Butterflies (Lepidoptera: Papilionoidea) of Mount Kilimanjaro: family Pieridae, subfamily Pierinae

Steven D. Lisekia,b* and Richard I. Vane-Wrightb,c,d

aTanzania Wildlife Research Institute, Arusha, Tanzania; bSchool of Anthropology and Conservation, Durrell Institute of Conservation and Ecology, University of Kent, Canterbury, UK; cLife Sciences, Natural History Museum, London, UK; dGeographical and Life Sciences, Canterbury Christ Church University, Canterbury, UK

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This paper, which presents an annotated checklist of the whites (Pieridae: Pierinae), is the third in a series on the butterfly fauna of Mount Kilimanjaro. Four genera (Colotis, Nepheronia, Belenois, Mylothris), with a total of 10 included species, are known to occur within the main forest zone, from c.1800 to c.2800 m. Of the species, only Mylothris sagala appears restricted to the primary forests. The fauna from the lower slopes, below 1800 m, is far richer, with a total of 11 genera and 40 species listed. An identification key to the genera of Pierinae that occur in Tanzania, together with a key to the adults of all pierine butterflies considered to occur or have occurred on Kilimanjaro, with 310 colour images, are included as online Supplementary Information.

Keywords: Africa; Tanzania; taxonomy; keys; checklist; inventory; monitoring; climate change; distribution; variation

Introduction

This paper, which offers a synopsis of the “white” butterflies of Mount Kilimanjaro, is the third in a series intended to present a checklist for all butterflies currently known or likely to occur on the mountain and its lower slopes. As indicated by Liseki and Vane-Wright (2011), the ultimate goal of this inventory programme is to facilitate monitoring the butterfly fauna of this exceptional mountain, including the potential to use these conspicuous day-flying insects as a focal group to document possible impacts of climate change in eastern Africa. Keys and photographs, provided as online Supplementary Information (SI), offer a practical means for identification of the adult butterflies.

Pierinae of Tanzania

For Tanzania, Kielland (1990) recorded 11 genera and 84 species of Pierinae. Additionally we recognize the genus Teracolus, recently resurrected by Nazari et al. (2011) from Colotis – but we do not accept their separation of Afrodryas from Eronia (see Discussion).

*Corresponding author. Email: sdliseki@yahoo.com

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Annotated checklist of Pieridae: Pierinae of Mt Kilimanjaro

The genera are treated in the sequence of Table 1. Within each genus, species are listed alphabetically (within Colotis, alphabetically by species group). Those genera and species known to occur within the montane forest reserve areas of Mount Kilimanjaro (above 1800 m) are listed in bold. Additional species known to occur or to have occurred on the lower slopes are listed in non-bold. Species about which we are uncertain, or that we consider to have been recorded from Kilimanjaro falsely, are listed in square brackets.

According to de Jong and Congdon (1993: appendix 8.2), Belenois raffrayi extendens (Joicey and Talbot, 1926) occurs in the montane forests of Kilimanjaro, but we believe this to be a mistake and have not included this taxon. The error may be due to the record of “Pieris raffrayi Oberth.” by Aurivillius (1910a, p.11), which refers to Belenois margaritacea Sharpe, 1891 – the latter was treated as a subspecies of raffrayi in “Seitz” (Aurivillius 1910c, p.39). Belenois r. extendens occurs from western Kenya to Rwanda and western Democratic Republic of Congo (DRC) (Larsen 1996, p.138), including western Tanzania.

As noted by Liseki and Vane-Wright (2011, 2013), to develop this list we have relied mainly on Kielland (1990), Ackery et al. (1995) and Congdon and Collins (1998), and the collections of the Natural History Museum (BMNH), London. In addition, for this paper RIVW searched the main butterfly collection of Oxford University Museum of Natural History (OUMNH), where valuable material from Kilimanjaro and nearby Taveta exists, notably arising from the work of K. St Aubyn Rogers (e.g. Rogers 1908, 1913). Fieldwork was carried out on Kilimanjaro in 2001 by SDL, who observed and sampled butterflies at three sites on the Marangu Route (southern slopes), at 2000, 2500 and 3000 m. Visits, lasting 5–7 days at a time, were made during January, March, May, July, September and November (Liseki 2009). RIVW accompanied SDL during the May 2001 sampling period.

Table 1. The 12 genera of Pierinae that occur in Tanzania. The order is based on Braby et al. (2006), with additional information from Vane-Wright and Liseki (2011) and Nazari et al. (2011).

| Pierinae | Colotis group | Teracolus Swainson, 1833 |
|----------|--------------|-------------------------|
|          |              | Colotis Hübner, 1819     |
|          |              | Nephersonia Butler, 1870 |
|          |              | Pinacopteryx Wallengren, 1857 |
|          |              | Eronia Hübner, 1823      |
|          |              | (including Afrodryas Stoneham, 1957) |
|          | Leptosia group | Leptosia Hübner, 1818    |
|          | Appiadinia   | Appias Hübner, 1819     |
|          | Pierina      | Pontia Fabricius, 1807  |
|          |              | Pieris Schrank, 1801    |
|          | Belenois group | Belenois Hübner, 1819  |
|          |              | Dixeia Talbot, 1932     |
|          | Aporiina     | Mylothris Hübner, 1819  |
|          |              | (=Pseudomylothris Neustetter, 1929) |
In most but not all cases, male and female forewing lengths are given for each species. The ranges are estimates. The means and standard deviations (SD) have been calculated from measurements of small samples of specimens in the BMNH, as in Liseki and Vane-Wright (2011). Wherever possible these size estimates are based on material entirely from northeastern Tanzania. Where necessary, however, BMNH material from elsewhere in Tanzania, Kenya or East Africa has been used. All sizes given should be regarded as indicative only (see discussion in Liseki and Vane-Wright 2011, p.2392).

In the text, altitudinal ranges for species are given in metres as rounded estimates, largely by reference to the work of Kielland (1990), but sometimes modified from other sources of information. In the SI figure legends and at certain places in the text, however, heights at which individual specimens were stated to have been captured are given in the units used on the data labels – notably “feet” (conversion to metres gives a spurious impression of accuracy, or rounding difficulties). In the legends, however, place names are generally standardized to modern spellings (e.g. Moshi for “Moschi”).

Genus *Teracolus*

*Teracolus eris eris* (Klug, 1829)

Larsen 1996: pl. 8, figs 71 i,ii. d’Abrera 1997: 87 (4 figs). SI: Figure 2a–h.

Forewing length: male 24–27 mm (mean \((n = 6)\) 25.32 mm, SD = 1.042); female 21–27 mm (mean \((n = 11)\) 25.32 mm, SD = 1.496).

**Records.** Occurs in savannah, Miombo woodland and open bush throughout Tanzania, at elevations from 250 to 2300 m (Kielland 1990, p.57). There are old specimens from the lower slopes of Kilimanjaro in the BMNH, including a male collected by F.J. Jackson, and three females from nearby Taveta (Kenya) collected by K. St Aubyn Rogers in the OUMNH. There is nothing to indicate that this species ascends into the forest zone on Kilimanjaro. The nominate race of this distinctive species is very widespread throughout arid areas of Africa, with separate subspecies recognized in parts of Arabia and South Africa (Ackery et al. 1995).

The males, although variable, are recognizable by the brownish apical area of the forewing upperside that encloses a series of golden or ochre-coloured spots (responsible for its common name of “gold tip”). Females are variable: some are fairly male-like but with a dull brownish forewing tip with pale spots, sometimes they are very lightly marked, and some have a bright yellow ground colour instead of white or off-white (both white and yellow forms are represented in the small sample in OUMNH). Van Son (1949, p.163) gives a key to four named forms of males and of females.

Genus *Colotis*

*Colotis* is a large and complex genus, with well over 40 recognized species in the Afrotropical Region. The recent work by Nazari et al. (2011) represents a quantum shift in understanding both the limits and interrelationships of these phenotypically very variable insects. To make it easier to appreciate the recent changes, we have adopted the informal scheme of nine numbered species-groups proposed by Nazari
et al. (2011), listing the species within each alphabetically. Group I does not appear to be represented among the butterflies of the Kilimanjaro massif.

**GROUP II**

The taxonomy of this group presents sufficient difficulties that it is necessary to offer some clarification. Talbot (1939), in his revisional account of the genus, placed all taxa belonging to this group within a single Indo-African polytypic species, *Colotis eucharis* (Fabricius, 1775). Unfortunately the name *eucharis* Fabricius is a junior primary homonym of *Papilio eucharis* Drury, 1773. *Colotis eucharis* (Fabricius) has been replaced by its junior synonym *Colotis aurora* (Cramer, 1780) (see Ackery et al. 1995). Both *eucharis* and *aurora* were based on material from the Indian subcontinent, and without doubt apply to the same species.

According to Nazari et al. (2011), the group is now seen as divisible into four species: the Asian Plain Orange Tip [*C. aurora* (Cramer, 1780)], the African Plain Orange Tip [*C. evarne* (Klug, 1829)], the Yellow Orange Tip [*C. incretus* (Butler, 1881)] – this last being divisible into two “ecological” subspecies, *C. auxo auxo* (“coastal forests and the bushveld”) and *C. auxo dissociatus* (“savannah habitats”). Although this may be correct, previously every major work relevant to understanding the members of this group found within Tanzania has employed the various available names differently. These changes in the major works referred to in this paper are tracked by Table 2. In addition, we have tried to interpret the important commentary of Bernardi (1989).

*Colotis auxo dissociatus* (Butler, 1897)

d’Abrera 1997: 81 (4 figs). SI: Figure 3a–h.

Forewing length: male 18.0–22.5 mm (mean (*n* = 6) 20.73 mm, SD = 1.313); female 16.5–22.0 mm (mean (*n* = 6) 19.8 mm, SD = 1.413).

**Records.** Kielland (1990, p.56, as *C. aurora dissociatus*) states that this butterfly occurs in savannah and dry woodland from 200 to 1700 m in many parts of Tanzania, but not in wet coastal areas or high mountains. However, the three specimens illustrated by Kielland (1990, p.267) as “*aurora dissociatus*” (Table 2) appear to us to represent *C. evarne*. If Kielland did confuse *auxo* and *evarne* as a single species then we cannot be sure where within Tanzania he found them, nor can we be sure how his description of general ecology applies. As *C. evarne* is generally considered not to extend south from Kenya and Uganda into Tanzania (although it does according to Bernardi 1989: map 4), it may well be that his choice of specimens for illustration was unfortunate, perhaps coming from northwestern Tanzania, whereas his description perhaps largely pertains to *C. auxo dissociatus*. Butler’s type series of *dissociatus* included specimens from Kilimanjaro. Although Tanzania was not included within the range of *dissociatus* by Bernardi (1989: map 4), this taxon is listed here as a member of the lower slopes fauna on the evidence of several specimens from Kilimanjaro and Taveta in the BMNH, and about 10 specimens from Taveta in OUMNH. Aurivillius (1910a, p.12) noted a pair as *Teracolus auxo* from Kilimanjaro.
Table 2. Nazari et al. (2011) recognized five taxa in “Colotis group II” (corresponding to the *eucharis* group of Talbot 1939); these taxa are listed in column 1 (on left). The corresponding names employed in six works affecting the Tanzanian fauna are tabulated in columns 2–7. Larsen’s (1996) system is apparently based on Hecq (1975). The system adopted by d’Abrera (1997) comes closest to the Nazari et al. arrangement. For problems affecting Kielland’s (1990) account, see entry for *C. evarne*. The interpreted type localities for the five taxa are: *aurora* Cramer, 1780 (southeast India: Chainey 2005); *evarne* Klug, 1829–1845 (South Sudan: Ackery et al. 1995); *incretus* Butler, 1881 (far northern Mozambique (not Tanzania!), Mamboia: Ackery et al. 1995); *dissociatus* Butler, 1897 (Malawi to Kilimanjaro and Lake Victoria: Ackery et al. 1995); *auxo* Lucas, 1852 (Port Natal, RSA: Ackery et al. 1995).

|                  | Talbot (1939)        | Bernardi (1989)     | Kielland (1990)    | Ackery et al. (1995) | Larsen (1996)    | d’Abrera (1997)   |
|------------------|----------------------|---------------------|--------------------|----------------------|------------------|-------------------|
| Asian Plain      | *eucharis eucharis*  | *aurora aurora*     | *aurora aurora*    | *aurora aurora*      | *eucharis eucharis* | *aurora aurora*   |
| Orange Tip       | C. *aurora*          |                     |                    |                      |                  |                   |
| African Plain    | *eucharis evarne*    | *aurora evarne*     | *aurora dissociatus?* | *aurora evarne*      | *eucharis evarne* | *aurora evarne*   |
| Orange Tip       | C. *evarne*          |                     | [figs misidentified?] |                    |                  |                   |
| Yellow Orange    | *eucharis incretus*  | *auxo incretus*     | *auxo incretus*    | *auxo [incretus as synonym]* | *auxo incretus* | incretus          |
| Tip              | C. *incretus*        |                     |                    |                      |                  |                   |
| Northern Sulphur | *eucharis dissociatus* | *dissociatus [part]* | *aurora dissociatus [account may refer to two species, auxo and evarne]* | *dissociatus [auxo dissociatus]* | *dissociatus* |                   |
| Orange Tip       | C. *auxo dissociatus* |                     |                    |                      |                  |                   |
| Southern Sulphur | *eucharis auxo*      | *auxo auxo [part]*  | *auxo auxo*        | *auxo*               | *[auxo auxo]*    | *auxo*            |
| Orange Tip       | C. *auxo auxo*       |                     |                    |                      |                  |                   |
More widely, the subspecies occurs in Malawi and Zambia south to Botswana and northern Mozambique (Ackery et al. 1995, p.188), while the nominate subspecies of *auxo* occurs in South Africa. However, the boundary between the two requires further investigation: it is difficult to reconcile the accounts of Bernardi (1989) and d’Abrera (1997), in which *auxo* and *dissociatus* are treated as separate species, with the current division into two “ecological” subspecies (see also comments in Pennington 1978, p.168).

Females of *C. auxo dissociatus* are essentially dimorphic for white or orange forewing tip. Some have a faintly yellowish ground, and some have a wider forewing apical black border than others.

*Colotis evarne* (Klug, 1829)

Kielland 1990: 267, 3 figs (as *C. aurora dissociatus*, misidentification?). Larsen 1996: pl. 7, figs 63 i,ii (as *C. eucharis evarne*). d’Abrera 1997: 81 (2 figs, as *C. aurora evarne*). SI: Figure 5a–j.

Forewing length: male 18.0–23.0 mm (mean (n = 10) 20.63 mm, SD = 1.154); female 17.0–23.0 mm (mean (n = 11) 20.09 mm, SD = 1.310).

**Records.** Nazari et al. (2011) separate *C. aurora* (Cramer, 1780, from Asia = *C. eucharis* Fabricius, 1775), invalid homonym) and *C. evarne* (from Africa) as distinct species. According to Ackery et al. (1995, p.185, as *C. aurora evarne*), *evarne* does not occur further south than Uganda and Kenya. Larsen (1996, p.134, as *C. eucharis evarne*) states that, although common in most of Kenya, to the south of the country it is replaced by *C. ineretus* (see below). Kielland (1990) figures what appears to be *C. evarne* as *C. aurora dissociatus* (see above), which we presume was a mislabelling — although, at the same time, he also refers in his text to an illustration by D’Abrera (1980), as *C. eucharis dissociatus*, which does seem to be genuine *dissociatus*, not *evarne*. As Kielland does not give provenance for his images, and he says of *dissociatus* that it occurs in most parts of Tanzania, it would appear uncertain whether true *evarne* occurs in Tanzania and, if it does, whether or not it occurs in the Kilimanjaro area (Talbot 1939, p.223, simply lists “Tanganyika Territory” as part of the range of “*eucharis evarne*”).

However, examination of the BMNH collection as arranged by Talbot reveals two lots of material from Kilimanjaro and adjacent regions grouped separately as *C. eucharis evarne* f. “evarne” and *C. eucharis evarne* f. “citreus” (Ackery et al. 1995, p.185, list *Teracolus citreus* Butler as a synonym of *C. aurora evarne*). The former lot includes four males from Ngaserai, West Kilimanjaro, collected by Cooper at “3000 ft” in May 1937, together with three females from Taveta. The second lot includes one female ex Cooper from Ngaserai (same data as males above), a pair from West Kilimanjaro collected by Cooper at “4500–5000 ft” during May–July 1938, old material of two males and a female from Kilimanjaro (probably the material recorded from slopes of Kilimanjaro by Butler 1888, p.92, as *Teracolus citreus*), and two males and two females from Taveta. We have illustrated five of these specimens (SI). On this basis we include *C. evarne* as a member of the lower slopes fauna. This is consistent with the map given by Bernardi (1989: map 4)
showing *C. evarne* (*aurora evarne*) extending south through the northern half of Tanzania.

Males vary in the extent of the width of the dark margin of the upperside forewing (in some cases practically obsolete) and in the presence or absence of the minute dark cell spot on the underside of the hindwing. Females vary in the extent and intensity of the upperside dark markings, and are also essentially dimorphic for orange or not orange at the forewing tip – although some largely white specimens do have a hint of orange, and are therefore somewhat intermediate. The full extent of the range of this species needs to be re-assessed.

**Colotis incretus** (Butler, 1881)

Larsen 1996: pl. 7, figs 64 i,ii (as *C. auxo incretus*). d’Abrera 1997: 81 (4 figs). SI: Figure 4a–h.

Forewing length: male 20.5–26.0 mm (mean \( n = 8 \) 23.09 mm, SD = 1.599); female 19.5–26.0 mm (mean \( n = 12 \) 23.4 mm, SD = 1.461).

Nazari et al. (2011) confirm that *inceetus* should be treated as a separate species, as proposed by d’Abrera (1980, 1997, p.80). *Colotis incretus* appears to be larger than *C. auxo dissociatus* and, according to Larsen (1996, p.134), it is also larger than *C. evarne*, or at least usually so.

**Records.** Occurs in savannah and dry woodland of Tanzania, at c.75–2100 m, in Mpanda and Kigoma, the northern highlands, central districts, Turiani, Morogoro, Pugu Hills, Rubeho Mts and Chimala (Kielland 1990, p.56, as *C. auxo incretus*). Noted by Aurivillius (1910d, p.60) from Kilimanjaro, and included here as a member of the lower slopes fauna based on several specimens in BMNH from West Kilimanjaro, Taveta (these probably including material recorded by Butler 1888, p.92) and Marangu, with 11 more specimens from Taveta in OUMNH. Liseki (2009) did not encounter this species at 2000 m or above, in the forest zone. Beyond Tanzania, according to d’Abrera (1997), this butterfly occurs north to Kenya and Uganda, and south and west to northern Malawi, Burundi and perhaps Rwanda and DRC – to which, based on the type locality at least, northern Mozambique must be added.

Females vary in ground-colour (yellow/white/intermediate), and forewing tip coloration (orange/no orange tip/intermediate). As a result they are very varied, with just these two variable factors giving up to nine possible phenotypes. However, although yellow ground can occur without an orange tip, this appears to be unusual – but is approached by the specimen illustrated at SI: Figure 4g.

**GROUP III**

**Colotis antevippe zera** (Lucas, 1852)

Kielland 1990: 266, 5 figs. Larsen 1996: pl. 7, figs 65 i–v. d’Abrera 1997: 83 (6 figs of other subspp.). SI: Figure 6a–h.
Forewing length: male 19.5–25 mm (mean \( n = 5 \) 22.1 mm, SD = 1.528); female 19–23 mm (mean \( n = 5 \) 21.0 mm, SD = 1.168).

**Records.** According to Kielland (1990, p.55), common in northern and western Tanzania in semi-deserts, open formations and woodlands, at altitudes of 780–2000 m. In Kenya it ranges from the coast to c.1800 m (Larsen 1996, p.134). The BMNH collection includes several specimens from west Kilimanjaro collected at heights below 1600 m. Butler (1888, p.92) recorded this species from Kilimanjaro as *T��olus antevippe*, while Aurivillius (1910a, p.12) recorded the species from Kilimanjaro under the invalid name *T��olus achine* (Cramer)[sic] [recte Stoll, 1781], but both without information on altitude. The OUMNH has five specimens from Taveta, which lies on the southeastern flank of the Kilimanjaro massif. Elsewhere, subspecies *zera* occurs from eastern DRC and Uganda north to Saudi Arabia and Oman. The species as a whole is found throughout much of the drier parts of Africa (Ackery et al. 1995).

Males vary, notably with respect to the hindwing margin, whereas the darker females occur in a range of forms, with frequent variations. Wet season forms have the veins on the underside of the wings heavily marked with black, unlike dry season forms (Brakefield and Larsen 1984, fig. 5).

*Colotis daira jacksoni* (Sharpe, 1890)

Larsen 1996: pl. 7, figs 68 i, ii. d’Abrera 1997: 83 (1 fig.). SI: Figure 7a–h.

Forewing length: male 12.0–19.5 mm (mean \( n = 6 \) 16.72 mm, SD = 2.133); female 14.0–19.0 mm (mean \( n = 8 \) 16.21 mm, SD = 1.299).

**Records.** North East Tanzania (Kielland 1990, p.56) and eastern Kenya. Neither Kielland (1990) nor Larsen (1996) gives an altitude range, but the latter described it as “a typical savannah species” (Larsen 1996, p.135). Included here as a member of the lower slopes fauna on the basis of material from Taveta and a single female from Kilimanjaro in BMNH. Recorded from Taveta by Rogers (1913, p.99).

Males vary in the amount of black, and females are notably variable in ground colour, named forms including “jacksoni” (male-like: whitish with orange apical tip to upperside forewing), “arusa” (yellow with upperside orange tip) and “flavidus” (yellow without upperside orange tip). Beyond East Africa, this small species occurs from Arabia to Nigeria (Ackery et al. 1995, p.186).

*Colotis euipe omphale* (Godart, 1819)

Larsen 1996: pl. 7, figs 67 ii. d’Abrera 1997: 83 (2 figs.). SI: Figures 7i,j, 8a–j.

Forewing length: male 17.5–25.0 mm (mean \( n = 7 \) 21.74 mm, SD = 2.665); female 19.0–23.5 mm (mean \( n = 6 \) 20.43 mm, SD = 1.299).

**Records.** According to Kielland (1990, p.58) this butterfly is common in wooded areas, open grassland and savannah, at sea level to 1900 m, from southern Tanzania throughout coastal areas north to the Kenyan border. Included here as a member of
the lower slopes fauna on the basis of the record by Butler (1888, p.92, as Teracolus omphaloïdes Butler, 1876), with several specimens from the slopes of Kilimanjaro and from Taveta in the BMNH and OUMNH collections. This subspecies also occurs in Kenya, eastern DRC, Malawi, the Comoros, and south to much of South Africa and west to Namibia. The species as a whole occurs widely in most of Africa and Arabia (Ackery et al. 1995, p.189).

Females vary in upperside ground colour, mostly white or yellow (some are a more sandy hue), and the extent of orange at the forewing tip. Males vary considerably in the extent of the black markings of the upperside. The ground colour of the underside hindwing varies from white to yellowish or pinkish.

**Colotis evagore antigone** (Boisduval, 1836)

Kielland 1990: 267, 1 female? Larsen 1996: pl. 7, figs 70 i, ii. d’Abrera 1997: 83 (11 figs). SI: Figure 9a–j.

Forewing length: male 17.0–19.50 mm (mean (n = 7) 18.46 mm, SD = 0.424); female 15.0–19.0 mm (mean (n = 6) 17.27 mm, SD = 1.131).

**Records.** Widespread and common in wooded habitats within Tanzania, from sea level to more than 1800 m (Kielland 1990, p.57). Kielland did not give specific records, but the presence of this taxon on Mt Kilimanjaro was recorded by Butler (1888, p.92, under the synonym *Teracolus comptus* Butler 1888 and Aurivillius (1910a, p.12), and confirmed by Liseki (2009), who encountered this species on 9 September 2000 at 2000 m (voucher in BMNH). The BMNH also has old material from Kilimanjaro and Taveta. Beyond Tanzania, subspecies *antigone* occurs in dry habitats throughout most of Africa south of the Sahara, with other subspecies in North Africa and southern Spain, Socotra and Arabia (Ackery et al. 1995, p.190).

Males of this small species vary somewhat with respect to the intensity of markings. Females are very variable, with dry season forms less marked with black than wet season individuals (Larsen 1996, p.136). Some females lack orange at the forewing tip, with intermediates (d’Abrera 1997, p.84). Individuals with yellow ground colour also occur, but we have not seen any from the Kilimanjaro area.

[Colotis rogersi Dixey, 1915]

Larsen 1996: pl. 7, figs 69 i. d’Abrera 1997: 85 (3 figs).

Not included by Kielland (1990) as a member of the Tanzanian fauna, this taxon was originally described from Taveta (type material in OUMNH, K. St Aubyn Rogers). Talbot (1939, p.205) gives records of *rogersi* from the coastal area of Kenya south to central Tanzania (various localities to the west of Dar es Salaam, up to a maximum recorded height of about 1800 m). More widely, *C. rogersi* is now considered to extend to northern Kenya, southern Ethiopia and southeastern Sudan (Ackery et al. 1995). Neither Ackery et al. (1995) nor d’Abrera (1997) seem to have been aware that Taveta is in the south of Kenya, on the border between Kenya and Tanzania, and only a few kilometres east of Moshi. Larsen (1996) encountered this species in Kibwezi. Given this
and the Taveta type locality, the presence of this butterfly on the lower slopes of Kilimanjaro seems likely. However, Talbot’s (1939) records do not list Kilimanjaro. Using the DNA barcode, Nazari et al. (2011, p.211) were unable to separate material identified as *C. rogersi* from *C. euippe*, and they urged further investigation into this nominal species (while noting that “misidentifications could not be ruled out”). Given all these uncertainties, *C. rogersi* is not formally included here.

**GROUP IV**

*Colotis evenina casta* (Gerstaecker, 1871)

d’Abrera 1997: 83 (2 figs). SI: Figure 10a–f.

Forewing length: male 18.5–24.5 mm (mean (*n* = 5) 22.18 mm, SD = 2.063); female 18.0–25.0 mm (mean (*n* = 12) 21.52 mm, SD = 2.263).

Records. Common in woodland and bush from the lowlands to about 2000 m, from coastal areas inland to Iringa, Morogoro, and the Ukaguru and Nguru Mts (Kielland 1990, p.57, as *C. e. sipylus* (Swinhoe, 1884)). Included here as a member of the lower slope fauna based on several specimens in BMNH from the northern and eastern slopes, and Taveta (from where it was recorded by Rogers 1913, p.99). There are two specimens from Taveta in the OUMNH. *Colotis e. casta* is an East African butterfly, extending northwards through Kenya to Ethiopia and Somalia, and southwards as far as Mozambique. Two other races of *C. evenina* are recognized, one in South Africa, Botswana and Namibia, the other in northwestern and central Tanzania, southwestern Kenya and southern Uganda (Ackery et al. 1995).

Females vary in ground colour, from white to yellowish, and in some cases with orange forewing tip more or less obsolete (f. “ledouxi” Talbot).

**GROUP V**

*Colotis annae hildebrandti* Staudinger, 1885

Larsen 1996: pl. 7, fig. 61 i. d’Abrera 1997: 79 (6 figs).

The taxon *C. hildebrandti*, formerly regarded as a separate species, has recently been demoted by Nazari et al. (2011) as a subspecies of *C. annae* (Wallengren, 1857).

This taxon is not mentioned by Kielland (1990, p.58) from the northern highlands. Ackery et al. (1995) state that *hildebrandti* occurs in “Dry Acacia woodland in northern Zambia, Malawi, Tanzania and central Kenya”, to which can be added Uganda (Talbot 1939, p.222) and southern Kenya – and there is a pair of this distinctive species from Taveta in the OUMNH. This probably represents the material recorded from Taveta by Rogers (1913, p.99) using the synonym *Teracolus callidia* Grose-Smith, 1886. Based on these Taveta records, this butterfly could well be a member of the lower slopes fauna, but it is not formally included here. This is probably the butterfly recorded by Aurivillius (1910a, p.11) as *Teracolus annae* Wallengren from the “Massaisteppe”, below Moshi.
Colotis danae eupompe (Klug, 1829)

Larsen 1996: pl. 7, figs 62 i–iii. d’Abrera 1997: 81 (3 figs). SI: Figures 10g–j; 11a–h.

Forewing length: male 22.5–27.0 mm (mean (n = 6) 24.48 mm, SD = 1.217); female 21.0–26.0 mm (mean (n = 8) 23.01 mm, SD = 1.490).

Usage of the name Papilio danae Fabricius, 1775, for this species has recently been conserved (Opinion 2279). Kielland (1990) included Tanzanian populations under the subspecies C. d. pseudacaste (Butler, 1876), but Nazari et al. (2011) have recently synonymized this taxon under the older name C. d. eupompe (Klug, 1829), a decision followed here.

Records. For Tanzania, Kielland (1990, p.57) described this butterfly as common in deciduous woods and shrubland at 500–1700 m, with records from Kigoma, Mpanda, Rukwa Basin, Ufipa Plateau, lower parts of Northern Highlands, Nguu Mts, Uluguru Mts, Mikumi NP, Ruaha NP, Dodoma area, and Rubehe Mts south to Chimala. Included here as a member of the lower slopes fauna on the basis of many specimens from Taveta and Kilimanjaro in BMNH, and additional material from Taveta in OUMNH. Butler (1888, p.92) recorded C. danae from the slopes of Kilimanjaro under the synonym Teracolus miles Butler, 1883, as well as under the name T. pseudacaste. Beyond Tanzania, this subspecies extends to Ethiopia and west along the southern fringes of the Sahara to Mauritania and Senegal (Ackery et al. 1995, p.187); the species as a whole occurs in almost all of Africa, and through Arabia to India (Larsen 1996, p.134).

Males sometimes have the upperside forewing tips yellow instead of red (SI: Figure 9i), but the females are more variable. In addition to differences in amount of black and, in some individuals, loss of red forewing tips, females are also dimorphic for white/yellow ground-colour. Although we have not seen yellow females from Kilimanjaro it seems likely that they occur there. Loss of forewing red tip combined with upperside white ground colour is called female form “depurpurata”; there is a specimen from Taveta in OUMNH, and one from Kilimanjaro in BMNH (SI: Figure 10c).

GROUP VI

Colotis calais calais (Cramer, 1775)

Larsen 1996: pl. 6, figs 45 i, ii (as C. amatus amatus). d’Abrera 1997: 72 (3 figs as C. amata calais). SI: Figure 12a–d.

Forewing length: male 19–22 mm (mean (n = 5) 20.74 mm, SD = 0.658); female 18.5–22.5 mm (mean (n = 5) 20.68 mm, SD = 1.169).

Records. Mainly in savannah areas of Tanzania, including Rukwa basin, Mpanda, Northern Highlands, Rubehe Mts, West Usambara (rare), Uluguru Mts, and Nguu, Kimboza, Dendene and Kiono forests, from sea level to 2100 m (Kielland 1990, p.55). Kielland (1990) does not give specific records for the Northern Highlands, but the presence of this taxon on Mount Kilimanjaro was apparently first noted by Butler
(1888, p.92), and has been confirmed by Liseki (2009), who encountered it at 2000 m in January and March. There is a single specimen from Taveta in the OUMNH. Recently elevated in rank from subspecies of the Indian taxon *C. amata* (Fabricius, 1775), this species occurs from Mauritania south across much of Africa to Natal, including separate subspecies in Namibia/Angola and in Madagascar (Nazari et al. 2011, p.214).

The females are variable but more or less dimorphic for male-like salmon pink versus off white. However, Tanzanian material in the BMNH main collection is largely male-like, pinkish, but white forms are present in BMNH from “Nyasaland” and Kenya (see also Larsen 1996, p.128). In general, females are more strongly maculated beneath, notably on the hindwing discal area.

*Colotis castalis* (Staudinger, 1885)

Larsen 1996: pl. 6, fig. 47i. d’Abrera 1997: 72 (3 figs). SI: Figure 12e–j.

Forewing length: male 22–26 mm (mean (*n* = 5) 23.86 mm, SD = 0.913); female 22–26 mm (mean (*n* = 5) 24.36 mm, SD = 1.315).

Nazari et al. (2011, p.214) reinstated the Afrotropical taxon *castalis*, formerly treated as a subspecies of the Indian *C. vestalis* (Butler, 1867), as a full species.

*Records.* Occurs in Tanzania in dry bush and savannah from 1000 to 1800 m, in the Northern Highlands, Ruaha National Park, Mikumi, Ruaha Gorge, eastern foot of Image Mountain and Mpwapwa (Kielland 1990, p.60), including Taveta (Rogers 1913, p.98) and Moshi (Larsen 1996, as *vestalis castalis*). The BMNH and OUMNH have many specimens from Taveta; Kilimanjaro is the type locality. Beyond Tanzania this butterfly occurs in Somalia, Ethiopia (south), Sudan and Kenya (Pokot, South Turkana, Garissa, Voi, Tsavo: Larsen 1996, as *vestalis castalis*).

Seasonally variable (Larsen 1996, p.129), females also vary with respect to ground colour which, although generally off-white, can also be yellow, or rarely orange or salmon pink (this last represented by a specimen from Kiboko River, southeastern Tanzania, in the Rothschild Collection, BMNH). We have not seen orange females from the Kilimanjaro district.

**GROUP VII**

*Colotis celimene celimene* (Lucas, 1852)

Larsen 1996: pl. 6, figs 52 i,ii. d’Abrera 1997: 75 (3 figs). SI: Figure 14a–d.

Forewing length: male 17.0–23.5 mm (mean (*n* = 5) 20.42 mm, SD = 2.329); female 22–25.5 mm (mean (*n* = 5) 23.98 mm, SD = 1.043).

*Records.* Arid parts of the Northern Highlands, 700–2000 m, including Serengeti, Morogoro, below Image Mountain, Ruaha Gorge, Ufipa and Mpanda (Kielland 1990, p.56). Included here as a member of the lower slopes fauna based on a
specimen in BMNH collected on West Kilimanjaro at about 900 m. Recorded from Taveta by Rogers (1913, p.99). Outside Tanzania this subspecies occurs in Ethiopia, Uganda, Kenya (Tsavo, Suk, Kibwezi, Emali, Rift Valley, Nanyuki) and Malawi.

This species, although not particularly variable in colour pattern compared with may other Colotis species, appears to be very variable in size.

**GROUP VIII**

*Colotis aurigineus* (Butler, 1883)

Kielland 1990: 267, 3 figs. Larsen 1996: pl. 6, figs 49 i–iii. d’Abrera 1997: 72 (5 figs). SI: Figure 13a–d.

Forewing length: male 20.0–23.5 mm (mean \(n=7\) 21.2 mm, SD = 1.275); female 18–21.5 mm (mean \(n=5\) 19.86 mm, SD = 0.984).

**Records.** According to Kielland (1990, p.56), generally common in drier parts of Tanzania, including forest margins and open forest, at 500–2200 m. First recorded from Kilimanjaro by Godman (1885, p.540) at 5000 and 6000 ft, Butler (1888, p.92) as *Teracolus venustus* Butler, 1888 (a synonym), and Aurivillius (1910a, p.11), extensive material of this species from the lower slopes of Kilimanjaro is present in the BMNH. Three specimens from Loitokitok (ex Brodie), on the northern flank of the massif, are preserved in the OUMNH. Also recorded from Taveta by Butler (1888, p.92) and Rogers (1913, p.98), this species may penetrate the lower reaches of the forest at about 2000 m. However, we have no evidence of this, and it was not encountered at that elevation by Liseki (2009). More widely, the species occurs from eastern DRC, southern Zambia and southern Malawi northwards to southern Sudan (Ackery et al. 1995; see also Bernardi 1989: map 3).

The butterfly is somewhat variable, but does not exhibit very marked sexual dimorphism or seasonal variation. Form “ansorgei” Marshall lacks grey-dusting at the base of the forewings, and is thought to be a wet season form (see also comment under *C. chrysonome*).

*Colotis chrysonome* (Klug, 1829)

Larsen 1996: pl. 6, figs 48 i. d’Abrera 1997: 72 (3 figs). SI: Figure 13e–h.

Forewing length: male 16–22 mm (mean \(n=5\) 19.70 mm, SD = 1.700); female 16–22 mm (mean \(n=5\) 19.68 mm, SD = 1.87003).

**Records.** Lower scrub country of Northern Highlands of Tanzania (Kielland 1990, p.56), from 1000 to 1600 m, where it overlaps with the more southerly *C. aurigineus* (Bernardi 1989: map 3). Included as a member of the lower slopes fauna of Kilimanjaro on the basis of the record by Butler (1888, p.92), and several specimens in BMNH collected at localities up to about 1500 m. Beyond Tanzania this taxon occurs in Mauritania, Senegal (north), Mali, Burkina Faso, Nigeria (extreme
northeast, Maiduguri area), Niger, central and eastern Sahara, Sudan, Ethiopia, Somalia, Arabia (south), Uganda (north), Kenya (north, east and south), and also in Arabia (except east), Palestine, Israel and Jordan.

No subspecies are currently recognized. Talbot (1939, p.217) listed three races, to which Bernardi (1989) added at least C. c. helvolus Butler, 1888. This issue may need to be re-addressed. In this context it should be noted that Ackery et al. (1995, p.186) gave the type-locality for helvolus as “Kilim-njaro”, but this must be corrected to “Somali-land”, as is very clear from Butler’s original text. Based on Talbot’s account, if C. chrysonome were regarded as polytypic, then the Tanzania populations would be included within the nominate subspecies, as accepted by Kielland (1990).

A sexually dimorphic species, the female is very similar to the “ansorgei” form of C. aurigineus – but all chrysonome females have a less strongly marked hindwing underside. Given its predilection for dry conditions, unlike aurigineus, this species is unlikely to move into even the lowest forest zone of Kilimanjaro.

[Colotis vesta catachrysops (Butler, 1878)]

Kielland 1990: 267, 1 fig. Larsen 1996: pl. 6, fig 50 i,ii (vesta hanningtoni). d’Abrera 1997: 73 (3 figs). SI: Figure 14e,f.

Records. Coastal areas, inland to Morogoro, Mpwapwa and Ruaha Gorge, from near sea level up to 1500 m (Kielland 1990, p.59). A male (forewing length 23.0 mm) from the Great Craters District considered to represent this race is illustrated in SI: Figure 12ef. However, Kielland (1980, p.158) records C. vesta from Ngorongoro as subspecies hanningtoni (Butler) (see below regarding this uncertainty). Although we are not aware of any records of C. vesta from Kilimanjaro, material of C. v. catachrysops in OUMNH from Taveta suggests that it is likely this taxon has occurred or does occur on the lower slopes of the mountain. Whether or not this is the taxon recorded from Taveta by Butler (1888, p.92) as Teracolus mutans Butler, 1877 (type locality “Lake Nyassa”) is uncertain but plausible.

More widely, subspecies catachrysops is said to occur in coastal areas of Kenya as well as Tanzania, while the species as a whole comprises about nine named races that, between them, occur through much of mainland Africa (Ackery et al. 1995). The sexes are similar but variable. Kielland (1990, p.59) indicates that catachrysops is a large race in which the upperside dark markings “are more extended than in other races”. However, Talbot (1939, p.179) described C. v. hanningtoni as “the darkest form”. As intimated by Larsen (1996, p.130), the current subspecies divisions appear somewhat arbitrary, and should be re-assessed.

GROUP IX

[Colotis elgonensis (Sharpe, 1891) subsp?]  

Larsen 1996: pl. 7, figs 60 i. d’Abrera 1997: 79 (4 figs). SI: Figure 14g,h.

Forewing length: male, about 23–26 mm.
Records. *Colotis elgonensis nobilis* Carcasson, 1960, occurs in undisturbed submontane forest in western Tanzania at 1300–2200 m (Kielland 1990, p.57). Typically encountered flying incessantly along forest edges, it occasionally visits flowers (Larsen 2005; Williams 2010, p.94, for subspecies *glauningi* Schultze, 1909), and it may also be found in grassy clearings between forest patches (Congdon and Collins 1998). Rogers (1913, p.99), who encountered this species in Kenya, states that its habits “are very different from those of the genus generally as it frequents forests and flies rather high.” Kielland (1990, p.57) does not give any records for the Northern Highlands of eastern Tanzania, but Liseki (2009, p.121) stated that he encountered this species on Mount Kilimanjaro during January and March 2001. There are no specimens from eastern Tanzania in the BMNH or OUMNH, nor, unfortunately, is there any voucher material for Liseki’s record. *Colotis elgonensis* is not included in our Kilimanjaro list here, as the record clearly requires investigation. However, there is in the BMNH a *Colotis* specimen identified as *C. elgonensis kenia* Talbot, 1939, from Kibwezi (SI: Figure 13g,h, forewing length 23.1 mm). The town of Kibwezi is only about 100 km north of Kilimanjaro. Torben Larsen (pers. comm.) suggests that, if there is a population of this species on Kilimanjaro, it could well represent a new, previously unknown subspecies. Beyond western Tanzania, *C. elgonensis* occurs in Nigeria, Cameroon, DRC, southern Sudan, Uganda, Rwanda, Burundi and Kenya (Larsen 1996, p.133).

*Colotis halimede australis* (Talbot, 1939)

d’Abrera 1997: 75 (4 figs of other subspp.). SI: Figure 15a–h.

Forewing length: male 24.0–27.0 mm (mean \( n = 5 \) 25.52 mm, SD = 0.409); female 23.0–26.5 mm (mean \( n = 5 \) 24.52 mm, SD = 1.003).

Records. This subspecies, endemic to Tanzania, is described as very local in open bush and semi-desert areas in northern and central areas, east to Morogoro (Kielland 1990, p.58). Included here as a member of the lower slopes fauna based on several specimens from Kilimanjaro, Taveta and Loitokitok in the BMNH, and numerous specimens from Taveta and the “Tanga–Moshi railway” in OUMNH. Recorded from Taveta (as *Teracolus leo*) by Butler (1888, p.92) and Rogers (1913, p.98). More widely, other subspecies of *C. halimede* occur to the north of Tanzania, from Nigeria to Libya, Arabia, Ethiopia, Somalia and Kenya.

Females are polymorphic in ground colour, white, yellow and piebald. The white form “acaste” (SI: Figure 15e) is represented in the BMNH by a very heavily marked specimen from Loitokitok, collected by Jackson in 1905.

*Colotis hetaera hetaera* (Gerstaecker, 1871)

d’Abrera 1997: 79 (4 figs). SI: Figures 16a–h, 17a–h.

Forewing length: male 27.0–38.0 mm (mean \( n = 7 \) 33.33 mm, SD = 3.603); female 29.0–37.0 mm (mean \( n = 7 \) 33.49 mm, SD = 2.092).

Records. This species, endemic to Tanzania, is described as very local in open bush and semi-desert areas in northern and central areas, east to Morogoro (Kielland 1990, p.58). Included here as a member of the lower slopes fauna based on several specimens from Kilimanjaro, Taveta and Loitokitok in the BMNH, and numerous specimens from Taveta and the “Tanga–Moshi railway” in OUMNH. Recorded from Taveta (as *Teracolus leo*) by Butler (1888, p.92) and Rogers (1913, p.98). More widely, other subspecies of *C. halimede* occur to the north of Tanzania, from Nigeria to Libya, Arabia, Ethiopia, Somalia and Kenya.
Records. Open woodland and grassy country in northeastern Tanzania (Kielland 1990, p.58), up to about 1600 m (records in BMNH). Included here as a member of the lower slopes fauna based on a number of specimens in BMNH from West Kilimanjaro, Ngare-Nairobi, Loitokitok and New Moshi, and one specimen from Taveta in OUMNH. Recorded from Taveta by Rogers (1913, p.99). The nominate race extends to coastal areas of Kenya; other subspecies occupy northern Tanzania, Uganda, DRC and central Kenya, Ethiopia, Somalia and southern Sudan.

Males vary notably in the extent of the crimson forewing apical patch. The females are variable and polymorphic, including white versus yellow ground-colour, and individuals lacking red at the forewing tip. Various form names have been applied to the females, six of which are discussed by Talbot (1939); of these, f. “strix” is fairly similar to “sulfureus”.

Colotis ione (Godart, 1819)

Larsen 1996: pl. 6, fig. 56 i, pl. 7, fig. 56 ii. d’Abrera 1997: 76, 77 (16 figs). SI: Figure 18a–j.

Forewing length: male 29.0–31.0 mm (mean (n = 5) 30.20 mm, SD = 0.495); female 28.0–33.5 mm (mean (n = 7) 30.97 mm, SD = 1.357).

Records. This beautiful purple-tip is common from sea level to 1700 m, sometimes above 2000 m, occurring from the northern highlands to Lake Victoria, central, southern and eastern Tanzania (Kielland 1990, p.58). Included as a member of the lower slopes fauna based on several specimens from West Kilimanjaro, New Moshi and Taveta in BMNH, with several more from Taveta in OUMNH. Rogers (1913, p.99) recorded this species from Taveta using the synonymous names Teracolus phlegyas (Butler) and T. bacchus Butler. Beyond Tanzania, this species occurs widely throughout most of Africa south of the Sahara (Ackery et al. 1995).

A very variable butterfly, including numerous male and even more female forms (15 named female forms are keyed by Talbot 1939), well illustrated by d’Abrera (1997). The females never have purple tips – if they have contrasting forewing tip coloration, it is always orange. Most of the female forms appear to involve an interaction between white versus yellow upperside ground colour, orange versus non-orange forewing tip coloration, and maculated versus non-maculated veins on the underside hindwing and forewing tip.

Colotis regina (Trimen, 1863)

Kielland 1990: 267, 1 fig. Larsen 1996: pl. 6 fig. 57i, pl. 7 fig. 57ii. d’Abrera 1997: 77 (4 figs). SI: Figure 19a–h.

Forewing length: male 29.0–35.0 mm (mean (n = 5) 32.52 mm, SD = 1.751); female 31.0–35.0 mm (mean (n = 5) 33.32 mm, SD = 1.190).

Records. This large Colotis has been recorded from Tanzania in woodlands at 300–1800 m in the Nguu Mts, Morogoro, Turiani, the slopes of Mt Image, Udzungwa, the Ukaguru Mts, Mikumi, the Mpwapwa District and much of the western part of the
country (Kielland 1990, p.59). Included here as a member of the lower slopes fauna on the basis of several specimens in BMNH collected at New Moshi in 1916 by F.C. Selous, and two males from Moshi caught at 2700 ft in June 1920 (Rothschild Collection). Larsen (1996, p.132) noted records for Taveta (see also Rogers 1913, p.99). The species ranges elsewhere south to Mozambique and northeastern South Africa, west to Namibia and Angola, and north to Somalia.

This “purple tip” has several female forms, principally reflecting white or yellow ground colour, and red or non-red forewing tip coloration. The extent of any red marking is particularly variable: in some females there are rows of more or less discrete proximal (two or three) and distal (four or five) spots within the apex, and neither, either one or the other, or both can be reddened (Kielland 1990, illustrates a white female of this last sort). As d’Abrera (1997) noted, the forms “are connected by intergrades”.

**Genus Nepheronia**

*Nepheronia argia mhondana* (Suffert, 1904)

Kielland 1990: 266 (1 fig). Larsen 1996: pl. 5, figs 39 i,ii. d’Abrera 1997: 69 (3 figs of subsp. *mhondana*; 8 figs of subsp. *argia*). SI: Figure 20a–d.

Forewing length: male 36–41 mm (mean \( n = 6 \) 38.28 mm, SD = 1.493); female 35–38 mm (mean \( n = 5 \) 36.72 mm, SD = 1.055).

**Records.** Considered to be the largest African pierid (Pringle et al. 1994), this species is found in coastal, warm and riparian (riverine) forest, and heavy woodland in eastern Kenya, Tanzania, Malawi, Zimbabwe, northern Zambia and Mozambique (Ackery et al. 1995; Williams 2010). Within Tanzania it occurs from the Northern Highlands to Pare Mts, and coastal forests to Pugu hills, the Ubuguru Mts, Rubeho Mts, the Udzungwa range to the Njombe highlands, Tukuyu and the Livingstone Mts, Masagati forest, and forests of the Ulanga District to Rondo plateau near Lindi, where it can be encountered from lowlands up to 2000 m (Kielland 1990, p.54). Kielland did not give specific records for the Northern Highlands, but there is old material from Kilimanjaro in the BMNH (probably including material noted by Butler 1888: 96, as *N. argia* (Fabricius, 1775)), form “varia” was recorded from Kilimanjaro at 2000 m by Aurivillius (1910a, p.12), and the species was encountered at the same height in the forest zone by Liseki (2009). Another subspecies is found in northwestern parts of the country. Outside Tanzania, this species occurs widely in southern and central Africa (Ackery et al. 1995, p.180).

Both sexes are variable. Across the range of *N. argia mhondana* the males never have any orange, but females are both variable and polymorphic. Illustrated is a female f. “aurosa” from Kilimanjaro (SI: Figure 20c,d), but we have not seen enough material from the mountain to assess its variability there. Female form “mhondana” looks very similar to “aurosa” but lacks forewing basal orange above. Form “giara” is a piebald “mhondana”. Male-like females occur; “sulphurea” is an all yellow “aurosa”; “idotea” has little or no orange; “semiflava” is reverse piebald with an orange flush to the forewings beneath; “varia” is like “giara” but with an orange flush to the upperside; while “mixta” is like a “semiflava” with orange on the upperside.
Several of these forms are well illustrated by d’Abrera (1997, p.69). The male is generally distinguished from other Nepheronia by the large, rhomboidal, dark apical marking on the forewing underside.

Nepheronia buquetii buquetii (Boisduval, 1836)

Larsen 1996: pl. 5 fig. 42i. d’Abrera 1997: 71 (2 figs). SI: Figure 21a–f.

Forewing length: male 29.5–35 mm (mean (n = 6) 30.72 mm, SD = 1.588); female 31.5–36 mm (mean (n = 5) 33.30 mm, SD = 1.005).

Records. According to Kielland (1990, p.54), in Tanzania this species occurs in dry woodlands and, coastally, in more moist forests, from sea level up to 1500 m, sometimes a little higher. Recorded by Kielland from lower and dryer parts of the Northern Highlands, the centre of the country, Rubeho Mts, Morogoro, and certain coastal localities (Dendene Forest, Pugu Hills and Sadani). There are several specimens from Taveta in UOMNH. Included here on the basis of two males and two females in BMNH from the slopes of Kilimanjaro. More generally, this species occurs widely in northern, central and eastern Africa, and Madagascar, with separate subspecies recognized for Madagascar and Arabia (Ackery et al. 1995).

A brown spot that is not centred with “mother-of-pearl” located near the apex of the hindwing underside discal cell helps to distinguish this otherwise rather plain species from a number of similar-looking butterflies (Larsen 1996, p.126). Although variable (d’Abrera 1997), there is relatively little difference between the sexes (Larsen 1996). Most individuals can be placed as one of three forms: f. “buquetii”, with a broad, dark and complete forewing border, f. “arabica” in which the border is usually not so broad or dark and is obsolete posteriorly, and f. “capensis”, in which the border is more or less completely obsolete. All three forms appear to affect both sexes in the material we have seen from the Kilimanjaro area. If correct, this represents a relatively unusual case of multiple unimodal polymorphism (Vane-Wright 1975).

Nepheronia thalassina (Boisduval, 1836)

Kielland 1990: 266 (1 fig). Larsen 1996: pl. 5, figs 40 i,ii. d’Abrera 1997: 71 (5 figs). SI: Figure 20e–j.

Forewing length: male 31–36 mm (mean (n = 5) 34.2 mm, SD = 1.564); female 32–38 mm (mean (n = 9) 35.47 mm, SD = 1.517).

Records. From Mpanda to Ugandan border, Northern Highlands, Pare Mts, Usambara Mts, Uluguru Mts, Turiani, Nguu forests, Image Mt, Mwanihana forest, Ukaguru Mts, Kiono forest, Pugu hills, Dendene, Masagati and the Rondo plateau, from sea level up to 1700 m (Kielland 1990, p.54). On Kilimanjaro it evidently does not penetrate into the forest reserve area, being confined to the lower slopes (records in BMNH from Moshi and New Moshi, and from Kilimanjaro at 4500–5000 ft). Outside Tanzania, found in forest and dense woodland across central Africa (Ackery
et al. 1995, p.181). There is debate as to whether this species is polytypic or not – here we follow Berger (1981, p.80) and Kielland (1990) in regarding it as monotypic (if divided into subspecies, then the Kilimanjaro population belongs to \( N. \ t. \ sinalata \) (Suffert, 1904) – treated by Berger 1981, as a form).

There are two forms of female \( N. \ thalassina \) in Tanzania: white (typical), and piebald (f. “sinalata”). Typical females tend to have some pinkish-grey at the forewing base, and yellowish at the base of the hindwing. Form “sinalata” may or may not have the colour at the base of the forewing; the hindwing is all yellow. Some females of both forms have a flush of yellow at the base of the forewing beneath. Elsewhere a few other female forms occur, such as “verulanus” in Cameroon. In life, males are notable for their pale blue ground colour, and both sexes have a nacreous sheen to the underside, which aids separation of female forms of this species from those of \( N. \ argia \) (Larsen 1996, p.126)

**Genus Pinacopteryx**

*Pinacopteryx eriphia melanarge* (Butler, 1886)

Kielland 1990: 266 (1 fig). Larsen 1996: pl. 5, fig. 38i. d’Abrera 1997: 67 (3 figs of subsp. *eriphia* (Godart, 1819)). SI: Figure 22e–h.

Forewing length: male 22–30 mm (mean (\( n = 6 \)) 26.67 mm, SD = 2.406); female 23–33 mm (mean (\( n = 9 \)) 27.83 mm, SD = 2.550).

*Records.* Throughout most of northern Tanzania (but absent from northwest), where it occurs in dry woodland at 500–2000 m (Kielland 1990, p.53). Included here as a member of the lower slopes fauna based on three old female specimens from Kilimanjaro in BMNH collection, and the type material of the synonym *Herpaenia iterata* Butler, 1888, described from material collected by Johnston (Butler 1888, p.96). Bernardi (1957: figs 18,29,23) recorded *P. e. melanarge* from Moshi and Taveta.

More widely the subspecies extends to Kenya, Somalia, Ethiopia, southern Sudan and northern Uganda, with the species as a whole widespread throughout the Afrotropical region (Ackery et al. 1995); however, the distinct Madagascan *Pinacopteryx eriphia mabillei* (Aurivillius, 1898) has recently been raised to full species status by Nazari et al. (2011). The sexes of *P. e. melanarge* are similar, but the female has a slightly more rounded forewing apex, and the underside forewing is less boldly marked than in the male.

**Genus Eronia**

*Eronia dilatata* (Butler, 1888)

Kielland 1990: 266 (1 fig., as *E. cleodora dilatata*). Larsen 1996: pl. 5, figs 43 i,ii (as *E. cleodora*). d’Abrera 1997: 71 (3 figs of *E. cleodora* Hübner, 1823). SI: Figure 23a–d.

Forewing length: male 34–37 mm (mean (\( n = 6 \)) 35.48 mm, SD = 0.804); female 32–39.5 mm (mean (\( n = 5 \)) 35.62 mm, SD = 2.766).
Note: Aurivillius (1910b, p.62) considered *dilatata* to be a seasonal form of *E. cleodora* Hübner, 1823. In more recent literature *dilatata* has been treated as a subspecies restricted to eastern Kenya and Tanzania (e.g. Ackery et al. 1995) – although Larsen (1996, p.127) considered that “the two sets of populations do not seem strongly differentiated”. However, Nazari et al. (2011), based on molecular evidence, elevated *dilatata* to full species status. While accepted here, in light of Larsen’s earlier opinion this taxon would be worth further examination, notably from the standpoint of ecology and behaviour.

**Records.** In Tanzania found in heavy woodland and dry forests, up to 1200 m, from Pemba and coastal areas inland to Kimboza Forest, the Ulugurus, lower parts of the Rubeho Mts, Rondo Plateau, and riverine forests below Moshi and Arusha (Kielland 1990, p.55). Listed for Lake Manyara National Park by Cordeiro (1990). The type series of *E. dilatata* Butler (1888, p.96) included material collected at Taveta by H.H. Johnston and by Bishop Hannington, and on Kilimanjaro by F.J. Jackson. Godman (1885, p.540) had earlier reported Johnston’s material as *E. cleodora*. Also recorded from Taveta (as *Teracolus cleodora*) by Rogers (1913, p.99). There is a single male in BMNH labelled “Kilimandjaro” apparently collected by Le Roy. Not encountered in the forest reserve zone by Liseki (2009), but on the evidence summarized here, it should be expected to occur in remnant riverine forest areas on the lower slopes.

*Eronia cleodora* occurs quite widely from Ethiopia to southern Africa (but is absent from West Africa). Generally, the dark wing margins of *dilatata* are broader than those of *cleodora* (Kielland 1990). Females vary from whitish through piebald (hindwing more yellow) to all pale yellow. Males appear invariably whitish, at least in East Africa.

*Eronia leda* (Boisduval, 1847)

Larsen 1996: pl. 6, figs 44 i,ii. d’Abrera 1997: 71 (4 figs). SI: Figure 23e–h.

Forewing length: male 25.5–30.5 mm (mean \( n = 7 \) 27.79 mm, SD = 1.798); female 28–31.5 mm (mean \( n = 6 \) 29.65 mm, SD = 0.878).

Note: Nazari et al. (2011) placed this species in the resurrected monobasic genus *Afrodryas* Stoneham, 1957, but we have not accepted this change (see Discussion).

**Records.** Found in various habitats from near sea level to 2100 m in Mpanda, Kigoma, Northern Highlands, Uluguru Mts, Mwanihana, Rubeho Mts, Pugu Hills and Masagati Forest (Kielland 1990, p.55). In the BMNH there are several specimens from Kilimanjaro, including a male from Ngare-Nairobi collected by B. Cooper at 4000–5000 ft, and a female from Old Moshi (SI: Figure 21g,h). Recorded from Taveta by Rogers (1913, p.99), and from the lower slopes of Kilimanjaro by Aurivillius (1910a, p.12). On this basis we include this species as a member of the lower slopes fauna, not having been encountered in the forest reserve area by Liseki (2009). Beyond Tanzania this butterfly has been recorded from Nigeria (northeast), Chad, Sudan (south), Ethiopia (south), Kenya, DRC (Kivu, Shaba, Haut-Lomani, Lualaba, Haut-Katanga, Tanganika), Zambia, Namibia (north), Zimbabwe, Botswana (north), Angola, Mozambique, parts of South Africa and Swaziland.
Males appear always to be bright yellow with orange tips. Females vary considerably, including male-like forms, others are almost all yellow with faint markings at the forewing apex, or with a more darkened forewing apex (f. “inargyrata”), yet others are whitish (f. “cygnophila”). Pale, whitish females never seem to have orange tips.

**Genus Leptosia**

*Leptosia alesta inalesta* (Bernardi, 1959)

Larsen 1996: pl. 10, figs 98 i,ii. d’Abrera 1997: 123 (1 fig.). SI: Figure 22a–d.

Forewing length: male 15–22 mm (mean (n = 5) 19.78 mm, SD = 2.575); female 18–23 mm (mean (n = 5) 19.84 mm, SD = 1.509).

**Records.** This fragile little white butterfly occurs widely throughout Tanzania, in dense woodlands, gallery forests and rainforests, from sea level to 1850 m (Kielland 1990, p.71). Recorded from Mt Kilimanjaro by Aurivillius (1910a, p.11), the type locality of *L. a. inalesta* is New Moshi, on the southern slopes at about 800 m. A very small male in NHM is labelled “Kilimanjaro [18]87-140”. However, this species was not encountered by Liseki (2009) in the forest reserves, from 2000 m upwards. This butterfly may survive in remnant gallery forests below the reserve area. Elsewhere the subspecies occurs from Ethiopia to South Africa, and other subspecies occupy forested areas throughout most of central and West Africa, and Madagascar (Ackery et al. 1995, p.226).

**Genus Appias**

*Appias (Glutophrissa) epaphia contracta* (Butler, 1888)

Larsen 1996: pl. 10, figs 96 i,ii [as subsp. orbona]. d’Abrera 1997: 107 (2 figs). SI: Figure 24a–f.

Forewing length: male 24–29.5 mm (mean (n = 9) 26.97 mm, SD = 1.758); female 22–30 mm (mean (n = 10) 26.53 mm, SD = 1.883).

**Records.** In Tanzania this butterfly is found in forests and woodlands at altitudes from sea level to 2100 m in the eastern half of the country inland to the northern highlands (including the Usambaras and North Pare Mts), Nguru Mts, Morogoro, Mikumi, Udzungwas, Rubeho Mts, parts of central Tanzania, and Tukuyu, together with more isolated populations in western Tanzania (Kielland 1990, p.64). Cordeiro (1990) found this taxon in Lake Manyara National Park. Recorded here from the lower slopes of Mt Kilimanjaro on the basis of three old males in BMNH collected by F.J. Jackson, and one specimen collected in a forested area of the southern slopes in June 1988 (Cordeiro 1995). More widely this subspecies occurs throughout eastern and southern Africa, and on the Comoros, with the species as a whole occurring west to Senegal, and on Madagascar, where it can be segregated as *A. e. orbona* (Boisduval, 1833) (Ackery et al. 1995, p.214).
Males are very similar to those of the next species (*A. sabina*) but, according to Larsen (1996, p.146), are usually separable by their smaller size (not borne out by our limited data) and the slightly less extensive black apical area of the forewing. Females are usually black and white, with a distinctive broad hindwing dark border, but paler and some yellowish forms also occur which lack the very broad hindwing margin. According to van Son (1949: figs 102–105) there are small but distinct differences between the male and female genitalia of both species. Notably, the juxta of *A. epaphia* is smaller and narrower than that of *A. sabina* and, in the female, the anterior apophyses are likewise much narrower.

*Appias (Glutophrissa) sabina phoebe* (Butler, 1901)

Larsen 1996: pl. 10, figs 95 i,ii. d’Abrera 1997: 107 (4 figs). SI: Figures 24g,h; 25a–h.

Forewing length: male 24–29 mm (mean (n = 6) 26.73 mm, SD = 1.914); female 26–30.5 mm (mean (n = 6) 28.50 mm, SD = 1.226).

*Records.* Forests and heavy woodland, at 800–1600 m, in most parts of Tanzania except in an area north from Kigoma to the Uganda border, where it is replaced by *A. s. sabina* Felder and Felder (Kielland 1990, p.65). Cordeiro (1990) encountered this species in Lake Manyara National Park. Included as part of the lower slopes fauna of Kilimanjaro on the basis of several specimens in BMNH collected by F.J. Jackson, B. Cooper and F.C. Selous. More widely the subspecies occurs in eastern Africa from northern Kenya (Marsabit) to northeastern Transvaal, with the species as a whole found west to Sierra Leone, and on the Comoros and Madagascar (Ackery et al. 1995, p.215).

Males and females of this species are variable, both with a number of named forms, some of which we have illustrated (SI). For separation from *A. epaphia*, see notes under that species.

**Genus Pontia**

*Pontia distorta* (Butler, 1886)

Larsen 1996: pl. 9, figs 88 i. d’Abrera 1997: 101 (3 figs).

*Records.* According to Kielland (1990, p.63), this very small species (fwl 12–20 mm) occurs in “North-eastern Tanzania”. Otherwise this butterfly is only known from very dry areas in Ethiopia, Somalia and Kenya (Kulal area, Kerio Valle, Archer’s Post (Samburu), Athi River, Lake Baringo?). Larsen (1996, p.143) doubts that *distorta* occurs in Tanzania, the confusion apparently arising due to BMNH specimens labelled “Namanga” (*F.C. Selous, 17.ii.1916*) which, according to N.D. Riley, most probably came from Lake Baringo, not Tanzania. There is nothing to link this butterfly with the Kilimanjaro massif.

*Pontia helice johnstonii* (Crowley, 1887)

Larsen 1996: pl. 9, figs 87 i,ii. d’Abrera 1997: 101 (2 figs). SI: Figure 26a–d.
Forewing length: male 22–26.5 mm (mean \(n = 7\) 24.70 mm, SD = 1.180); female 23–26.5 mm (mean \(n = 7\) 24.44 mm, SD = 0.802).

**Records.** Mufindi, West Usambara and Northern Highlands, in open grasslands and bush at 1500–2200 m elevation (Kielland 1990, p.63). Based on 14 specimens collected by Johnston, this butterfly was recorded from “Kilima-njaro, wooded, rocky, and cultivated ground, grassy downs, at 4000 to 5,500 feet, July and August” (Godman 1885, p.539, as *Pieris hellica*), noting that it differed slightly in coloration from “the examples in our own collection”. Two years later Crowley described *Synchloe johnstonii* [sic] based on material from the same source. A pair in OUMNH were collected on the slopes of Kilimanjaro in September 1905, at about 5000 ft, by K. St Aubyn Rogers. Aurivillius (1910a, p.11), based on the fieldwork of Sjöstedt, recorded this butterfly from Kibongoto, flying up to at least 1200 m. This species, not encountered by Liseki (2009) at 2000 m or above, is included here as a member of the lower slopes fauna, flying below the main forest zone at c.1200–1800 m.

Beyond Tanzania, subspecies *johnstonii* occurs in grassy areas in the highlands of Uganda, Kenya, Rwanda, Burundi and eastern DRC (Kivu and Ituri). The nominate race flies from eastern Zimbabwe south to Cape Province (Ackery et al. 1995, p.210). There is slight sexual dimorphism and minor variation in this species, but in appearance compared with most other regional Pierinae this is a constant and distinctive butterfly.

Genus *Pieris*

*Pieris brassicoides marghanita* Hemming, 1941
d'Abrera 1997: 101 (3 figs of subsp. *brassicoides brassicoides* Guérin-Méneville).

As noted by Kielland (1980, 1990, p.53, as *P. b. meridionalis* Joicey and Talbot, 1922), *P. brassicoides* is a very local species known from Ethiopia and, in Tanzania, from the Ngorongoro area and Mt Meru only, where it flies above 2000 m. Why this species does not occur on Mt Kilimanjaro is something of a mystery.

Genus *Belenois*

*Belenois aurota aurota* (Fabricius, 1793)

Larsen 1996: pl. 8, figs 73 i–iii. d’Abrera 1997: 91 (4 figs). SI: Figure 26e–j.

Forewing length: male 23–28.5 mm (mean \(n = 6\) 26.27 mm, SD = 1.679); female 23.5–28.5 mm (mean \(n = 7\) 25.97 mm, SD = 1.552).

This species (together with the two following: e.g. Talbot 1943a) has often been placed in the genus *Anapha* and in the past was also known by the older species name *Papilio mesentina* Cramer, 1780 – which is invalid, due to primary homonymy.

**Records.** All kinds of habitat from sea level to high mountains (2600 m) throughout Tanzania (Kielland 1990, p.60). Kielland (1990) did not give specific records but Liseki (2009) encountered *B. aurota* commonly on Mount Kilimanjaro throughout the year,
at 2000–3000 m. The BMNH collection includes three males and three females from W. Kilimanjaro collected, at 3000–4500 ft, by B. Cooper. Williams (1930, p.159, as *B. mesentina*) recorded this species migrating in vast numbers at Moshi in February 1926. Beyond Tanzania this subspecies is found throughout much of Africa (Ackery et al. 1995, p.199), and in Arabia, Egypt, the Middle East and India (the type locality is peninsula India). Two peripheral races are considered to occur in Asia.

Males are relatively constant, with white ground colour. Females vary notably in the intensity of their dark markings, especially the wing borders, which can include submarginal pale spots or streaks, but are most often broad and almost entirely infuscated. Female ground colour varies from off-white to yellowish (very rarely bright yellow).

**Belenois creona severina** (Stoll, 1781)

Larsen 1996: pl. 8, figs 73 i–iii. d’Abrera 1997: 91 (5 figs). SI: Figure 27a–h.

Forewing length: male 24–30 mm (mean \((n = 9)\) 26.68 mm, SD = 1.348); female 22.5–28 mm (mean \((n = 5)\) 25.38 mm, SD = 1.333).

**Records.** A very widespread species of the Afrotropics, including Madagascar, found in moist, frost-free savannah, secondary grasslands and forest margins. Subspecies *severina* occurs throughout Tanzania, at altitudes from sea level to 2600 m, but Kielland (1990, p.60) does not give specific records. Recorded from Kilimanjaro at 5000–6000 ft by Godman (1885, p.539), in August by Aurivillius (1910a, p.11), and migrating in large numbers near Moshi in June 1928 (Williams 1930, p.158). The BMNH collection includes a small number of specimens from W. Kilimanjaro collected in 1937 at 4000–5000 ft by B. Cooper, and from Taveta at 2500 ft by E. Barns. The continuing presence of this butterfly on Mount Kilimanjaro was confirmed by Liseki (2009), who found it to be common at all periods of the year across the transect studied, from 2000–3000 m. Beyond Tanzania, this subspecies occurs from East Africa and DRC to Cape Province, with the species as a whole occupying almost all of the Afrotropics (Ackery et al. 1995) – including, perhaps, the Cape Verde islands (Mendes and Bivar de Sousa 2010).

Although some male forms have been named, on the upperside the males are relatively constant in appearance, always with a bright, white ground colour. In contrast, females are more variable, with much broader and darker wing borders, and most often with a yellow ground colour (although some females are yellowish-white or off-white). On the underside, however, both sexes vary in ground colour and intensity of the dark markings. Notably in males, the ground colour of the hindwing underside, which is usually clear yellow, can be white – and most or even all of the wing veins can be picked out by dark scales, or several or most veins can be concolorous with the ground.

Separation of male *B. aurota* and *B. creona* can at first sight appear difficult. As pointed out by Migdoll (1987, p.228) and Woodhall (2005, p.336), in Africa the hindwing underside of *B. aurota* is predominantly white, whereas that of *B. creona* is evenly yellow (perhaps notably, however, the underside of *B. aurota* from the Indian subcontinent can be white or yellow; see Discussion). *Belenois aurota* has a relatively
narrow postdiscal black band towards the apex of the forewing underside, the corresponding band in *creona* generally being much broader. This is reflected on the male forewing upperside by typically longer preapical pale streaks in *aurota*, shorter streaks in *creona*. Female *aurota* have much narrower dark hindwing margins than *creona*, with the hindwing underside discal cell white in *aurota*, yellow in *creona*.

**Belenois gidica** (Godart, 1819)
Larsen 1996: pl. 8, figs 74 i,ii. d’Abrera 1997: 99 (7 figs). SI: Figure 28a–j.

Forewing length: male 28–35 mm (mean \( n = 8 \) 30.89 mm, SD = 1.853); female 26.5–31 mm (mean \( n = 5 \) 28.74 mm, SD = 0.932).

Ackery et al. (1995) accepted the former division of this species into three subspecies, but Kielland (1990), Larsen (1996) and d’Abrera (1997) all rejected this arrangement, and it is not followed here.

*Records.* According to Kielland (1990, p.61), found in most parts of Tanzania at altitudes from near sea level to 2100 m, it has since been recorded at 3000 m on Mount Kilimanjaro (Liseki 2009). The BMNH collection includes four males and five females from Kilimanjaro (including two from Loitokitok), one of the males having been collected in W. Kilimanjaro at 5000 ft (Cooper). At times a common butterfly, irregular and relatively minor migrations are known to occur (Larsen 1996). Seasonally very variable, with distinct wet-season and dry-season forms (Kielland 1990; Pringle et al. 1994, p.296), *B. gidica* occurs throughout much of the Afrotropical Region, although it is absent from southwestern Cape Province (South Africa), Madagascar, Seychelles and the Mascarene Islands (Ackery et al. 1995).

On the upperside males are invariably white in ground colour, and relatively constant in pattern. On the hindwing underside, however, they are either white or yellowish-white with black markings, or largely suffused with mid-brown and divided by a long whitish fascia (dry-season f. “abyssinica”; intermediates occur). Females vary in upperside ground colour from white (male-like) through whitish-yellow to yellow, and vary greatly in the extent of the dark markings – rarely they are almost entirely infuscated. On the underside, females vary in the same way as males.

**Belenois margaritacea plutonica** (Joicey & Talbot, 1926)
Kielland 1990: 267 (1 fig). d’Abrera 1997: 89 (2 figs). SI: Figure 29a–d.

Forewing length: male 24–28 mm (mean \( n = 8 \) 26.13 mm, SD = 0.873); female 24–30 mm (mean \( n = 7 \) 27.61 mm, SD = 1.627).

*Records.* Northern highlands (Mt Kilimanjaro, Ngorongoro Crater), Pare Mts, Usambaras and Rubeho Mts, montane forest glades and margins at 1500–2700 m (Kielland 1990, p.61). Recorded on Kilimanjaro by Aurivillius (1910a, p.11) as “*Pieris raffrayi*” from the agricultural zone around Kibongoto upwards into the primary forest, as high as 2200 m, during March, April, September, October and December. This taxon shows geographical variation, with some populations intermediate to *B. margaritacea*
kenyensis Joicey and Talbot, described from southeastern Kenya (Kielland loc. cit.). The Kilimanjaro population (represented in BMNH by numerous male and a few female specimens collected by B. Cooper) appears to be typical plutonica (type locality: Ngorongoro Crater). However, it was not encountered on Kilimanjaro by Liseki (2009). Belenois margaritacea is limited to highland forests in Tanzania and Kenya.

The butterflies are fairly constant in appearance, with very slight sexual dimorphism: the greyish-blue discal coloration of the male hindwing upperside is slightly more extensive than in females. Additionally, females lack preapical forewing streaks on the forewing upperside, whereas males usually have two, three or four such streaks. However, some males have only one streak – and occasionally, like the females, the apex is entirely black. In this regard the supposed near diagnostic difference between B. margaritacea and the essentially allopatric B. raffrayi is not entirely reliable (cf. Larsen 1996, p.138). See also Discussion.

Belenois thysa thysa (Hopffer, 1855)

Larsen 1996: pl. 9, figs 84 i,ii,iii. d’Abrera 1997: 97 (6 figs). SI: Figure 29e–j.

Forewing length: male 30–35.5 mm (mean (n = 8) 32.25 mm, SD = 1.431); female 31.5–37.5 mm (mean (n = 6) 33.23 mm, SD = 1.950).

Records. Larsen (1996, p.141) states for Kenya that “[this species] is less at home at altitudes above 1600 m and in wetter parts of the country.” Kielland (1990, p.62) notes subspecies thysa as common in savannah, woodlands and forest margins in eastern Tanzania, from sea level to 2600 m, but comments “not common in the northern highlands” – and it was not encountered on Kilimanjaro by Liseki (2009). Included here as a member of the lower slopes fauna on the basis of old material in BMNH from Kilimanjaro, Old Moshi and Taveta. Ackery et al. (1995, p.207), who recognized three subspecies of B. thysa, indicated that the species occurs widely throughout southern and eastern Africa, west to Angola and north to Ethiopia.

Males vary in extent of the orange-red at the base of the forewing underside and the black marginal upperside markings. The females are variable but not clearly polymorphic. The overall ground colour is usually whitish or yellowish, with the upperside forewing base dusky or pinkish, and the hindwing whitish to yellow, often basally dusky or pinkish-orange.

Belenois zochalia agrippinides (Holland, 1896)

Larsen 1996: pl. 8, figs 70 i,ii. d’Abrera 1997: 89 (5 figs). SI: Figure 30a–f.

Forewing length: male 26–31 mm (mean (n = 12) 28.79 mm, SD = 1.190); female 24.5–33 mm (mean (n = 7) 28.29 mm, SD = 2.791).

Records. Abundant in open and forest habitats, 300–2700 m, in most parts of the country, including Mt Kilimanjaro (Kielland 1990, p.63). Aurivillius (1910a) recorded this butterfly around Kibongoto and into the primary forest, flying up to 2000 m. Liseki (2009) encountered this taxon throughout the year, at both 2000 and
2500 m, and there is material in the BMNH from the lower slopes. Outside Tanzania this subspecies is found in Malawi, Kenya, Uganda and DRC (Ituri, Kivu), while the species as a whole occurs throughout most of eastern and southern Africa, with an outlier in Cameroon (Ackery et al. 1995).

Males have a white ground colour and are relatively constant in appearance. Females generally have much broader and darker wing margins, most notably on the forewing. Females are also more variable, and occur with (male-like) ground colour to both wings, yellowish-white to both wings, or piebald, the very yellow hindwing discal coloration contrasting strongly with the white forewings (f. “flavipennis”).

Genus Dixeia

D. charina liliana (Grose-Smith, 1889)

Pennington 1978: 525, figs 626: i–viii, 626a: i,ii (10 figs of other subspecies). d’Abrera 1997: 105 (5 figs of other subspecies, plus at least one (yellowish) female of charina liliana misidentified as D. doxo costata). SI: Figures 30i,j, 31a–h.

Forewing length: male 23–27.5 mm (mean (n = 7) 25.47 mm, SD = 1.110); female 21–25.5 mm (mean (n = 7) 23.97 mm, SD = 1.268) [all based on material from Taveta in BMNH].

Note: Due to similar and widely overlapping exophenotypic variation, routine identification/separation of this species and the next, Dixeia doxo (Godart), is frequently difficult. This has given rise to confusion in the literature regarding the correct allocation of the various subspecies into which they have been subdivided. The two species can only be separated reliably by dissection (Carcasson 1981, p.30). However, according to Bernardi (1954), the subspecies now grouped under D. doxo are widespread in central and western parts of Africa, whereas those grouped as D. charina have a distinctly eastern distribution, including southeast Ethiopia, northern Kenya, Kenya coast, Madagascar and South Africa – but in various places representatives of the two “exerges” (Bernardi 1958) apparently fly together, including parts of western Kenya and South Africa. In Tanzania the two species, as they are now regarded, appear to overlap in the Gregory Rift region, around Lake Manyara (Cordeiro 1990; Moehlman and Liseki 2003).

Records. Kielland (1990, p.63) listed only one subspecies of D. charina from Tanzania: D. c. dagera (Suffert, 1904), stating that it was restricted to “coastal areas”. Bernardi (1954) was unable to examine the genitalia of dagera but, judging by its eastern provenance, it should belong to charina (and could even be a synonym of D. c. liliana). Ackery et al. (1995, p.211) also noted dagera as the only D. charina representative from Tanzania, regarding D. c. liliana as a subspecies limited to eastern and coastal areas of Kenya (Ackery et al. 1995, p.212; Larsen 1996, p.144). However, within Tanzania D. charina has been recorded from Kilimanjaro by Aurivillius (1910a, p.11), Rau Groundwater Reserve and Karanga River, just to the south of Moshi by Cordeiro (1995, as D. c. liliana), Taveta (Aurivillius 1910c, p.47; Rogers 1913, p.98, both as liliana), Lake Manyara National Park (Cordeiro 1990, as D. c. liliana), and Ngorongoro (Kielland 1980, p.158). There is extensive material in
OUMNH, including specimens collected at Taveta by Rogers, identified as “D. doxo liliana” – all of which fits the current concept of D. charina liliana. We have dissected a male from Taveta collected by Wiggins (received on loan from OUMNH), and this clearly exhibits the eastern “charina” genital phenotype (Bernardi 1954). On this basis, together with several specimens from Taveta and a specimen from Old Moshi in BMNH, we include this butterfly as a member of the Kilimanjaro lower slopes fauna. Further work is, however, desirable (see discussion under D. doxo).

If we are correct (below) in attributing Kielland’s records of D. doxo costata to D. c. liliana, then in the Kilimanjaro area liliana is a savannah and forest edge butterfly that occurs from near sea level up to about 1200 m. Female specimens in the BMNH from Taveta have a greater or lesser number of scattered black scales on the hindwing underside (SI: Figure 31a–h). These Taveta specimens include at least one illustrated (doubtfully) by d’Abrera (1997) as D. doxo costata. Variation in this taxon includes supposed “dry season” males (f. “transiens” Talbot), in which the upperside wing veins are far less blackened than in the more commonly encountered wet season forms, and whitish versus yellowish female morphs.

[Dixeia doxo costata Talbot, 1943]

Larsen 1996: pl. 10, figs 91 i,ii. d’Abrera 1997: 105 (supposedly 5 figs – but at least one of these is D. charina liliana from Taveta).

Note: As already discussed under D. charina, based on exophenotypic characters alone, these two variable species can be very difficult to separate. As we do not consider that D. doxo costata occurs on Kilimanjaro we do not present images or size data, but it appears that the more western doxo costata is significantly smaller in forewing length compared with D. charina liliana.

Talbot (1943b) considered D. doxo and D. charina to represent variants of a single species. Kielland (1990) recognized charina and doxo as separate, citing both D’Abrera (1980) and Carcasson (1981) as authorities. Larsen (1996, p.144), following d’Abrera (1980, p.90, 1997, p.104) and Ackery et al. (1995, p.211), incorrectly cited Bernardi (1961) as the source of the division, commented on confusion in the literature(!), and further suggested that the reality might be more complex, with various morphs potentially representing several allopatric species.

Bernardi (1954) is the correct reference for the genitalic division of these taxa as separate species. In the more western D. doxo, the valve and phallus are relatively short, whereas in the more eastern D. charina both are relatively long. In making this distinction, Bernardi (1954) acknowledged van Son (1949: figs 94, 96), who illustrated exactly the same differences but nonetheless treated the two in South Africa as conspecific (as D. doxo charina and D. doxo parva Talbot, in the local fauna). In this context it is interesting to note that Bernardi (1958), in naming a new subspecies from southeast Ethiopia having the charina genital phenotype, chose to include it likewise under an umbrella D. doxo – potentially giving rise to confusion. In effect, Bernardi regarded doxo as a superspecies (D. doxo s.l.) with two semispecies, D. doxo s.s. and D. charina.

In Tanzania, Kielland (1990, p.63) considered D. charina (as subspecies dagera) to be limited to “coastal areas”, whereas the two subspecies of doxo that he recognized occurred inland. Of these, he noted D. d. costata from savannah and forest edges “from near sea level to 1200 m”, with records from the region of Dar es Salaam south
to Kisiju, and inland to Mikumi, and to Morogoro (which lies about 400 km south of Kilimanjaro), and subspecies *D. d. alberta* (Grünberg, 1911) from “central to north-central Tanzania”. We believe that Kielland’s records for “doxo costata” must refer to *D. charina liliana*. Bernardi (1954: fig. 2) recorded *doxo costata* from Lake Manyara National Park, 140 km west of Kilimanjaro, based on dissection of the male genitalia; Cordeiro (1990, p.28) recorded both *doxo costata* and *charina liliana* from Lake Manyara as “common”; and Moehlman and Liseki (2003) also noted both species from LMNP, based on “literature” (e.g. Cordeiro 1990). Bernardi (1954) was unable to dissect *alberta*; this taxon is currently treated as a subspecies of *doxo* from eastern DRC, and central and northwestern Tanzania. Talbot (1943b), in describing *costata* from extensive material in BMNH and OUMNH, noted it from Kondoia in the Great Craters area, Kasanga (Lake Tanganyika), and various localities in western Kenya and Uganda – but certainly not from eastern Tanzania. This may explain why Kielland (1990, p.64) commented that he had “not come across it [costata] in northern Tanzania, but the coastal population agrees with costata”. On exo-phenotypic grounds, *D. charina liliana* and *D. doxo costata* are very similar in appearance.

Currently we see no convincing evidence that true *D. doxo* sensu Bernardi (1954) occurs on Kilimanjaro or its lower slopes.

### Dixeia orbona vidua (Butler, 1900)

Larsen 1996: pl. 9, figs 90 i,ii. d’Abrera 1997: 105 (4 figs). SI: Figure 32a–h.

Forewing length: male 21–30.5 mm (mean (n = 6) 26.58 mm, SD = 3.150); female 21–28 mm (mean (n = 7) 24.11 mm, SD = 1.953).

**Records.** Bukoba, Rukwa basin and Northern Highlands; found in open woodland and open montane forest, to 2000 m (Kielland 1990, p.64). Cordeiro (1990) recorded this taxon from Lake Manyara National Park. Although Kielland did not give specific records for Kilimanjaro, and the butterfly was not encountered in the forest zone by Liseki (2009), it is included here as a member of the lower slopes fauna based on a female in BMNH from W. Kilimanjaro, 4500–5000 ft, collected in 1937 by B. Cooper, and a pair from Kilimanjaro collected by F.J. Jackson. In addition, OUMNH has a male from Taveta, and a female from Kilimanjaro, both ex Rogers. Beyond Tanzania this subspecies occurs in Sudan, Ethiopia, DRC (east Kivu), Uganda and Kenya. More widely, the species occurs across much of central Africa, from Senegal to Ethiopia and south to Zambia (Ackery et al. 1995, p.212).

Males are white, with or without a black forewing apex and margin; females are mostly fairly similar, more or less lightly maculated, and generally with a greyish-yellow cast. Larsen (1996, p.143) states that “The smaller *D. orbona* is very similar [to *D. pigea*] and the two may be impossible to tell apart”. Talbot (1943b, p.106) originally indicated that female *pigea* (“fw. 26–32 mm”) were larger than female *orbona* (“fore-wing 21–25 mm”). However, our limited data indicate a substantial overlap in size. Form “nigricans” (SI: Figure 32g,h), first described from Taveta by Aurivillius (1910c: 47), is dusky and this, together with the existence of a number of rare morphs (e.g. the bright orange form noted by Larsen 1996, p.143), indicates that the female of this species is polymorphic as well as variable, including at least two
yellow morphs. Talbot (1943b, p.106) gave a key to 11 named female forms for this species.

*Dixeia pigea* (Boisduval, 1836)

Larsen 1996: pl. 9, figs 89 i,ii. d’Auberta 1997: 103 (8 figs). SI: Figure 33a–j.

Forewing length: male 22–28 mm (mean $(n = 6)$ 25.35 mm, SD = 1.518); female 23–29.5 mm (mean $(n = 14)$ 26.94 mm, SD = 1.508).

*Records.* Most parts of Tanzania, in woodland and forest margins, up to 2000 m (Kielland 1990, p.64). Cordeiro (1990) recorded this taxon from Lake Manyara National Park. Although Kielland did not give specific records for Kilimanjaro, and this species was not encountered in the forest zone by Liseki (2009), this butterfly almost certainly occurs on the lower slopes (two old specimens from “Kilimanjaro” in BMNH) – and was recorded at up to 1800 m above Kibongoto by Aurivillius (1910a, p.11). There are at least three ex Rogers specimens from the slopes of Kilimanjaro in OUMNH. Beyond Tanzania found in woodland and riverine forest in Cameroon, DRC, Angola, Ethiopia, Kenya (east, southwest), Zambia, Mozambique, Zimbabwe (east and northwest), South Africa (Limpopo Province, Mpumalanga, KwaZulunatal, Eastern Cape Province) and Swaziland.

Males are white, with variation in the amount of black scaling at the tip of the forewing apex upperside, and the marginal black spots. Females are polymorphic (white, piebald white/yellow, and yellow) and very variable regarding the extent of dark markings and different forewing and hindwing pinkish-grey or yellowish suffusions. However, the only two females we have seen from the Kilimanjaro massif are whitish, male-like. The BMNH has nine “yellow” females from Amani (Usambaras Mts) collected by Pinkie Jackson. Talbot (1943b, pp.106/7) gave a key to 17 named female forms. Some of these forms are similar to other *Dixeia*, notably *D. charina*, but, according to van Son (1949, p.194), *D. pigea* can be recognized by its relatively short antennae (shorter than length of forewing discal cell). However, in our view this subtle difference is not easily relied upon.

*Dixeia spilleri* (Spiller, 1884)

Larsen 1996: pl. 10, fig. 93 i. d’Auberta 1997: 105 (2 figs). SI: Figure 34a–f.

Forewing length: male 20.5–25 mm (mean $(n = 7)$ 22.56 mm, SD = 1.112); female 19–24 mm (mean $(n = 12)$ 21.32 mm, SD = 0.853).

*Records.* This distinctive monotypic species occurs in riverine and dry forests from South Africa northwards to eastern Tanzania and northern Kenya (Ackery et al. 1995, p.213). For Tanzania Kielland (1990, p.64) records *D. spilleri* as a rather local bushland and forest roadside species found in coastal areas inland to Ifakara, Mikumi and the Usambaras, flying at altitudes up to 1700 m. Cordeiro (1995) noted an old specimen in BMNH from Moshi – but we failed to re-locate this material in the museum’s main or Rothschild collections (perhaps the specimen was found among
accession or supplementary material). However, given the details noted by Cordeiro, we think it unlikely he was mistaken. On this basis, and the evidence of three males from Taveta and a female from “Terta” in the BMNH, we include this butterfly as a member of the lower slopes fauna.

Males of *D. spilleri* are always a bright, clear yellow, while the females vary from white to cream or yellow (Larsen 1996, p.144, as “spilleri spilleri”). Probably there is an underlying polymorphism in the females, which are generally yellow (male-like), piebald (forewing whitish, hindwing yellow or orangey-yellow), or whitish, with only the anal area of the hindwing with some orange scales. Worn specimens are difficult to assess.

**Genus *Mylothris***

*Mylothris agathina agathina* (Cramer, 1779)

Larsen 1996: pl. 11, figs 105 i,ii. d’Abrera 1997: 113 (3 figs). SI: Figure 34g–j.

Forewing length: male 29–35 mm (mean \(n = 5\) 32.08 mm, SD = 1.921); female 28.5–35 mm (mean \(n = 7\) 31.84 mm, SD = 1.908).

**Records.** Kielland (1990, p.65) considered this butterfly to be widespread throughout Tanzania, occurring in deciduous woodlands, forest margins and clearings, even gardens, from sea level to 2200 m. Rogers (1908, p.537) recorded a single female from Kilimanjaro, collected 26–31 January 1906, apparently at about 5000 ft elevation (c.1600 m); this specimen, together with several males and females from Taveta, is preserved at OUMNH. One male and three females were reported from Kibongoto, Kilimanjaro, by Aurivillius (1910a, p.11), occurring at up to 1200 m, where the species was encountered in April and December. Specimens in BMNH include several from Engaruka (about 100 km west of Kilimanjaro), and a single male from Old Moshi. On this basis, *M. agathina* is included as part of the lower slopes fauna.

Beyond Tanzania, nominate *agathina* is very widespread in the eastern half of Africa, from Sudan south to South Africa. A second subspecies occurs in Cameroon, Central African Republic, Uganda and Ituri (DRC) (Ackery et al. 1995). This is a dimorphic species, the male upperside ground colour being pure white, while most females are a vibrant orangey-yellow – although they can be paler, with some almost white, male-like. Females, on average, have slightly larger “dotted border” spots on the hindwings.

*[Mylothris jacksoni* Sharpe, 1891]*

Kielland 1990: 266 (3 figs). Larsen 1996: pl. 10 fig. 103i. D’Abrera 1997: 109 (5 figs). SI: Figure 35a–d.

Occurs in submontane forest, apparently at slightly lower altitudes than the closely related *M. sagala* (Larsen 1996). Kielland (1990), however, gave 1900–2600 m for *jacksoni* and 700–2700 m for *sagala* (for Kenya, Larsen op. cit., indicates that *sagala*...
ascends to at least 3200 m). Adults of *M. jacksoni* (an abundantly distinct species in its life history: Colin Congdon, pers. comm.) are said to differ from those of *M. sagala* in the following respects: smaller; forewing upperside black border usually extending all around the wing, and forewing apex more acute and distal margin less rounded (Kielland 1990, p.66). According to Larsen (1996, p.149) the dark markings of *sagala* are “less glossy and less deep than in *M. jacksoni*.” Examination of the genitalia of a single male *M. jacksoni* from northern Tanzania compared with four males of *M. sagala* from the West Usambara Mts suggests a slight difference in valve shape.

Kielland (1990) considered that two subspecies of *jacksoni* occur in northern Tanzania: nominate *jacksoni* from the Loliondo Hills (Kenya border), and *M. jacksoni neumanni* Sharpe, 1896, from Mt Longido and the Meto Hills.Ackery et al. (1995, p.220; perhaps following Rogers 1913, p.98) treated *neumanni* (type locality: region of Mt Kenya) as a synonym of nominate *jacksoni* (type locality: Kavirondo, eastern Lake Victoria, Kenya). Larsen (1996, p.149, pl. 10, fig. 102i), however, treated *neumanni* as the representative of *M. sagala* in Kenya’s central highlands. Beyond Tanzania and Kenya, *M. jacksoni* is considered to occur in Nigeria, Equatorial Guinea (Bioko), Cameroon, Sudan, Ethiopia, DRC, Uganda, Rwanda and Burundi.

As Larsen (1996) noted, *M. jacksoni* and *M. sagala* – which were first distinguished at species level in the modern literature by Berger (1981) – are very variable and similar to each other. Larsen’s treatment of *neumanni*, as noted above, suggests a possible problem in consistent separation. Liseki (2009) recorded both species from Mount Kilimanjaro. The forewing shape difference reported by Kielland (1990) seems difficult to apply consistently, and the extent of the forewing black border is variable in Kilimanjaro material. An additional character that appears to separate most *sagala* from *jacksoni* is the black spot at the tip of vein Rs on the hindwing underside, which is often enlarged in the former (SI: Figure 35f,h) but apparently not or only very slightly in the latter (SI: Figure 35b,d). All SDL’s available material from Kilimanjaro has this spot more or less enlarged compared with the posterior marginal spots. We now consider that identification of SDL’s Kilimanjaro material as *M. jacksoni* was an error due to unfamiliarity with the range of variation of *M. sagala* (see also below). However, in our view, the whole question of the identity and separation of these two species should be re-investigated.

**Mylothris kilimensis kilimensis** (Kielland, 1990)

Kielland 1990: 271 (2 figs); figs 35, 45 (genitalia). D’Abrera 1980: 102 (1 fig., as male *M. yulei yulei*). D’Abrera 1997: 121 (1 fig., as male *M. yulei yulei*, misidentification). SI: Figures 36a–d.

Forewing length: male 22.5–29 mm (mean (n = 18) 26.38 mm, SD = 1.327); female 21.5–29 mm (mean (n = 7) 25.86 mm, SD = 1.856). Note these data are all drawn from old BMNH specimens from Kilimanjaro and Taveta; in some contrast, Kielland (1990, p.67) gave male 22–27 mm (mean 24 mm), female 22.5–27.8 mm (mean 26 mm).

Note: Jan Kielland (1990) recognized that the relatively widespread species *Mylothris yulei* Butler, originally described from a male from the Songwe area in
northern Malawi (Butler 1897, p.853, pl. 43, fig.2) and a female from Kilimanjaro, was based on a mixed (syntypic) series. He resolved this by designating the male, from “Songwe Plain”, as lectotype of *M. yulei*, and included the female syntype of *yulei* within the type material of a new species, *M. kilimensis* (Kielland 1990, p.67; type locality Amani, East Usambara Mts).

**Records.** Occurs in submontane and montane forest in far southern Kenya (Taveta), and northeastern and eastern–central Tanzania. In Tanzania the nominate subspecies occurs at altitudes of 900–2000 m; it has a weak flight, and floats around trees and shrubs (Kielland 1990, p.67). Recorded by Kielland (loc. cit.) from Mt Kilimanjaro, North and South Pare Mts, the Usambaras, Nguu and Nguru Mts, Mt Kwaraha, Mbulu forests and Mt Meru. Liseki (2009) did not record this butterfly from Kilimanjaro. Found on the lower slopes of Kilimanjaro by Hannington, at New and Old Moshi by Selous, and on W. Kilimanjaro at 4500–5000 ft by Cooper (material in BMNH). As *M. yulei*, Rogers (1908, p.537) noted four females from Kilimanjaro collected 5–16 January 1906, and Aurivillius (1910a, p.11) recorded it from the agricultural zone around Kibongoto. There are several specimens from Kilimanjaro in OUMNH, including some from Mamba – a small village close to Marangu, just below the national park border. On Kilimanjaro this appears to be a lower slopes insect. Possibly it does just enter the lower margin of the main forest zone, at around 1800 m, but we have no direct evidence of that.

Variation is relatively slight, most notably in the precise extent of the yellow flushing to the base of the wings. The only other race recognized occurs on the Rondo Plateau, southeastern Tanzania.

### *Mylothris ruepellii tirikensis* (Neave, 1904)

Larsen 1996: pl. 11, figs 110 i,ii. d’Abrera 1997: 117 (4 figs). SI: Figure 36e–j.

Forewing length: male 24–29 mm (mean (n = 5) 27.26 mm, SD = 1.641); female 25–30 mm (mean (n = 6) 27.87 mm, SD = 1.776).

**Records.** Pare Mts and Northern Highlands including Loliondo, in heavy woodland, forest margins and open forest, at c.600–2000 m elevation (Kielland 1990, p.68). Kielland did not cite specific records for the Northern Highlands, but material in the BMNH (from 4000–5000 ft collected by B. Cooper, and from Old Moshi collected by Selous) confirms its presence. This species has been reported as apparently migrating in large numbers near Moshi, in June 1928 (Williams 1930, p.158). Rogers (1908, p.537) noted one female (as “*M. poppea*”) from Kilimanjaro collected in January 1906; Aurivillius (1910a, p.11) recorded this butterfly in the Kibongoto area, up to 1800 m, during May, September and October. There are several specimens from the slopes of Kilimanjaro and from Taveta in OUMNH. Liseki (2009) observed this species on Kilimanjaro from March to November, at 2000 m.

There is variation in the amount and extent of yellow and orange flushing to the fore and hindwing bases – and this can lead to uncertainties over identification (see under *M. superbus*, below). Females are male-like or yellowish, probably dimorphic. Beyond Tanzania subspecies *tirikensis* occurs in Uganda and the Kenya highlands.
The species occurs throughout much of eastern Africa, in a series of races from Ethiopia to South Africa, extending to the west as far as southeastern Angola (Ackery et al. 1995, p.223). Like *M. kilimensis*, on Kilimanjaro *M. rueppellii* appears primarily to be a denizen of the lower slopes, just entering the margin of the forest zone at around 2000 m.

*Mylothris sagala narcissus* (Butler, 1888)  
Kielland 1990: 270 (2 figs). Larsen 1996: pl. 10, fig. 102ii. SI: Figure 35e–j.

Forewing length: male 23.5–31 mm (mean \( n = 7 \) 26.29 mm, SD = 2.030); female 25–31 mm (mean \( n = 5 \) 27.48 mm, SD = 1.746).  
Note: there is an unresolved dispute concerning the name of this race, due to uncertainties regarding the true type locality of *Mylothris sagala* Grose-Smith, 1886. Here we follow both Kielland (1990, pp.68,69) and Larsen (1996, p.149) in applying the name *narcissus* Butler to the subspecies found on Mt Kilimanjaro, rather than follow the position adopted by Ackery et al. (1995, p.223) – who included Kilimanjaro within the nominate race. As *M. narcissus* was originally described from Taveta, there seems no doubt that this name at least does apply to the Kilimanjaro population.

*Records.* Within Tanzania known from Mt Kilimanjaro, Mt Meru, North and South Pare, Mount Lossoganeu and the Usambaras, at 900–2500 m (Kielland 1990, p.69). Recorded by Aurivillius (1910a, p.11, as *M. narcissus*) from the primary forest above Kibongoto in October, at 2000 m. Found commonly throughout the year on Mount Kilimanjaro at 2000, 2500 and up to 3000 m (Liseki 2009). Outside Tanzania this subspecies also flies in parts of southern Kenya, including Taveta (type locality of *narcissus*). *Mylothris sagala* is geographically very variable, and comprises up to 10 or more races across its range, from Ethiopia to Zambia and Zimbabwe. Its separation from *M. jacksoni* is not always straightforward (see account of *jacksoni* above).

**[Mylothris superbus Kielland, 1985]**  
Kielland 1985: 97 (4 figs), 99–101 (male genitalia); 1990: 270, 2 figs. d’Abrera 1997: 111 (2 figs – female mislabelled as “*M. similis dollmani*”).

Kielland (1985) gave the following measurements for *superbus*: male 32.5–33.5 mm, female 31.8 mm [sic – even though Kielland listed seven females in addition to six males in the type series].

Known from Nguru Mts: Morogoro District, Mkombola, Maskati and above Mhonda Mission (Kielland 1990, p.70). According to Kielland this species is endemic to the Nguru Mts, but it was recorded from Mount Kilimanjaro by Lieski (2009), who reported seeing it rarely during November, when a few were caught at 2000 m. SDL’s identification was made at the BMNH in 2002, and confirmed at the time by RIVW. However, we now consider this to have been a misidentification of certain specimens of *M. rueppellii tirikensis* with orange at the base of the hindwing upperside
in addition to the orange flush at the base of the forewing – giving a superficial resemblance to (the much larger) male of *M. superbus*. There is no evidence to suggest that *M. superbus* occurs on Kilimanjaro, and this record should be discounted.

**Discussion**

**Size and sexual dimorphism**

Liseki and Vane-Wright (2011) suggested that high-quality data on the size of adult butterflies are potentially relevant for monitoring the effects of climate change. The statistics included here provide baseline, or at least indicative information. But size data are also of academic interest, notably with respect to the evolution of sexual size dimorphism. In eutherms, females are generally larger than males (Teder and Tammaru 2005). However, in some cases an allometric effect can also be observed. For example, Rensch’s Rule indicates that, among a group of closely related species, if the male is the larger sex then the bias will increase with increasing body size, but the bias will decrease with increasing body size if the female is the larger (Fairbairn 1997). First proposed by Bernhard Rensch in 1950 with respect to various groups of mammals, the rule appears to fit many groups of organisms, but by no means all (Fairbairn 1997; Webb and Freckleton 2007).

We measured forewing length from small samples of both sexes for a total of 43 species of Pierinae that occur on Kilimanjaro and its lower slopes. For this account these data are of importance with respect to identification using an artificial key (see SI). However, given that a total of 283 males and 305 females were measured, these data are briefly explored here with respect to sexual size dimorphism.

Based on our data, the smallest species of Pierinae found around Kilimanjaro is *Colotis daira* (mean male forewing length 16.72 mm/female 16.21), while the largest (often regarded as the largest species of pierid in Africa) is *Nepheronia argia* (corresponding values 38.28 and 36.72 mm). This linear size discrepancy of c.2.25 is suggestive that the difference in wing area between the smallest and largest Tanzanian species of Pierinae is about five-fold. Unfortunately there are no comparable data on the mass of male and female pupae before eclosion – which could be a more sensitive and biologically relevant parameter than forewing length as a surrogate for overall body size (see Peixoto and Benson 2008). Even so, a strong and positive correlation between forewing length and body mass has been demonstrated in at least one pierid (Jones 1992).

Our raw data for mean size indicate a majority of species in which males are the larger sex (24 versus 18, with one species exactly equal). However, in 29 cases (67%) the mean sexual difference in forewing length is not more than 5%. In eight species the mean values for males are more than 5% larger than their respective females, with the reverse in six cases. Of these, *Dixeia orbona* is the most extreme for male bias, and *Colotis celimene* the most extreme for female bias. However, all our samples are small, and the overall conclusion must be that we have not found evidence of marked sexual dimorphism with respect to forewing length in Kilimanjaro Pierinae (and by inference African Pierinae as a whole). Large samples of *D. orbona* and *C. celimene* might be a good starting point to see if any convincing, statistically significant evidence could be found.
A comparison of size dimorphism in Pieridae and Papilionidae related to their general biology and sexual behaviour would be an interesting study, notably within the current framework regarding the evolution of sexual dimorphism among the Lepidoptera (Allen et al. 2011). In Pieridae it looks as if there is little or no evidence for striking and/or widespread female-biased sex dimorphism in size, at least with respect to the single parameter measured here. Nor, as might be expected given this lack of evidence, is there any suggestion that Rensch’s Rule applies. In contrast, based on the findings in Liseki and Vane-Wright (2011), it is possible that various biases might occur in the genus *Papilio* – although it seems unlikely that the allometric changes would fit the classic Rensch model (cf. Webb and Freckleton 2007). In making any such investigations, the potential problem of seasonal variation in sexual size dimorphism would need to be addressed. Furthermore, some intraspecific as well as interspecific variation in sexual size dimorphism appears to be due to sexual differences in phenotypic plasticity (Stillwell et al. 2010), all indicating that extensive as well as well-designed research protocols would be necessary for any reliable investigations into these phenomena.

**Polymorphism and polyphenism**

Many species dealt with in this paper are remarkably variable with respect to their colour patterns – apparently due to the interaction of phenotypic plasticity (notably seasonal variation) with (presumptive) genetic polymorphism, including sexual dimorphism. Although seasonal variation in these and other African butterflies has long been known and commented upon, mainly in the taxonomic literature, almost no experimental work has been done on polyphenisms in African Pieridae. There is a short discussion with respect to the seasonal forms of *Colotis* in Brakefield and Larsen (1984). With respect to polymorphism, which is spectacular in *Nepheronia argia* (Owen 1971, p.124) for example, and many species of *Colotis*, observation of museum specimens suggests the interaction of a small number of genetic loci, probably involving dominance and epistasis, to give rise to the range of forms observed. This is speculation, however, as up to the period of Robinson’s (1971) great compendium on Lepidoptera genetics, almost no work appears to have been published on the classical genetics of African Pierinae – and little or nothing appears to have been done since. Potentially these butterflies represent a great opportunity for studies in evolution and development, if reliable laboratory-rearing protocols could be established.

**Separation and status of Teracolus and Afrodryas**

The separation of most genera of African Pierinae has been relatively stable since the seminal work of Klots (1933). However, Nazari et al. (2011), based on molecular data, recently recognized two additional genera, for which the available names *Teracolus* Swainson, 1833 (type species *Teracolus subfasciatus* Swainson), and *Afrodryas* Stoneham, 1957 (type species *Dryas leda* Boisduval) were employed.

Klots (1933) included *Teracolus* as a subgenus of *Colotis*. The characters he noted are sufficient to provide a clear morphological basis for separation of the two groups, and these features are indicated in our key to genera (SI). *Teracolus* contains three currently recognized species: *C. subfasciatus*, *C. eris* (Klug) and *C. agoye* (Wallengren). Nazari et al. (2011) examined all three species, their results clearly
indicating that they form a monophyletic group more closely related to *Gideona* and *Pinacopteryx* than to *Colotis*. On this basis we accept the separation and reclassification of these three species as *Teracolus*.

In contrast, the monobasic *Afrodryas* can at present only be separated from *Eronia* (to include *E. dilatata* Butler and *E. cleodora* Hübner) on molecular evidence and colour pattern. Neither Klots (1933) in his original account, nor van Son (1949, p.161), indicated any structural distinction between the two species then included in *Eronia: leda* and *cleodora*. In the molecular-based cladograms of Nazari et al. (2011) these species are widely separated, prompting the authors to resurrect *Afrodryas* – but without appeal to or citation of other differences. The placement of *E. leda* was not stable in their combined analyses, clustering with *Pareronia* and *Nepheronia* under maximum likelihood, and the five species of *Colotis* group II in the Bayesian tree (Nazari et al. 2011: figs 1,2). Other than the striking divergence in overall colour pattern of *E. leda* compared with *E. cleodora* and *E. dilatata*, the three species concerned are morphologically very similar. This raises the possibility of an error affecting the molecular work of Nazari et al. (2011) – and/or the need to look at the morphology of these species again. Either way, there are unresolved issues affecting separation of *Eronia* and *Afrodryas*, which appears premature, and we have decided not to adopt *Afrodryas* here.

Species separations

In preparing this account we have encountered various difficulties with the separation and/or critical identification of a number of species.

Within the very large genus *Colotis*, as Table 1 indicates, there has been continuing uncertainty and disagreement regarding the species that make up “group II” – and this does not seem to have been fully resolved, at least with respect to identification based on phenotypes, by the work of Nazari et al. (2011).

Within *Appias*, the differences in male and female genitalia of *A. epaphia* and *A. sabina* noted by van Son (1949) should be confirmed for Tanzanian populations. If upheld, on this secure basis a renewed search for reliable exo-phenotypic characters to separate the males of the two species should be undertaken.

Talbot (1943a, p.325), in his revisional notes on *Belenois*, did not comment on the status of *B. margaritacea*, and only discussed *B. raffrayi* to confirm its membership of the genus. Kielland (1990, p.61) refers to small colour pattern differences between them, including the absence in *raffrayi* of the hindwing underside yellow tornal spot present in *margaritacea*. Larsen (1996, p.138) did not mention this spot, but suggested that in the Sotik/Mara area of Kenya “the two are apparently sympatric, or nearly so.” We suggest their status as wholly separate species must be subject to considerable doubt.

The recognition and separation of *Dixeia doxo* and *D. charina* remains problematic, despite the clear differences in male genitalia established by Bernardi (1954). The reader is referred to the discussion of these two species in the main text. *Dixeia pigea* and *D. orbona* can also be very difficult to separate. A molecular investigation into the whole of *Dixeia* would be very valuable.

With respect to *Mylothris*, Larsen (1996, p.148) commented on the many changes that have occurred in the taxonomy of this genus over recent decades, and suggested that some of the subgroups are “strongly in need of revision.” Kielland (1990, p.65)
stated simply that “the whole genus [emphasis added] is badly in need of revision.” Braby (2005) also drew attention to taxonomic problems affecting *Mylotris*, and called for new data, including immature stages, to help resolve relationships and species boundaries. The requirements for fresh collections of these beautiful, often montane butterflies, more life-history data, and extensive dissection and molecular work are evident.

With respect to the “dotted borders” of Mt Kilimanjaro, renewed work on the precise identification of *M. sagala* is needed to resolve uncertainty with respect to its subspecies assignation, and research into the variation seen in *M. rueppellii* would be desirable to eliminate the possibility that it might represent a species complex. We have made a few preliminary dissections which suggest that this is not the case, but our work is far from definitive. Finally, although we do not see taxonomic problems with *M. agathina* and *M. kilimensis*, new research on their distribution on Kilimanjaro would be very desirable, as both may just enter the lower margins of the forest reserve. As a result, they may be particularly valuable species for monitoring potential climate change effects.

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**Supplemental material**

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