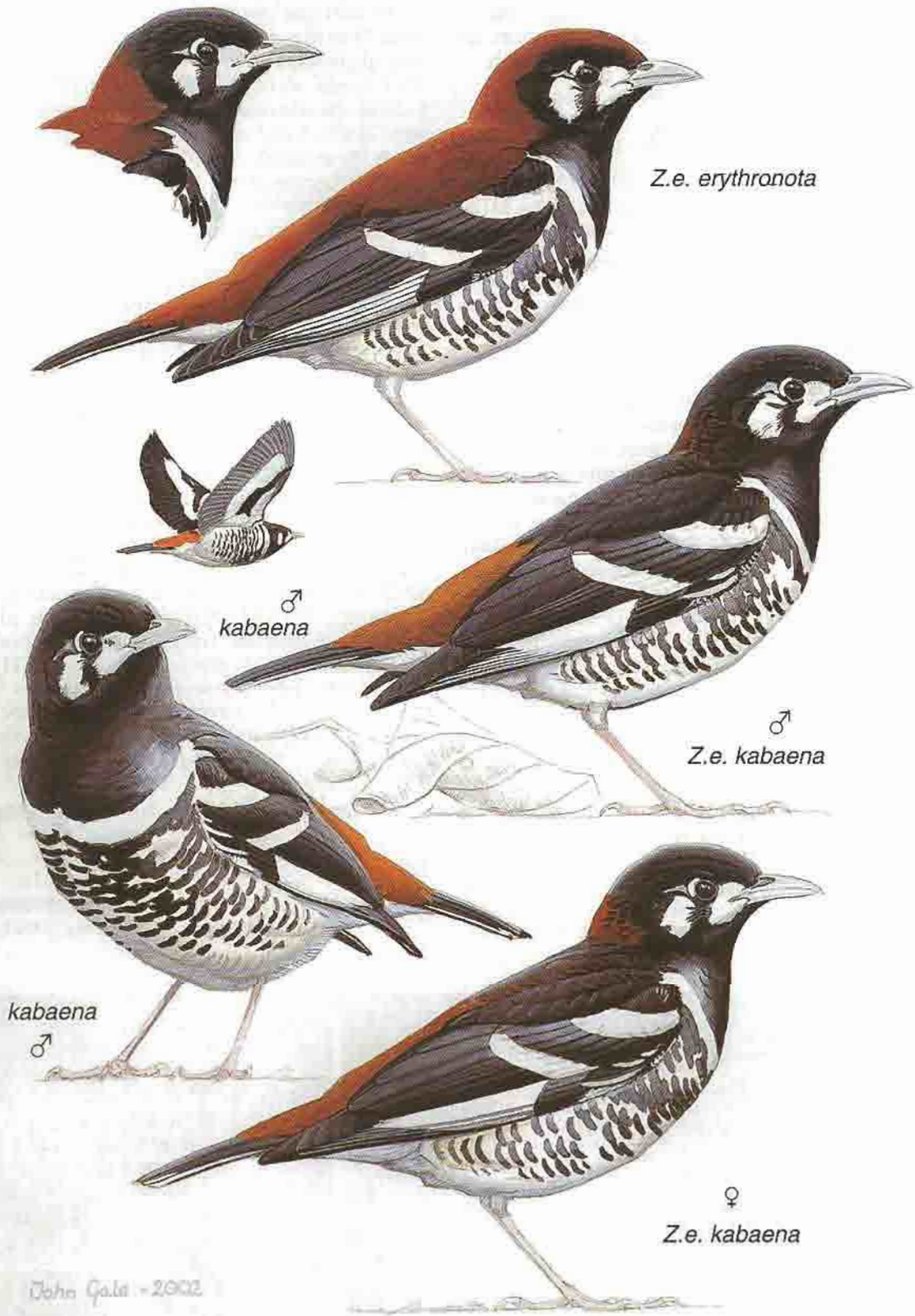
Head variation in *Z.e. erythronota*

Figure 4. *Zooihera erythronota*: top left and top, *Z. e. erythronota*, adult male and head variation; middle right, middle left, *Z. e. kabaena* and flying bird, male; bottom, *Z. e. kabaena*, female. By John Gale.

Indonesia, Sulawesi subregion, Pulau Kabaena (Kabaena Island), Tangkeno, 4 km south (5°17'27"S 121°54'33"E), 431 m, collected by Julia Robinson-Dean (bird #6). Top panel (c.2 m from ground) 18 m net at foot of slope. Specimen deposited in MZB. Muscle tissue samples and stomach (sample 1) deposited in NMS.

Paratype (Fig. 3b-d,4): Museum registration # MZB 30.364, female, adult, 3 September 2001, 10h30, Indonesia, Sulawesi subregion, Pulau Kabaena (Kabaena Island), Tangkeno, 4 km south (5°17'27"S 121°54'33"E), 470 m, collected by Julia Robinson-Dean (Bird #5). Bottom panel 18 m net on ridge-top. Specimen in MZB, to be deposited in NMS, full skeleton, muscle tissue samples and stomach (sample 2) deposited in NMS.

Adult male: Holotype (Figs. 3a,4): Maxilla (from skull) 20.5 mm; bill width at nares 6.8 mm; tarsus 32.1 mm; wing (max. chord) 115 mm; tail 83 mm; tail tip to wing tip 32 mm; weight at capture 59.0 g. Fat score 3 (EFF system). Larger testis: 4 mm by 1.5 mm. Not in breeding condition. Skull not completely ossified.

Plumage: Upperparts Forehead and entire crown black to base of feathers. Feathers on nape black with chestnut tips. Mantle feathers proximally black, narrowly fringed chestnut. Upper back and upper lower back: feathers black proximally with narrow chestnut fringes. Lower back and rump: chestnut, proximally grey. Upper tail coverts: chestnut. Tail: Upper surface of tail feathers black. Feathers 1, 2 and 3 completely black. Feather 4 with minute white spot at tip. Feather 5 with white tip extending up inner web 9.5 mm and outer web 4.3 mm. Feather 6 with extensive white tip extending up inner web 38.5 mm and outer web 14.8 mm. Wing: Lesser coverts black. Median coverts proximally black with broad white tips, extending up shaft to a maximum of 14.1 mm. Greater coverts black proximally with white tips increasing in size from feathers 9 to 1 (following secondary numbering). Primary coverts black. Alula 1 (smallest) black with fine white outer margin to outer web, alula 2 with small white/grey spot on outer web 4 mm long and 1.5 mm wide, alula 3 outer web with broad white patch 13.7 mm long and maximum of 4 mm wide. Primaries (numbered descendently, i.e. starting at innermost): all feather shafts black. Inner and outer webs proximally white, more extensive on PP 6 to 1. PP 8, 7, 6, 5 and 4 outer web edged white above notch, not meeting shaft. PP 4 to 1 outer web proximally white to shaft, PP 7, 6 and 5 having inner web proximally white not meeting shaft, PP 4 to 1 with inner web proximally white to shaft. Secondaries: black feathers proximally white extending further on inner webs than outer webs, creating wing-bar. Wing-bar 16.4 mm wide below underwing-coverts. Tertiaries: S9 black with small white patch on tip of outer web, S8 black with fine white margin on outer web, and S7 black, proximally grey/white. Wing formula: P10 21 mm >alula 3. Wing point P7; P9 falls between P4 and P5. P6 = WP-0.6 mm, P8 = WP-2.9 mm, P5 = WP-4.2 mm, P9 = WP-9.9 mm, P4 = WP-11.2 mm, P3 = WP-17.5 mm, P2 = WP-21.5 mm, P1 = WP-24.3 mm. Emarginations on outer web measured from tip: P8 (43.3 mm), P7 (38.9 mm), P6 (31.9 mm), P5 (23.4 mm). Notches on inner web

measured from tip: P9 (32.0 mm), P8 (32.2 mm), P7 (31.4 mm), P6 (22.6 mm).

Plumage: Underparts Face predominantly black. Eye-ring broken, having white feathers with black shafts behind eye, and just in front extending to lores. Base of sub-moustachial stripe white. Patch of grey bare skin immediately behind white eye-ring extending 9.1 mm. Ear-coverts white behind cheek and below eye. Chin and throat black. Upper part of breast with white breast-band. Breast to belly with white feathers narrowly tipped with black. Lower belly and vent white. Undertail-coverts white. Flanks: white, feathers with black scalloped tips as on breast. Underside of tail slate grey. Wing: Lesser underwing-coverts white with black tips. Median underwing-coverts white narrowly tipped black. Greater underwing-coverts black, broadly tipped white. Greater primary underwing-coverts slate-grey. Lesser primary underwing-coverts black, edged and tipped white. Axillaries white, tipped black. Underside of PP and SS slate-grey.

Bare parts: Orbital ring dark grey. Bill pale grey, darker at nares. Legs flesh-pink. Iris dark brown. Gape grey. Tongue pink.

Adult female: Paratype (Fig. 3b-d): Maxilla (from skull) 20.1 mm; bill width at nares 7.6 mm; tarsus 32.8 mm; wing (max. chord) 115 mm; tail 83 mm; tail-tip to wing-tip 32 mm; weight at capture 52.9 g. Fat score 2. Largest ovary: 1.1 mm diameter. Skull completely ossified.

Plumage: Upperparts Forehead and entire crown black to base of feathers. Feathers on nape chestnut with proximal quarter black. Mantle: feathers proximally black, narrowly fringed chestnut. Upper back: feathers black proximally with narrow (to broader) chestnut fringes. Lower back and rump: chestnut, proximally grey. Upper tail-coverts: chestnut. Tail: Upper surface of tail feathers black. Feathers 1, 2 and 3 completely black. Feather 4 with central white spot extending up inner web 7.2 mm and outer web 5.5 mm. Feather 5 with broad white tip extending up inner web 16.9 mm and outer web 10.7 mm. Feather 6 with extensive white tip extending up inner web 35.2 mm and outer web 13.0 mm. Wing: Lesser coverts black. Median coverts proximally black with broad white tips. Greater coverts black proximally with white tip increasing in size from feathers 9 to 1 (following secondary numbering). Primary coverts black. Alula 1 (smallest) black, alula 2 narrowly edged white starting 3.6 mm from tip extending for 5.6 mm towards base, alula 3 outer web with 12.5 mm white. Primaries (numbered descendently, i.e. starting at innermost): all feather-shafts black. Inner and outer webs proximally white, more extensive on PP 6 to 1. PP 9, 8, 7, 6 and 5 outer web edged white above notch, not meeting shaft. PP 4 to 1 outer web proximally white to shaft. PP 7 to 1 having inner web proximally white to shaft. Secondaries: Black feathers proximally white extending further on inner webs than outer webs, creating wing-bar. Wing-bar c.16 mm wide below underwing-coverts. Tertiaries: S9 completely black, S8 black with small white panel on outer web starting 30.9 mm from tip and extending to base, and S7 black with white panel on inner and outer

web as part of wing-bar. Wing formula: P10 19.35 mm > alula 3. Wing point P6; P9 falls between P4 and P5. P7 = WP-2 mm P8 = WP-2.5 mm, P5 = WP-4.5 mm, P9 = WP-9.8 mm, P4 = WP-10.4 mm, P3 = WP-12 mm, P2 = WP-16.3 mm, P1 = WP-18.7 mm. Emarginations on outer web measured from tip: P8 (39.4 mm), P7 (35.4 mm), P6 (29.9 mm), P5 (very slight at 20.5 mm). Notches on inner web measured from tip: P9 (33.5 mm) P8 (34.6 mm) P7 (31.2 mm).

Plumage: Underparts Face predominantly black. Eye-ring broken, having white feathers with black shafts behind eye, and just in front extending to lores. Base of sub-moustachial stripe white. Patch of grey bare skin immediately behind white eye-ring extending 6.6 mm. Ear-coverts white behind cheek and below eye. Chin and throat black with a single white feather on throat. Upper part of breast with white breast-band. Breast to belly with white feathers narrowly tipped with black. Lower belly and vent white. Undertail-coverts white. Flanks grey, becoming chestnut towards rump. Underside of tail slate-grey. Wing: Lesser underwing-coverts white with black edges. Median underwing-coverts white narrowly tipped black. Greater underwing-coverts black, broadly tipped white. Greater primary underwing-coverts slate-grey. Lesser primary underwing-coverts white. Axillaries white, tipped black. Underside of PP and SS slate-grey.

Bare parts Orbital ring grey. Bill pale grey, darker at nares and a slight overgrowth on upper mandible (1.7 mm beyond lower mandible). Legs flesh pink. Iris dark brown. Gape grey. Tongue pink.

Other specimens examined (not designated as types; numbering is chronological)

1 juvenile (bird #1): Indonesia, Sulawesi subregion, Pulau Kabaena (Kabaena Island), Rahadopi (05°16'43"S 121°52'55"E), 380 m, 15 September 1999. Captured by DJK, BP and NMM, and released. *1 adult (bird #2 – male?)*: Indonesia, Sulawesi subregion, Pulau Kabaena (Kabaena Island), Tangkeno (05°16'29"S 121°55'23"E), 600 m, 5 September 2000, 17h45. Blood samples at MZB and NMS. *2 adults (bird #3,4 – male?)*: same data as HT except 450 m, 8 September 2000, 17h45. Blood samples at MZB and NMS. *2 adults (bird #7,8 – male?)*: same data as holotype (HT) except 431 m, 4 September 2001, 11h00. Blood samples at NMS. *1 adult (bird #9 – female?)*: same data as HT except 380 m, 6 September 2001, 08h30. Blood samples at NMS. *1 adult (bird #10 – female?)*: same data as HT except 386 m, 6 September 2001, 16h45. Blood samples at NMS. All specimens captured by JR-D, DJK and Martin Meads, and released.

Etymology

The name *kabaena* is that of the type locality, the island of Kabaena, which is also the presumed range of this subspecies. It is treated as a noun in apposition. The local name of the bird is 'ara-ara bai'.

DISCUSSION

Diagnosis and variation

This taxon differs from the nominate subspecies (Fig. 4) in consistently having predominantly black feathers

on the head and upper back, instead of chestnut-brown. There is evidence for slight sexual dimorphism in the amount of black on the nape and back – the paratype female and two similar, presumed female specimens, birds #9 and 10 (permit restrictions did not allow additional specimens to be killed, which would have verified the sex), have slightly less black on the nape and lower back than the holotype male and the other six adult specimens captured (Fig. 3a). The paratype and other presumed female specimens have black only in an ill-defined area in the centre of the upper back and mantle, with more extensive chestnut on the nape (Fig. 3b-d). In this respect, the paratype is somewhat similar to the juvenile specimen (bird #1) captured in 1999 (Fig. 3e,f) near the village of Rahadopi. The latter specimen also has less black on the crown.

A single specimen of *Z. erythronota* labelled 'N Celebes. Female. Rurukan. 34.665 1931', in ZMB, also has some black feathers on the upper back. However, the capture locality lies in northern Sulawesi, within the range of typical *Z. erythronota erythronota* (White and Bruce 1986, Coates and Bishop 1997), of which we believe it is an aberrant specimen.

Some specimens examined of *Z. erythronota erythronota* also differ from the syntypes of this name (from Makassar, in south-western Sulawesi) in having the crown entirely black (Fig. 4), like *Z. e. kabaena*. However, this variation appears to be individual, rather than sexual or geographic – a series in ZMB of one male and four females from Rurukan (north Sulawesi) shows individual variation in the amount of black on the crown. No museum specimens of *Z. erythronota* have been examined from mainland south-eastern Sulawesi or Buton island (see Appendix 1), but field observations and captured individuals from these areas suggest no substantial plumage differences from the syntypes of the nominate subspecies. (For simplicity in this paper, we provisionally refer to *Z. erythronota* from these areas as the nominate subspecies.) Apart from the single specimen referred to above from Rurukan, the nominate subspecies therefore remains consistently different from *Z. e. kabaena* in the coloration of the upper back in all other specimens examined (n = 31; 30 museum, 1 field), in north, south-western and south-eastern Sulawesi and Buton island.

The wing length of *Z. e. kabaena* is significantly greater than that of *Z. e. erythronota* (Mann-Whitney U test (2-tailed): $z = -2.78$, n = 9 *kabaena*, n = 4 *erythronota*, P = 0.005 (captured specimens only), or $z = -3.13$, n = 9 *kabaena*, n = 15 *erythronota*, P = 0.002 (including museum specimens) (Appendix 1).

Zoothera dohertyi differs from *Z. e. kabaena* (and other *Z. erythronota* taxa) in retaining buff flanks in adult plumage, and never shows a distinct breast-band. Buff flanks and an indistinct breast-band were seen on presumably young birds of *Z. e. erythronota* in collections and on mainland Sulawesi (JR-D), and buff flanks were seen on a presumably young individual of *Z. e. kabaena* (JR-D), but this feature was not apparent on the juvenile captured by DJK, BP and NMM. *Zoothera dohertyi* has a distinctive song, which is probably responsible for its popularity as a cage bird (observations in Makassar and Kendari bird markets; also Clement *et al.* 2000), while virtually no song has been described or recorded for *Z. erythronota* (Neumann 1939, Coates and Bishop 1997; but see Clement *et al.* 2000, and Vocalisations, below).

Zoothera e. mendeni (Banggai) has the white face pattern and cinnamon head colouring characteristic of some specimens of *Z. e. erythronota*, but shows no other white except as an underwing bar.

Taxonomic status and relationships

The species-level taxonomy of *Zoothera*, like that of most bird taxa fragmented into island populations, has inspired debate in the past (e.g. Ripley 1952; Ripley and Hadden 1982). Several currently recognised species, such as *Z. dohertyi*, were, until comparatively recently, regarded as subspecies of other allopatric taxa (Eck 1976; White and Bruce 1986; Coates and Bishop 1997). Coates and Bishop (1997) suggest that populations of *Z. erythronota* from Banggai (*Z. e. mendeni*) and the Sula islands (undescribed) (Clement *et al.*, 2000), off eastern Sulawesi, should perhaps be treated as a distinct species. *Zoothera erythronota mendeni* was originally described as a full species by Neumann (1939), but accorded subspecific rank by Stresemann (1940), a decision upheld by Eck (1976), who also noted that the island of Peleng otherwise supported no endemic bird species. The black on the underside, which partially distinguishes *Z. e. mendeni* from the nominate subspecies, is also an intra-specifically variable character in the closely related *Z. dohertyi* (Colenutt 2002: 28 illustrates an especially dark specimen of the latter taxon).

Zoothera e. kabaena is externally most similar to *Z. e. erythronota*, which it replaces on Kabaena island - both of these taxa have a white breast-band and reduced chestnut on the flanks, which are distinctive characters (though not necessarily derived) of the nominate subspecies. The black plumage coloration on the upperside that distinguishes *Z. e. kabaena* from the nominate subspecies is slightly variable within the taxon, and one phenotypically similar specimen from well within the range of the nominate subspecies was found in ZMB (see Diagnosis above). Our examination of museum specimens shows that the plumage coloration of the head of the nominate subspecies is also individually or geographically variable (Fig. 4). We therefore regard the phenotypic differences between *Z. e. kabaena* and *Z. e. erythronota* as being worthy only of subspecific recognition. In addition, while differences were noted in the habitats and call of *Z. e. kabaena* and *Z. e. erythronota* (discussed below), we do not feel that these are sufficiently significant or rigorously evaluated for the taxon to be treated as a distinct species. To date, no molecular analyses have been performed on the feather or blood samples taken, but these might also provide data to establish the most suitable rank for this taxon.

Vocalisations

Two types of call were heard from *Z. e. kabaena*, both of which were also heard from *Zoothera e. erythronota* on Buton and mainland south-eastern Sulawesi (JR-D). As with *Z. e. erythronota*, the bird calls infrequently and is generally discreet. When alarmed, both taxa give a harsh, repetitive 'chacking' call, consisting of five short 'chacks' of varying frequency. When undisturbed, Kabaena individuals were heard to produce a second type of call, adding two notes to the thin upslur call typical of the nominate subspecies. These notes were before the upslur, the first note being high, the second low, and the upslur starting in the middle of that range. The entire

call lasts no more than two seconds; it is usually delivered only once and may be heard throughout the day. Recording calls was difficult due to their unpredictability, but recordings of the distress call of a bird in the hand (which was typical of the Turdinae, e.g. Song Thrush *Turdus philomelos*), and an alarm call of a wild individual, have been made and will be deposited at NMS.

In comparison to other Indonesian *Zoothera*, *Z. erythronota* apparently sings very infrequently (Coates and Bishop 1997); the only record of a song of which we know is Clement *et al.* (2000: 224), who report it, in the nominate subspecies, to be a 'liquid and typically thrush-like series of notes'. No song is definitely known for *Z. e. kabaena*, which perhaps sings very briefly; a possible song for this subspecies was recorded in 2001, but remains to be analysed. Similarly, there is also no published indication of a song for *Z. e. mendeni* (Neumann 1939; Coates and Bishop 1997), though this is hardly surprising given the rarity of that taxon.

Ecology and behaviour

The first sighting of this taxon by NMM, and the first adult captured by JR-D in 2000, were in a small, linear strip of secondary forest in which the understorey had been partially cleared for cultivation, at an elevation of 600 m. The bird that was captured was first flushed from the ground in the late afternoon and flew into a nearby area of secondary growth across a small stream, at 2 m above the ground, before landing once more. A mist-net was placed in the stream gully, within the apparent territory of the bird, and within 10 minutes of the net being in place, at 16h00, the bird had flown into the third shelf of the net at a height of 1.5 m.

A number of other individuals were observed around the villages of Rahadopi and Sampalakambula, and in the river valley of Lakampula below Rahadopi (Fig. 2), by MJC, DJK, NMM, BP and volunteers in 1999. The habitat in this area consisted of secondary growth in ravines, old cashew-nut plantations, bamboo stands and extensive areas of scrub. In 1999, the juvenile bird was caught on the edge of Rahadopi football field in an area of overgrown cashew-nut plantations, rank grass and scattered patches of heavily degraded secondary forest and thickets. A single bird was also seen in secondary growth near the village of Enano in 2001 (DJK). These sightings suggest that this taxon is able to tolerate fairly substantial habitat alteration.

Two individuals were captured by JR-D in a larger area of relatively undisturbed secondary forest, approximately 4 km south of Tangkeno village, at an elevation of 380-450 m. The forest was composed predominantly of hardwood species, with some reasonably large buttressed trees still surviving, although pine trees were also abundant. Tree falls were common and the forest supported few large trees, due to the dry climate and thin ultrabasic soils. There was a mid-storey at around 5 m and a closed canopy at about 12 m, admitting very little light. Consequently, the forest floor was mostly clear, with only dry leaf and branch litter, much of it contributed by pine trees, except for occasional bamboo stands. As with the birds near Tangkeno, both of these individuals were also found in close proximity to shallow stream gullies. One individual flew into the net in the late afternoon at dusk, again into the third shelf, while the second individual was

caught at first light the next day in the second shelf at 1 m. Three other individuals were also heard in the same area. These birds, like almost all other individuals observed, were more visible than the nominate subspecies, flying higher (over 2 m) and being noticeably less shy.

The 2001 research trip was made to the latter site, which appeared to have changed little since the previous visit, and a total of six further individuals were captured. Two individuals were seen around 2 m above the ground following a noisy party of Sulawesi Babblers *Trichastoma celebense* in the subcanopy, and one individual was observed on two occasions foraging in the leaf litter near rotting fallen trees. On both occasions, on becoming aware of the observer's presence, the bird hopped onto a nearby log and cocked its tail into an upright position reminiscent of Eurasian Blackbird *Turdus merula*, before flying away just above ground level uttering a chacking alarm call. Insects were collected around the foraging area for comparison with gut contents analysis.

Gut contents of the two type specimens were analysed by AW (Appendix 2). Adult *Z. e. kabaena* eat Arthropoda, including insects from the orders Hymenoptera, Hemiptera (Heteroptera), Coleoptera and Lepidoptera (in order of quantity of fragments in the sample). Within the Hymenoptera, the sample was almost entirely from the Formicidae (ants) although there were wing fragments that could not be conclusively assigned to this family. The two samples (representing the holotype and paratype) contained vastly different numbers of fragments. Sample 1 (holotype) had 573 fragments, of which 54% were not identifiable to any particular body part of any particular taxon. Sample 2 (paratype) had 54 fragments, of which 46% fell into the same category. In Sample 1, the fraction that represented Formicidae was 32%, rising to 37% if the hymenopteran wing fragments of uncertain identity were included. The Formicidae fraction of Sample 2 was 35%. The ant petioles found in the large ant fragments of the two samples were not from the same species, thus direct comparisons between the samples cannot be made.

There is strong evidence that at least two individuals of a large species of ant were eaten by the holotype male (Sample 1). There were two whole heads and four (two per head) terminal antennal segments. There is similar evidence to suggest the same bird ate up to six smaller individuals of a smaller ant species, a bug (Heteroptera), and possibly a beetle (Coleoptera), a moth (Lepidoptera), and some other small to medium-sized arthropods.

Distribution, habitat and conservation

Zoothera erythronota kabaena is known only from Kabaena island, to which it appears to be endemic. Kabaena island is roughly oval in shape, 48 km long and 31 km wide, lying 18 km south of mainland Sulawesi and 25 km west of Muna island (Fig. 2). The topography is rugged, with a central mountain range consisting of both limestone and igneous peaks rising to 1,570 m. The significantly greater geographic isolation of Kabaena in comparison with nearby Buton island, which seems to contain the nominate subspecies (but see Clement *et al.* 2000: 224) and lies only 6 km south of the mainland, may be an important factor in the differentiation of *Z. e. kabaena* from *Z. e. erythronota*. It is worth noting that while the avifaunas of Buton and

Kabaena are largely comparable, there are some significant differences, with several characteristic forest species that are present on Buton being currently unknown from Kabaena, including Bay Coucal *Centropus celebensis*, White-necked Myna *Streptocitta albicollis*, and Knobbed Hornbill *Rhyticeros cassidix*. However, the sea depth between Kabaena, Muna and Buton islands, and the adjacent mainland, is nowhere deeper than 180 m (100 fathoms, Fig. 2), and all would almost certainly have been connected during previous glacial periods (White and Bruce 1986, Coates and Bishop 1997).

The taxon has been recorded only in the vicinity of Tangkeno, Rahadopi (c.5 km west of Tangkeno; see data under specimens examined), Lakampula river below Rahadopi, the village of Sampalakambula (c.1.5 km east of Rahadopi), and the village of Enano (125 m; 05°15'3"S 121°57'39"E), between 125 m and 650 m (Fig. 2). The more natural remaining habitat in this region is grassland-forest mosaic on igneous rock, similar to habitats in the south of Rawa-Aopa National Park on the adjacent mainland. When present, the forest has a low (10-20 m) closed canopy in some parts, but becomes more open, with grasses appearing, towards the edge. It is unclear whether this habitat is natural or anthropogenic, resulting from long-term selective tree removal (or cutting) and fire. Taller, moister forest, more similar to that on central Buton island, was only found in pockets in the river valley south and west of Gunung Sambapolulu, surrounded to the south, north and west by high peaks. This area of forest, ranging from 100-1,000 m in elevation, represents perhaps the largest relatively intact block left on Kabaena, with most of the lower-lying regions of the island being totally denuded of natural vegetation and covered with dry grassland and scrub, except on very steep slopes.

In contrast to *Zoothera erythronota* on Buton island (Catterall 1997, Baltzer 1998; JR-D, unpublished data), *Z. e. kabaena* seems to tolerate a wide range of thickly vegetated and forested habitats, including overgrown, shady plantations and bamboo stands, and it appears to be relatively common in the Tangkeno-Rahadopi area. Nevertheless, in ten days of fieldwork away from this area, in the vicinity of the villages of Lengora and Dongkala (see Fig. 2), JR-D failed to record *Z. e. kabaena*, and its range, as currently known, is highly restricted. In addition, the extensive dry season, probably exacerbated by widespread deforestation, means that fire poses a serious hazard to remaining forest patches.

The authors would like to thank all the Operation Wallacea volunteers who assisted with fieldwork, in particular David Heath, Isabel Behncke, Dick and Hanneke Coates and Martin Meads. Operation Wallacea provided the necessary logistical support throughout our time in Sulawesi, and we are grateful to all those who helped in whatever way to get us into the forest. Permits for the study, collection and export of specimens were provided through WDI and LIPI. A number of field trips by JR-D, MJC, DJK, BP and NMM, were funded in whole or part by volunteers, through Operation Wallacea. JR-D thanks in particular those who generously helped to fund her flight to Indonesia in 2001, to collect the type specimens: The Orkney Islands Council, Ola Gorie, Orkney Herring Co. Ltd., Charles Tait Photographic, The A. S. Butler Charitable Trust and an anonymous donor. Radio Orkney and The Orcadian helped to publicise the trip and thus obtain funding. JR-D is grateful to the all the curators who gave her access to the *Zoothera* collections in their care, often at short

notice: Paul Sweet (AMNH), Mark Adams and Robert Prýs-Jones (NHM), Chris Milensky (USNM), Matthias Nuss (SMTD), and Sylke Frahnert (ZMB). A special debt is owed to Bob McGowan, Peter and Phil at the NMS, who provided hours of time in explaining the finer points of field taxidermy, advice on the required materials and methods, and constant encouragement. Charles and Magnus Tait willingly gave hours of their time in scanning slides and helping with numerous other computer matters. Matthias Nuss laboriously translated chunks of Eck (1976), with imaginative use of 'straight-gherkin' analogies to explain obscure biogeographic concepts. Eric Meek helpfully provided copies of a number of relevant papers. Euan MacIllraith made sound recordings on Kabaena in an attempt to record calls. We are extremely grateful to John Gale for generously providing the meticulous artwork that illustrates the taxon (Fig. 4 and front cover). We thank Edward Dickinson and Stuart Butchart for helpful comments on the manuscript, and Nigel Collar for comments on an earlier version.

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- J. C. Robinson-Dean, Turriedale, Finstown, Orkney, KW17 2JX, U.K. Email: jrd@zetnet.co.uk
- K. R. Willmott, Department of Entomology, The Natural History Museum, Cromwell Road, London, SW7 5BD, U.K. Email: keiw@nhm.ac.uk
- M. J. Catterall, 94, Alkincoats Road, Colne, Lancashire, BB8 9QQ, U.K. Email: m.catter@virgin.net
- D. J. Kelly, B. Phalan and N. M. Marples, Department of Zoology, Trinity College, Dublin 2, Ireland
- A. Whittington, Geology and Zoology Department, National Museums of Scotland, Chambers Street, Edinburgh, U.K.
- Boeadi, Museum Zoologi Bogor, LIPI, Cibinong, Bogor, Indonesia

APPENDIX 1

Morphometric data (in mm and g) for *Zoothera erythronota* specimens

Taxon	Collection	Sex	Type status	Specimen #	Maxilla	Bill width	Tarsus	Wing	Tail	Weight	Wing point	Comments	PP9=
<i>kabaena</i>	Released			2	20.3	7.2	33.6	120.5	85	63	7		4/5
<i>kabaena</i>	Released			3	18.0	7.2	31.55	116.0	83	44	7		4/5
<i>kabaena</i>	Released			4	18.1	7.0	31.9	118.0	87	53	7		4/5
<i>kabaena</i>	MZB	female	PT	30.364	20.2	7.6	32.82	115.0	83	52.9	6		4/5
<i>kabaena</i>	MZB	male	HT	30.363	20.5	6.8	32.1	115.0	83	59	7		4/5
<i>kabaena</i>	Released			7	19.0	8.3	31.6	116.0	83	55	7		4/5
<i>kabaena</i>	Released			8	21.7	6.6	32.85	120.0	86	61.5	6		4/5
<i>kabaena</i>	Released			9	20.0	6.9	32.5	116.0	84	47	6		4/5
<i>kabaena</i>	Released			10	21.5	6.1	33.8	117.0	84	57	6		4/5
<i>mendeni</i>	SMTD	male	HT	C44567	19.6 (*)	6.4	29.5	116.0	73				
<i>erythronota</i>	Released			Buton: TW	21.1			111.0	75	50			
<i>erythronota</i>	Released			Buton: LBB	18.7		32	113.0	76	52	7		
<i>erythronota</i>	Released			Buton: LBB	18.8		33.5	114.0	73	51.5	7		
<i>erythronota</i>	Released			Buton: LG	18.1	6.7	31.8	113.0	83	59		moult P7	4/5
<i>erythronota</i>	SMTD	male		C13869	17.8	6.0	32.05	114.0	76				
<i>erythronota</i>	ZMB	female		34.666	17.4	7.3	30	109.0	71				
<i>erythronota</i>	ZMB	female		34.665	17.2	6.8 (*)	33.3	113.0	80				
<i>erythronota</i>	ZMB	female		34.667	19.5	6.4	34	110.0	66				
<i>erythronota</i>	ZMB	male		34.664	19.5	7.4	25.8	120.0	81				
<i>erythronota</i>	NHM		ST	58.12.2.96	18.7	7.0	32	115.0	78				
<i>erythronota</i>	NHM		ST	58.12.2.95	19.6	7.4	33.2	114.0	72				

Taxon	Collection	Sex	Type status	Specimen #	Maxilla	Bill width	Tarsus	Wing	Tail	Weight	Wing point	Comments	PP9=
<i>erythronota</i>	NHM			81.5.1.743	18.0	7.2	31.2	108.0	72				
<i>erythronota</i>	NHM			88.2.20.415	18.3	6.9	32.5	112.0	72				
<i>erythronota</i>	NHM	male		1965-M.12479	19.7	7.2	30.6	116.0	67				
<i>erythronota</i>	NHM			88.2.20.414	*	6.2	27.1	110.0	73				

NOTE: PT = paratype; HT = holotype; ST = syntype; * = broken; TW = Taman Wisata; LBB = Labundobundo; LG = Lagunturu.

APPENDIX 2

Gut contents analysis

Taxon	Fragment	Sample 1 (HT)	Sample 2 (PT)
Hymenoptera: Formicidae: sp. 1	head (\pm whole)	2	
	left mandible	3	
	right mandible	2	
	pedicel	7	1
	scape	3	3
	antennal segments	19	
	terminal antennal segment	4	
	coxa	6	
	femur (type 1)	11	1
	femur (type 2)		1
	tibia (type 1)	10	1
	tibia (type 2)		1
	basal tarsomere	3	
	terminal tarsomere	3	
	tarsomere	11	1
	thorax (\pm whole)	3	
	thoracic fragment	7	3
	petiole	1	1
	abdominal tergite	34	8
Hymenoptera: Formicidae: sp. 2	left mandible	9	
	right mandible	12	
	antennal segments	3	
	coxa	9	
	femur	2	
	tibia (type 1)	6	
	tibia (type 2)	12	
	tarsomere	1	
	thoracic fragment	2	
abdominal tergite	2		
Hymenoptera (Formicidae ?)	wing fragments	29	
Lepidoptera	sclerite	1	
Coleoptera ?	head (\pm whole)	1	
	leg (coxa, femur and tibia)	1	
Hemiptera (Heteroptera)	head (\pm whole)	1	
	wing fragments	12	
	tibia	2	
Other Arthropoda	mandibles: claw-like	4	
	mandibles: long, thin, with spur	5	
	mandibles: long, thin, with broad base and cleft apex	1	
	leg fragments	3	6
	tergites	15	2
	Miscellaneous fragments of unidentifiable taxa	311	25
TOTAL		573	54