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Revision of the genus *Neptis* Fabricius, 1807 (Lepidoptera: Nymphalidae) in the Afrotropical Region, Part 2: Two new species in the Agatha group

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Abstract: Richardson's 2019 revision of the genus *Neptis* showed that DNA barcoding can assist with the separation of species and there may be more undescribed species than previously thought. Two of these species from the Agatha group are described here: *Neptis nzedurui* sp. nov. and *Neptis morosopsis* sp. nov. The barcodes allow the species to be separated from one another and from the similar *Neptis kiriakoffi* Overlaet, 1955. Small differences in external morphology and genitalia are consistent with this separation.

Key words: Barcode, Neighbour Joining, Morphology, Genitalia, Phylogeny, Agatha Group, *Neptis*.

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INTRODUCTION

The revision of the genus *Neptis* (Richardson, 2019) defined a group of closely related species as the Agatha group after the oldest member, *Neptis agatha*. That taxon was suppressed by Overlaet (1955), but the name has been retained in Richardson (2019) for the group of species. The species in the group fall into three subgroups characterised by the form of the white markings in the cell of the forewing upper side:

1. white spotted cell
2. unmarked cell
3. white radial bar in the cell

Fourteen described taxa were assigned to the group and barcodes were obtained for twelve of these as well as four further undescribed species (Richardson, 2019). Two of these were given the place holder names species19 and species20 and are described here as *N. nzedurui* sp. nov. and *N. morosopsis* sp. nov., respectively. These new species belong to the first subgroup with a white spotted forewing cell.

The two new taxa are clearly close relatives of *N. kiriakoffi* Overlaet, 1955 and have no doubt been overlooked as that species by lepidopterists. Of the other two potential taxa, species86 is also closely related to *N. kiriakoffi*, while species72 is closely related to *N. laeta* Overlaet, 1955. At the time of writing, both are based on single barcoded specimens and further barcoded specimens are required to confirm that they are distinct species that should be formally described.

The tree developed from barcode data and presented in Richardson (2019) is shown in Fig. 1 with the new taxa substituted for the place holder names. A study is ongoing at the City University of New York to develop a multi-gene tree for the Afrotropical *Neptis*, using 13 genes including the barcode. So far the results are entirely consistent with the barcode-based tree for the Agatha group, confirming that the two new taxa are good species.

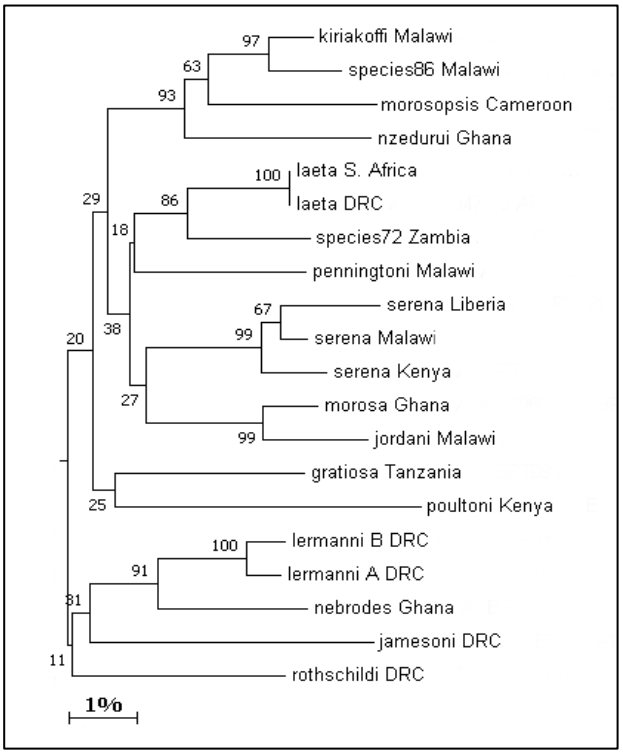

Figure 1 – Phylogenetic tree for the Agatha Group from Richardson (2019).

MATERIAL AND METHODS

The methodology for this part of the *Neptis* study is as set out in Richardson (2019). The salient points are restated below.

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Specimen photography

Dorsal and ventral aspects of all specimens for DNA sequencing were photographed using the technique described in Richardson (2019).

The accession numbers of photographed specimens are stated in the figure captions and a shortened version of the ABRI (African Butterfly Research Institute) accession number is used. For example, ABRI-2018-1234 becomes ABRI-181234.

DNA sequencing

A single leg was removed from each selected specimen and submitted to the CCDB (Canadian Centre for DNA Barcoding), Guelph, Canada, along with an image of the dorsal and ventral aspects of the set specimen.

The methods for inferring phylogenetic trees available in MEGA7 (Kumar *et al.*, 2016) were used to generate a phylogenetic tree using the neighbour joining method.

Additionally, a distance chart or Klee diagram was constructed showing the K2P (Kimura 2 Parameter) corrected pwd (pairwise difference) between all barcodes.

Genitalic dissection

The techniques employed to dissect out and photograph the genitalia of both male and female specimens are described in detail in Richardson (2019). Note that the internal organs of the females are not distinctive in *Neptis*, only the form of the 7th and 8th sternites may be helpful.

All the images of male and female genitalia are shown with a 1 mm scale bar.

Distribution map

A map of Africa covering the localities for the two new species described was developed from the website https://maps-for-free.com/. The map shows terrain altitude, the principle rivers and lakes and international boundaries. The map is used as the background for an Excel chart in a workbook with formulae to transform specimen capture latitude and longitude to the map coordinates.

The symbols for each species indicate the status of the specimen as follows:

- Holotype: red fill
- Paratype: yellow fill
- Other specimens: white fill
- Barcoded specimens: black outline
- Specimens not barcoded: grey outline

The latitude, longitude and altitude of the localities mentioned in this paper are listed in the Gazetteer (p. 93).

DESCRIPTION OF NEW SPECIES

Genus *Neptis* Fabricius, 1807

Illiger, K., *Magazin für Insektenkunde* **6**: 282 (277–289).
Type-species: *Papilio aceris* Esper, by subsequent designation (Crotch, 1872. *Cistula Entomologica* **1**: 66 (59–71).)

***Neptis nzedurui* sp. nov.** (Fig. 2)
urn: lsid:zoobank.org:pub:664D3404-6AE9-4524-97E8-0F2BFBD3ED16

Holotype ♂: Ngaoundere, Cameroon, 07°20′N, 13°35′E, 1 000 to 1 200 m; ii.1989; M. Libert collection.
Paratypes: 3♂; 4♀; 1 unknown: data see Table 1 (p. 92).

Description of facies

Holotype Male, ML-96249 (Fig. 2ab):
Wingspan: 5.0 cm. Forewing length: 2.7 cm. Antenna-wing ratio: 0.45.
Head White spots at the base of each antenna, a pair of white spots between the eyes and an elongated white mark along the posterior distal edge of each eye; palps white distad and greyish proximad; antennae black at the root, grading progressively to orange brown at the tip on the underside, on the upper side a sharply defined change from black to orange yellow for the terminal six segments.
Thorax Upper side black with a pair of white spots formed by tufts of white scales at the junction of the head and thorax, a pair of larger white marks roughly mid-way along the thorax, a further three pairs of fainter white marks on the posterior half of the thorax and a half-moon shaped white mark centrally about four fifths of the way along the thorax. Underside and legs whitish.
Abdomen Upper side dark grey, a broken line along each side comprising a white mark on each segment, a solid white ventral line.
Wings Forewing upper side, background colour dark brown, a small white spot at the root of the wing. Cell with three large near circular white marks and a more elongate white mark proximad, a further three fainter white marks within the cell and two white marks at the distal end of the cell, that nearest the costa being elongated. A long discal band mark in space 2A rounded proximad and tapering distad, mark in space Cu2 shorter. The marks in spaces Cu1 and Cu2 well separated by ground colour, band in spaces Cu1 to R3 continuous with the veins only faintly marked and with a distinct notch proximad along vein M3, the distal edge of the band indented at the veins and the individual marks rounded distad. A weakly defined post-discal band with spots in cells Cu1, M3, M2, M1 and R3 the latter two being the largest. Two submarginal bands of linear marks separated by dark ground colour at the veins, the separation broadest along veins M3, M1 and R5, the proximal band marks in spaces R3 and R4 triangular pointing proximad. Outer margin scalloped with black tufts of cilia at the end of the veins and white cilia in between. Forewing underside, background colour lighter than on upper side and more reddish brown, markings as upper side but larger and a third narrow submarginal band nearest the margin. The submarginal lines broadly broken or shadowed at vein M3 and more narrowly at vein R5. Spaces 2A and Cu2 with a noticeably lighter background colour. Hindwing upper side, precostal vein at base of wing marked with white scales. Discal band broad at more than 40% of the length of the hindwing, indented at the veins distally, individual marks flat ended distally, veins only faintly marked. Post-discal band indistinctly marked lighter brown. Two submarginal bands, proximal band composed of long slightly curved dashes, distal band composed of many short dashes. Hindwing underside, narrow whitish band (hb1) along the costa extending from the base roughly one third of the way to the apex. Two

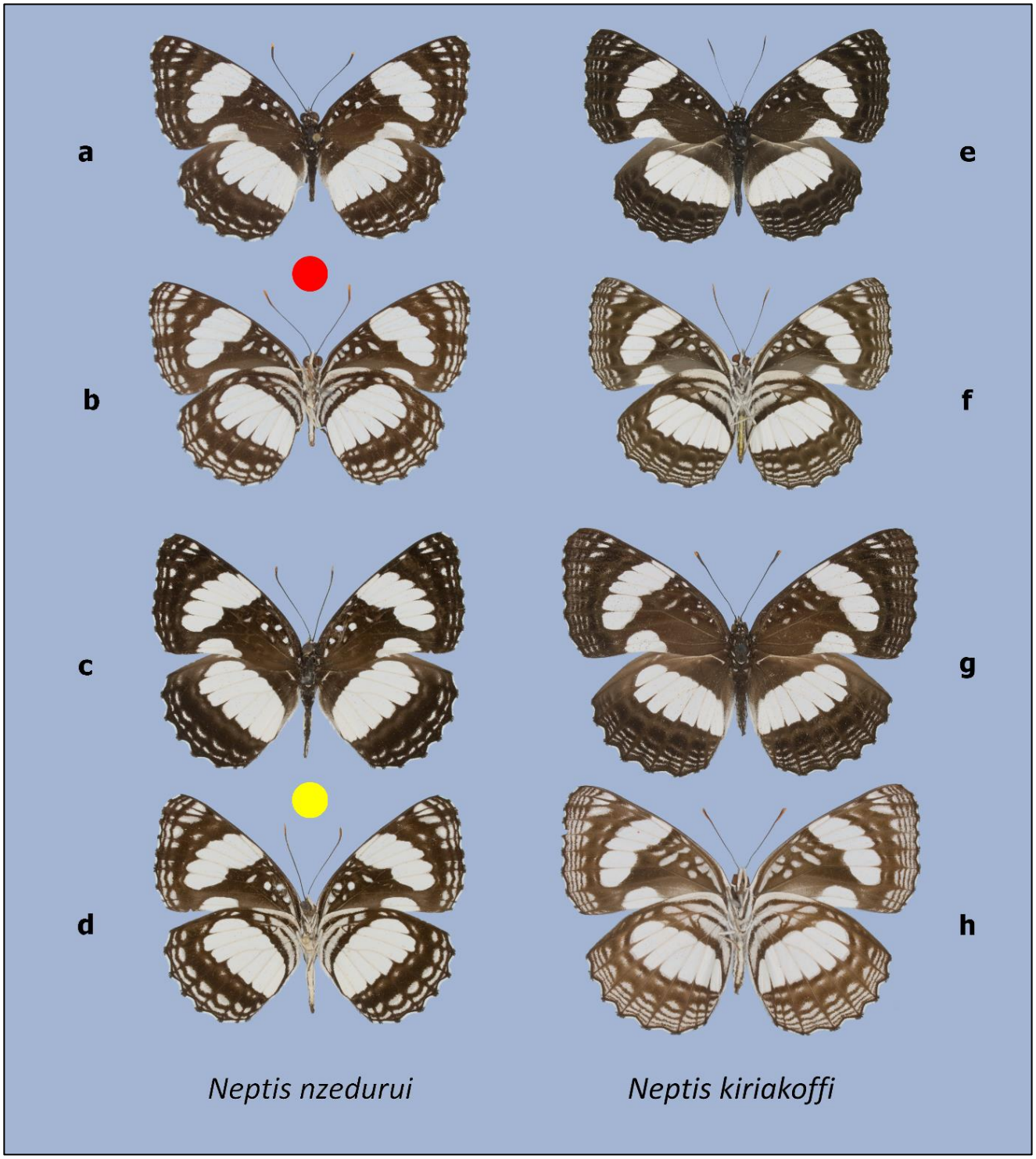

Figure 2 – *Neptis nzedurui* sp. nov. compared with *Neptis kiriakoffi* Overlaet, 1955. Left *Neptis nzedurui*: Holotype ♂: ML-96249; Ngaoundere, Cameroon; ii.1989; M. Libert; a) dorsal, b) ventral. Paratype ♀: ABRI-153071; Mole, Ghana; ix.2014; c) dorsal, d) ventral. Right *Neptis kiriakoffi*: ♂: IDR-A01547; Nkhorongo, Malawi; 19.vi.2016; R.J. Murphy; e) dorsal, f) ventral. ♀: IDR-A01568; Kalwe Forest, Malawi; 24.ix.2016; R.J. Murphy; g) dorsal, h) ventral.

further narrow bands, proximal band (hb2) extending from the inner margin and curving distally to parallel the costa with a narrow break before the distal extremity, distal band (hb3) extending from the inner margin curving to follow the proximal band and terminating with a small narrowly separated triangular spot. Discal band as upper side. Post-discal band a series of small white spots extending from the inner margin and circling round the distal edge of the discal band with two spots on the anterior side of the discal band. Two submarginal bands well defined, proximal band (hsm1) comprising eight broad white spots in spaces 3A to Rs, distal band (hsm2) comprising curvilinear marks convex proximally in the same spaces, a thin third submarginal band (hsm3) distad comprising pairs of dashes either side of veins Cu2 to M1. Outer margin scalloped with white cilia between the veins interrupted by black tufts at the veins.

Genitalia ♂ (Fig. 3): Uncus curved ventrad with hooked tip, valve with a long apical spine roughly in line with the axis of the valve and curving distad towards the tip, a distinct hump on the dorsal edge of the valve anteriad

from the spine, a tooth on the ventral side of the root of the spine. Aedeagus/valve length ratio 1.05.

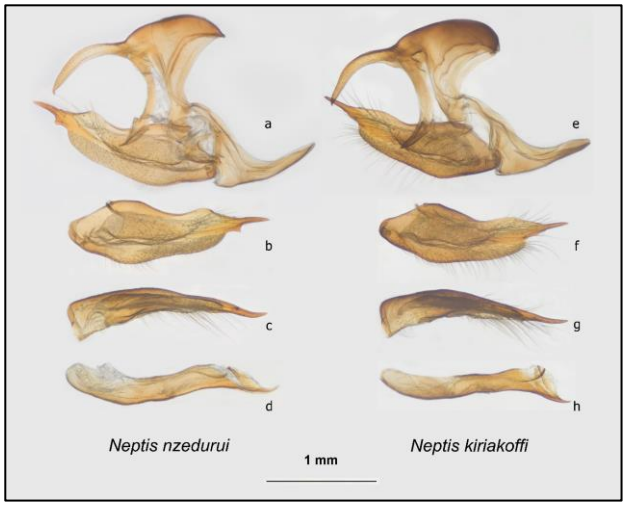

Figure 3 – Male genitalia of *Neptis nzedurui* sp. nov. and *Neptis kiriakoffi* Overlaet, 1955. Left *Neptis nzedurui*: ML-96249; Ngaoundere, Cameroon; ii.1989; M.Libert; a) genitalia with aedeagus and right valve removed, b) right valve lateral view, c) right valve dorsal view, d) aedeagus lateral view. Right *Neptis kiriakoffi*: IDR-A01830; Nkhorongo, Malawi; 12.vii.2016; R.J. Murphy; e) genitalia with aedeagus and right valve removed, f) right valve lateral view, g) right valve dorsal view, h) aedeagus lateral view.

Paratype female, ABRI-153071 (Fig. 2cd):
Wingspan: 4.9 cm. Forewing length: 2.9 cm. Antenna-wing ratio: 0.43.
Head and thorax These body parts of the paratype are covered with a fine mould residue that hides the markings. It is to be expected that the markings on the female will be similar to those on the male holotype.
Abdomen Upper side dark grey, a broken line along each side comprising a white mark on each segment, a solid white ventral line terminating posteriad in a dark grey area (Fig. 4).
Wings Forewing markings as in the holotype. Hindwing markings as in the holotype, except that the third submarginal band (hsm3) is more weakly defined.
Sclerotisation of the abdominal exoskeleton ♀ (Fig. 5) Ostium plate on 8th sternite comprising a substantial, central, domed plate with wings extending dorsad either side. Posterior edge of 7th sternite sclerotisation thickening towards the centre to form a straight sided pocket.

Barcoding

Four specimens have been barcoded, two males and two females. The barcodes of these four specimens, and of a specimen captured by Ms Nzeduru, are assigned to the same BIN (Barcode Index Number) in BOLD (Barcode of Life Data System) BOLD:ACU3936. The details of these barcoded specimens are given in Table 1 (p. 92), along with forewing length data.

The apwd between the four specimens barcoded in the current study is 0.16% or 1 base pair and the maximum pwd is 0.3% or 2 base pairs. The specimen captured by Ms Nzeduru is identical to one of the ABRI specimens (ABRI-153072) over the 303 base pairs in common.

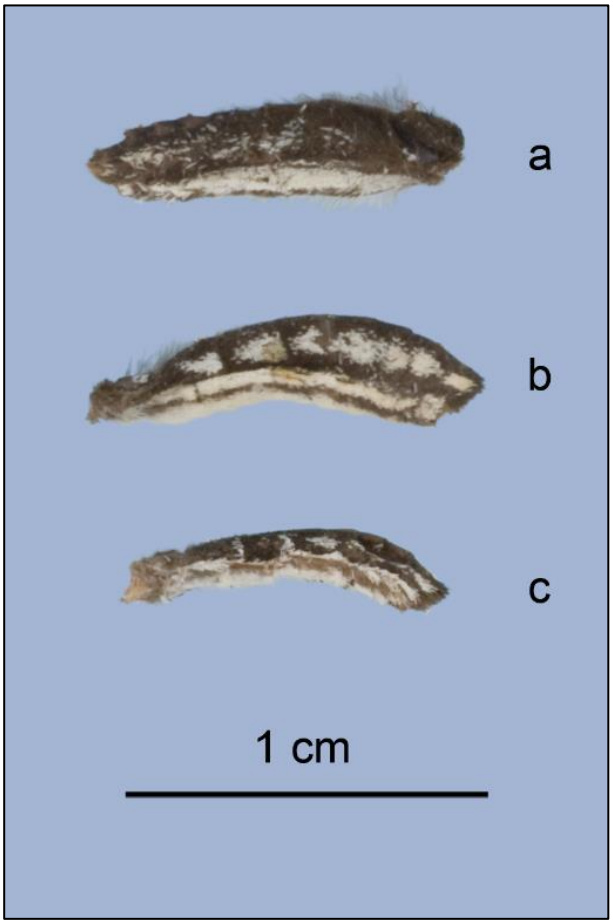

Figure 4 – Comparison of abdomens of females, lateral view. a) *Neptis kiriakoffi*, b) *Neptis nzedurui*, c) *Neptis morosopsis.*

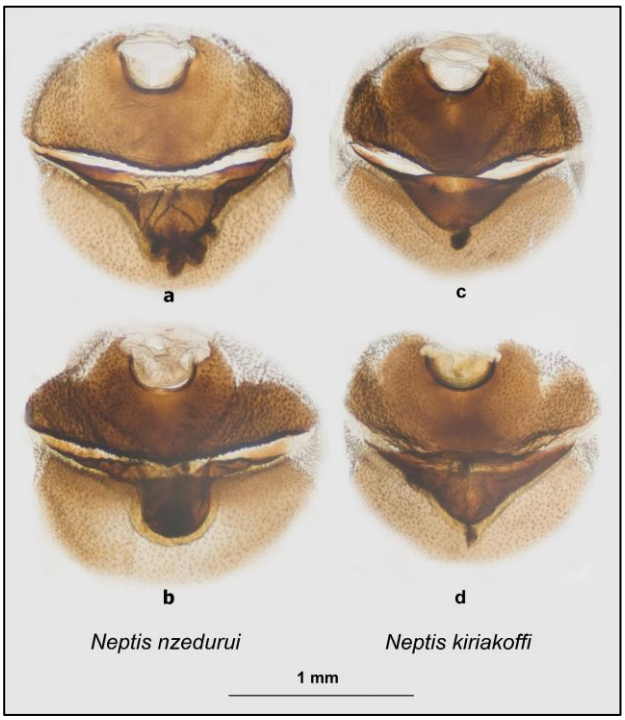

Figure 5 – Ostium plates of *Neptis nzedurui* sp. nov. and *Neptis kiriakoffi* Overlaet, 1955. a) *N. nzedurui*: ABRI-153071; Mole, Ghana: ix.2014, b) *N. nzedurui*: ABRI-153072; Mole, Ghana: ix.2014, c) *N. kiriakoffi*: IDR-A01402; Nkhorongo, Malawi: 25.vii.2015: Raymond Murphy, d) *N. kiriakoffi*: IDR-A02623; Lubemba, DRC: iv.2019: Thierry Bouyer.

Etymology

The species is named for Ms Chinyere Nzeduru who captured the first specimen to be barcoded and designated as a distinct species, *Neptis* sp. HMF-2011 (Nzeduru *et al.*, 2012).

Material examined and distribution

Details of all nine specimens examined are listed in Table 1 (p. 92). The capture localities for these specimens are plotted on the map (Fig. 6), indicating a range from The Gambia to Cameroon in the Guinea savannah North of the main forest.

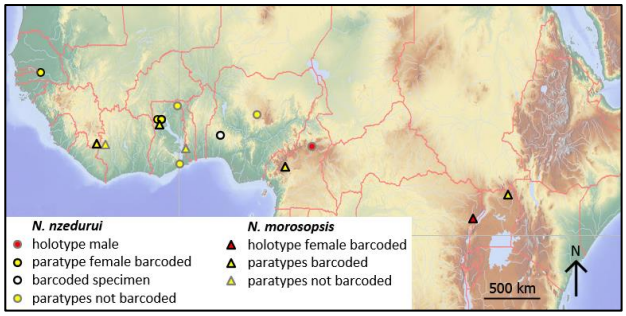

Figure 6 – Map showing capture localities for the specimens of *N. nzedurui* and *N. morosopsis* analysed in this study.

***Neptis morosopsis* sp. nov.** (Fig. 7)
urn: lsid:zoobank.org:pub:664D3404-6AE9-4524-97E8-0F2BFBD3ED16

Holotype ♀: Nyankunde, Democratic Republic of the Congo (DRC), 01°25' N, 30°02′ E, 1 200 to 1 300 m; 08.ii.2016, ABRI leg.
Paratypes: 9♂; 4♀; 2 unknown: data see Table 2 (p. 92).

Description of facies

Holotype Female, TD0033 (Fig. 7cd):
Wingspan: 4.1 cm. Forewing length: 2.3 cm. Antenna-wing ratio 0.46.
Head White spots at the base of each antenna, a pair of white spots between the eyes and a faint elongated white mark along the posterior lateral edge of each eye; palps white distad and greyish proximad; antennae black at the root, grading progressively to orange brown at the tip on the underside, on the upper side a sharply defined change from black to orange yellow for the terminal six segments.
Thorax Upper side black with a pair of small white spots formed by tufts of white scales at the junction of the head and thorax, various very faint white marks on the posterior half of the thorax. Underside and legs white.
Abdomen Upper side dark grey, a broken line along the posterior half of each side comprising a white mark on each segment, a thin white line below and a brownish line ventrad, a solid white ventral line terminating posteriad in a dark grey area (Fig. 4).
Wings Forewing upper side, background colour dark brown. Cell with two large circular white marks, a third smaller white mark proximad and a more elongate white mark at the base of the cell, a further three fainter white marks and two white marks at the distal end of the cell. A long discal band mark in space 2A rounded proximad and tapering distad, mark in space Cu2 shorter. The marks in spaces Cu1 and Cu2 well separated by ground colour, band in spaces Cu1 to R5 continuous with the veins only faintly marked and with a distinct notch proximad along vein M3, the distal edge of the band indented at the veins and the individual marks rounded distad. The discal band mark in space R3 narrowly separated from the mark in R5. A weakly defined post-discal band with spots in cells Cu1, M3, M2, M1and R3 the latter two being the largest. This band almost obsolete in the holotype. Three submarginal bands of short linear marks widely separated by dark ground colour at the veins, the separation broadest along veins M3 and R5, the proximal band mark in space R3 triangular pointing proximad. Outer margin scalloped with black tufts of cilia at the end of the veins and white cilia in between. Forewing underside, background colour lighter and more reddish brown, markings as upper side but larger and the third submarginal band nearest the margin well defined. The submarginal lines distinctly broken or shadowed at veins M3, M1 and R5. Hindwing upper side, precostal vein at base of wing marked with white scales. Discal band broad at approximately 40% of the length of the hindwing, indented at the veins distally, individual marks flat ended or only slightly curved distally, veins faintly marked. Post-discal band indistinctly marked lighter brown. Three submarginal bands, proximal band (hsm1) composed of rather diffuse, long, slightly curved dashes. Second band (hsm2) well defined and composed of pairs of short dashes either side of the veins. Distal submarginal band (hsm3) comprising pairs of indistinct dashes either side of the veins. Hindwing underside, narrow whitish band (hb1) along the costa extending from the base roughly one third of the way to the apex. Two further narrow bands, proximal band (hb2) extending from the inner margin and curving distally to parallel the costa with a narrow break before the distal extremity, distal band (hb3) extending from the inner margin curving to follow the proximal band and terminating with a small narrowly separated triangular spot. Discal band as upper side. Post-discal band a series of small fuzzy white spots extending from the inner margin and circling round the distal edge of the discal band with two spots on the anterior side of the discal band. Three submarginal bands well defined, proximal band (hsm1) comprising eight broad white spots in spaces 3A to Rs, middle band (hsm2) comprising curvilinear marks convex distally in the same spaces, a well-defined third submarginal band (hsm3) distad comprising long curved dashes bracketing veins Cu2 to M1. Outer margin scalloped with white cilia between the veins interrupted by black tufts at the veins.
Sclerotisation of the abdominal exoskeleton ♀ ostium plate on 8th sternite comprising a substantial, central, domed plate with wings extending dorsad either side. Posterior edge of 7th sternite sclerotisation broken at the centre with a triangular pocket anteriad (Fig. 8).

Paratype male, ABRI-164805 (Fig. 7ab):
Wingspan: 4.2 cm. Forewing length: 2.4 cm. Antenna-wing ratio: 0.43.

Wings Forewing markings as in the holotype. Hindwing markings as in the holotype, except veins Rs and M1 of the hindwing upper side marked pale yellow, almost reaching the proximal edge of the discal band (this marking is less distinct in some specimens).

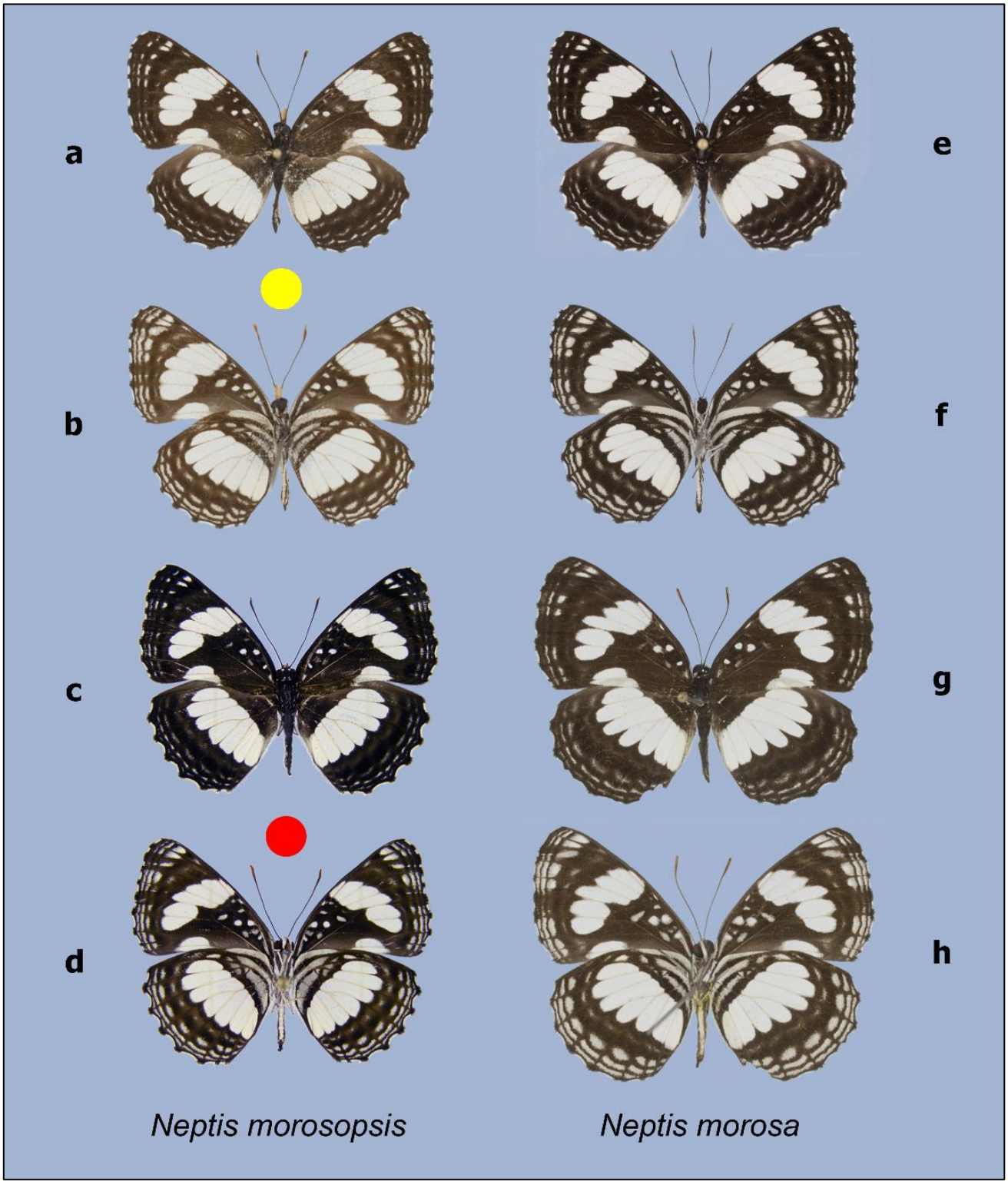

Figure 7 – *Neptis morosopsis* sp. nov. compared with *Neptis morosa* Overlaet, 1955. Left *Neptis morosopsis*: Paratype ♂: ABRI-164805; Mt Rom, N. Uganda; ix.2016; a) dorsal, b) ventral. Holotype ♀: TD0033; Nyankunde, DRC; 08.ii.2016; T. Desloges; c) dorsal, d) ventral. Right *Neptis morosa*: ♂: ABRI-164045; Koutaba, Cameroon; vi.2016; e) dorsal, f) ventral. ♀: ABRI-153075; Sovie Volta, Ghana; ix.2011; g) dorsal, h) ventral.

Genitalia: Uncus curved ventrad with hooked tip, valve with a long apical spine roughly in line with the axis of the valve and curving slightly distad, dorsal edge of the valve lacking a hump anteriad from the spine, a small projection (not always present on other specimens and of variable size and shape) on the ventral side of the root of the spine (Fig. 9). Aedeagus/valve length ratio 0.98.

Barcoding

Ten specimens have been barcoded, four males, four females and two not sexed (Table 2: p. 92). The barcodes of these 10 specimens are assigned to BIN BOLD:ACU3009, forming a low variance group with apwd 0.41%.

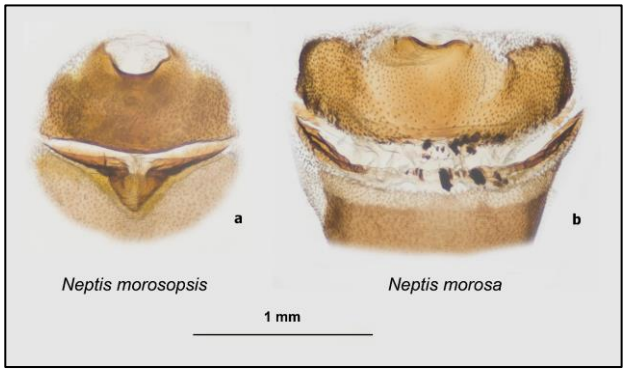

Figure 8 – Ostium plates of *Neptis morosopsis* sp. nov. and *Neptis morosa* Overlaet, 1955. a) *N. morosopsis*: IDR-A01948; Nyankunde, DRC; 08.ii.2016; Thomas Desloges. b) *N. morosa*: ABRI-164269; Koutaba, Cameroon; vii.2016.

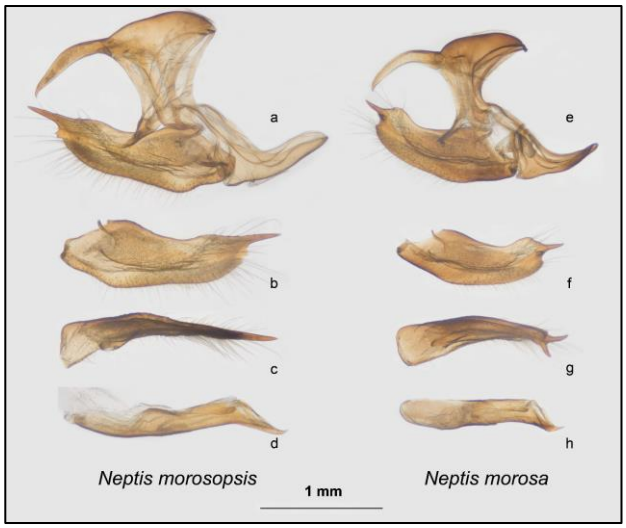

Figure 9 – Male genitalia of *Neptis morosopsis* sp. nov. and *Neptis morosa* Overlaet, 1955. Left *Neptis morosopsis*: ABRI-164730; Mole, Ghana; vi.2015; a) genitalia with aedeagus and right valve removed, b) right valve lateral view, c) right valve dorsal view, d) aedeagus lateral view. Right *Neptis morosa*: ABRI-164268; Koutaba, Cameroon, vii.2016; e) genitalia with aedeagus and right valve removed, f) right valve lateral view, g) right valve dorsal view, h) aedeagus lateral view.

Etymology

The taxon *morosopsis* has been chosen for a species with the "appearance of" *Neptis morosa*, ancient Greek opsis meaning appearance.

Material examined and distribution

Details of the 15 specimens examined are listed in Table 2 (p. 92). The capture localities for these specimens are plotted on the map (Fig. 6), indicating a range from Liberia to Uganda in a band North of the main forest.

DIAGNOSIS

Neptis nzedurui and *N. morosopsis* are very similar in appearance. They can be differentiated in the male by the presence of pale scaling on the basal section of the veins Rs and M1of the hindwing upper side. Both species have noticeably bright and large white markings on the upper side compared with *N. kiriakoffi*, which is a much duller butterfly in comparison.

Neptis morosa is easily confused with *N. morosopsis* and the two species fly together in W. Africa and further East to N. DRC and Uganda. *Neptis morosa* has the distal ends of the discal band markings on the hindwing distinctly rounded, whereas they have flatter ends in both *N. nzedurui* and *N. morosopsis*.

Many of the species in the Agatha group with spotted forewing cells are difficult to separate and a key is provided below to identify these species. The separation of the groups of species listed at steps 9 and 10 is well documented in Richardson (2019).

Partial key to the Agatha group species

1. Forewing cell with white spots on the upper side 2
   Forewing cell without white spots on the upper side 8
2. Tips of the antennae bright orange/yellow on the upper side (see Note 1) 3
   Tips of the antennae dull on the upper side 9
3. Dark shading of submarginal bands either side of vein M3 on the forewing underside 4
   No dark shading of submarginal bands on the forewing underside 5
4. Distal edge of individual marks in the hindwing discal bands rounded and bands deeply indented at the veins 6
   Distal edge of marks in hindwing discal bands more flattened and less deeply indented at the veins 7
5. Hindwing discal band broad (see Note 2) ..... *N. serena* Overlaet
   Hindwing discal band narrow ..... *N. kiriakoffi* Overlaet
6. Distal edge of anterior section of forewing discal band concave ..... *N. jordani* Neave
   Distal edge of anterior section of forewing discal band straight ..... *N. morosa* Overlaet
7. Hindwing upper side: veins Rs and M1 marked whitish in the male at the base and whitish suffusion present in the female ..... *N. morosopsis* sp. nov.
   Veins Rs and M1 not marked in the male and whitish suffusion absent in the female ..... *N. nzedurui* sp. nov.
8. Forewing cell unmarked on the upper side ..... *N. poultoni* Eltringham
9. Species in the Agatha group with antennae dark on the upper side ..... *N. laeta* Overlaet ..... *N. penningtoni* van Son ..... *N. larseni* Wojtusiak & Pyrez ..... *N. eltringhami* Joycey & Talbot
10. Species in the Agatha group with a radial club shaped mark in the forewing cell ..... *N. lermanni* Aurivillius ..... *N. nebrodes* Hewitson ..... *N. jamesoni* Godman & Salvin ..... *N. rothschildi* Eltringham

Note 1: For test No 2, note that the undersides of the antennae of many species are coloured a more reddish orange over about ¼ to ⅓ of the antenna length. Also, bear in mind that antennae often twist when a specimen is set out.

Note 2: For test No 5, wing length is measured from the wing root to the end of vein Cu2 and the discal band width is measured as the length of the mark in

cell M2, i.e. hd3. The ratios of discal band width/ wing length for 10 specimens of each of the two species to be differentiated are as follows:

- *N. serena*; average 45.3%, σ = 2.1%, broad discal band
- *N. kiriakoffi*; average 39.6%, σ = 1.6%, narrower discal band

For the specimens examined, the hindwing discal band width criterion is unambiguous for separating *N. kiriakoffi* and *N. serena*.

Neptis nzedurui is generally a larger species than *N. morosopsis*, as can be seen from Tables 1 and 2 (p. 92). This difference showed promise for as a character to separate these two species. For the specimens examined and sexed, the forewing lengths are as follows:

- *N. nzedurui* ♂ 2.71 cm (N=4), σ = 0.09
  N. morosopsis ♂ 2.48 cm (N=9), σ = 0.08
- *N. nzedurui* ♀ 2.90 cm (N=4), σ = 0.13
  N. morosopsis ♀ 2.50 cm (N=4) , σ = 0.17

Although the forewing length difference is evident when comparing series of the two species, examination of Tables 1 and **Error! Reference source not found.** (p. 92) shows that it fails as a distinguishing criterion in the case of the two male specimens of *N. nzedurui* from The Gambia. These are small specimens, and their forewing length falls well within the range for *N. morosopsis*.

In the event that a diagnosis based on the facies is indeterminate, dissection may resolve the identification of a specimen in some cases. *Neptis morosopsis* and *N. morosa* are easily separated, in both sexes, by dissection. The valve of *N. morosa* has a spur at the base of the apical process that is almost as long as the apical process itself (Fig. 9). The spur is not present in *N. morosopsis* and for that matter in *N. nzedurui* or *N. kiriakoffi*. In the female, *N. morosa* has only vestigial sclerotisation on the posterior edge of the 7th sternite without a pocket, whereas *N. morosopsis*, *N. nzedurui* and *N. kiriakoffi* have much more substantial sclerotisation with a distinct pocket on the 7th sternite (Figs 5, 8).

Based on four dissected specimens, the valve of *N. nzedurui* has a definite hump on the dorsal edge anteriad from the base of the terminal process or spine (Fig. 3). This is not present in *N. morosopsis or N. kiriakoffi* (Figs 3, 9), and so is a useful character to distinguish *N. nzedurui* from the other two species.

Note that *N. morosa* also has a very distinct hump on the dorsal side of the valve (Fig. 9), but the spur eliminates any confusion with *N. nzedurui*.

Other characters of the genitalia are not distinctive though:

- the tooth on the ventral side of the apical process is a variable feature in *N. nzedurui*, *N. morosopsis* and *N. kiriakoffi*, being present in some specimens, double pointed in others or even entirely absent.
- the mean aedeagus/valve length ratios measured are: *N. nzedurui*, 1.04 (N=2); *N. morosopsis*, 1.01 (N=2); *N. kiriakoffi*, 0.98 (N=1); not distinctive in view of variability within each species.
- in the females, two specimens of *N. nzedurui* have a distinctive straight sided pocket on the 7th sternite, whilst the third has a more rounded pocket similar to that of *N. kiriakoffi* and *N. morosopsis*.

The four species, discussed above, that can potentially be confused on the external morphology, are very clearly separated by barcode. They each comprise populations with low barcode variance (intra-species apwd) in comparison with the barcode separation between populations (inter-species apwd) (Table 3: p. 92). The intra-species apwd is shown along the diagonal of Table 3 (p. 92) and the remaining cells show the inter-species apwd. It is recommended that specimens that do not appear to fit with any described species be submitted for barcoding. At the time of writing this might be done through the author or the BED (Butterfly Evolutionary Diversity) project for example.

DISCUSSION

Both of the new species have undoubtedly been collected widely in West Africa already and attributed to *N. kiriakoffi*.

Coache *et al.* (2017) illustrates two specimens from Benin identified as *N. kiriakoffi*, but likely to be *N. nzedurui* judging by the comparatively large wingspan. In the text the wingspan is given as 40 to 57 mm suggesting that both the smaller *N. morosopsis* and the larger *N. nzedurui* are included under the taxon *N. kiriakoffi*. The species is stated to be common in open areas in the Sahel and in wooded savannah.

Larsen (2005) lists *N. kiriakoffi* from West Africa and gives a forewing length of 24 mm, consistent with the smaller *N. morosopsis*. Larsen states that it is sometimes common in the Guinea savannah in tall grass where several specimens may congregate to suck dew from the grass stems. The illustration though, in Larsen (2005), is of *N. kiriakoffi* from Kenya and the description appears to be of that species as well.

Bivar-de-Sousa *et al.* (2016) lists *N. kiriakoffi* for Guinea-Bissau and states the forewing length to be 24 mm, again suggesting the smaller *N. morosopsis*. It inhabits the Guinea savannah and is categorised as “frequent”.

All three references list food plants, but these possibly refer to records for *N. kiriakoffi* from the eastern side of the continent.

Table 1 – Details of specimens of *N. nzedurui* examined. The sex of the specimen JQ733362 is not known.

Specimen	Locality	Capture Date	Collection (Collector)	Barcode	Forewing length (cm)
Holotype ♂ ML-96249	Ngaoundere, Cameroon	ii.1989	Michel Libert		2.70
Paratype ♀ ABRI-153071	Mole, Ghana	ix.2014	ABRI	ANEPT082-15 (658 bp)	2.87
Paratype ♀ ABRI-153072	Mole, Ghana	ix.2014	ABRI	ANEPT083-15 (658 bp)	2.84
Paratype JQ733362	Nr Ogbomosho Nigeria	7.vii.2010	(Chinyere Nzeduru)	GBMIN26474-13 (303 bp)	Unknown
Paratype ♀ ABRI-180190	Shai Hills, Volta, Ghana	8.xi.2008	ABRI (Steve Collins)		3.09
Paratype ♀ ABRI-172300	Nakpanduri, Ghana	vii.2006	ABRI		2.81
Paratype ♂ ML-96259	Kachia, Nigeria	27.vii.1993	Michel Libert		2.71
Paratype ♂ IDR-A02732 MN-GEN-043	7 km E. Basse The Gambia	12.x.2008	Ian Richardson ex coll Mike Newport (Jon Baker)	ANEPT1023-20 (616 bp)	2.64
Paratype ♂ IDR-A02733 MN-GEN-044	7 km E. Basse The Gambia	12.x.2008	Ian Richardson ex coll Mike Newport (Jon Baker)	ANEPT1024-20 (639 bp)	2.52

Table 2 – Details of specimens of *N. morosopsis* examined. The sex is only shown for specimens that have been dissected.

Specimen	Locality	Capture Date	Collection (Collector)	Barcode	Forewing length (cm)
Holotype ♀ TD0033	Nyankunde, DRC	08.ii.2016	ABRI (Thomas Desloges)	ANEPT935-18 (658 bp)	2.29
Paratype ♂ ABRI-164805	Mt Rom, Uganda	ix.2016	ABRI	ANEPT829-17 (658 bp)	2.41
Paratype ♂ ABRI-152852	Nimba Mts, Liberia	22.i.2014	ABRI	ANEPT227-15 (658 bp)	2.58
Paratype ABRI-152853	Nimba Mts, Liberia	22.i.2014	ABRI	ANEPT228-15 (633 bp)	Unknown
Paratype ♀ ABRI-152854	Nimba Mts, Liberia	22.i.2014	ABRI	ANEPT229-15 (658 bp)	2.43
Paratype ♀ ABRI-152855	Nimba Mts, Liberia	22.i.2014	ABRI	ANEPT230-15 (658 bp)	2.64
Paratype ABRI-152856	Nimba Mts, Liberia	22.i.2014	ABRI	ANEPT231-15 (658 bp)	Unknown
Paratype ♀ ABRI-153073	Mole, Ghana	ix.2014	ABRI	ANEPT084-15 (658 bp)	2.62
Paratype ♂ ABRI-153078	Koutaba, Cameroon	v.2014	ABRI	ANEPT089-15 (658 bp)	2.49
Paratype ♂ ABRI-164044	Koutaba, Cameroon	vii.2016	ABRI	ANEPT692-17 (658 bp)	2.42
Paratype ♂ ABRI-164730	Mole, Ghana	vi.2015	ABRI		2.46
Paratype ♂ ABRI-172299	Lipke Mate, Ghana	viii.2006	ABRI		2.37
Paratype ♂ IDR-A01874	Mt Tonkui, Côte d'Ivoire	01–10.iii.2016	Ian Richardson (Patrick Boireau)		2.60
Paratype ♂ IDR-A01875	Mt Tonkui, Côte d'Ivoire	01–10.iii.2016	Ian Richardson (Patrick Boireau)		2.51
Paratype ♂ IDR-A01876	Mt Tonkui, Côte d'Ivoire	01–10.iii.2016	Ian Richardson (Patrick Boireau)		2.45

Table 3 – Barcode apwd within and between series of *N. nzedurui, N. morosopsis, N. kiriakoffi* and *N. morosa*.

	N. kiriakoffi	***N. nzedurui***	***N. morosopsis***	***N. morosa***
N. kiriakoffi	0.4%			
N. nzedurui	5.4%	0.6%		
N. morosopsis	4.2%	5.1%	0.4%	
N. morosa	6.0%	7.1%	7.2%	0.6%

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LITERATURE CITED

BIVAR-DE-SOUSA, A., VASCONCELOS, S., MENDES, L.F., LARSEN, T.B., BAKER, J. & GUILHERME, J.L. 2016. Butterflies of Guinea-Bissau: VIII. New data, new reports, corrections and biodiversity (Lepidoptera: Papilionoidea). *Zootaxa* **4201 (1):** 001–077.

COACHE, A., RAINON, B. & SINZOGAN, A. 2017. *Atlas illustré des Rhopalocères du Bénin.* CEREB (Centre d'Etudes et Recherches Entomologiques Béninois), Université d'Abomey.

KUMAR S. STECHER G. & TAMURA K. 2016. MEGA7: Molecular Evolutionary Genetics Analysis version 7.0 for bigger datasets. *Molecular Biology and Evolution* **33**: 1870–1874.

LARSEN T.B. 2005. *Butterflies of West Africa*. Apollo Books, Svendborg, Denmark: 1–595pp. (text) & 1–270 (plates).

NZEDURU, C.V., RONCA, S. & WILKINSON, M.J. 2012. DNA barcoding simplifies environmental risk assessment of genetically modified crops in biodiverse regions. *PloS ONE* **7(5)**: e35929. doi:10.1371/journal.pone.0035929

OVERLAET F.G. 1955. *Danaidae, Satyridae, Nymphalidae, Acraeidae.* Exploration du Parc National de l'Upemba, Institut des Parcs.

RICHARDSON, I.D. 2019. Revision of the genus *Neptis* (Lepidoptera, Nymphalidae) in the Afrotropical Region: Currently described taxa. *Metamorphosis* **30**: 69–221.

GAZETTEER

Where altitude is not specified on the specimen labels, it has been deduced using Google Earth. In hilly or mountainous terrain, a range of altitudes is given when the specific altitude of capture within a locality is unknown.

Locality	Country	Latitude (deg°min′sec″)	Longitude (deg°min′sec″)	Altitude (m)
Basse (7 km E.)	The Gambia	13°18′ N	14°06′ W	50
Kachia	Nigeria	09°55′ N	07°58′ E	700 – 800
Kalwe Forest Reserve	Malawi	11°36′ S	34°15′ E	600
Koutaba	Cameroon	05°42′ N	10°49′ E	1 100 – 1 300
Lipke Mate	Ghana	07°11′ N	00°37′ E	400 – 750
Lubemba	DRC	10°54′30″ S	28°32′30″ E	1 050
Mole	Ghana	09°30′ N	02°00′ W	200 – 250
Nakpanduri	Ghana	10°38′ N	00°11′ W	400
Ngaoundere	Cameroon	07°20′ N	13°35′ E	1 000 – 1 200
Nimba Mts	Liberia	07°34′ N	08°30′ W	600 – 1 100
Nkhorongo	Malawi	11°23′ S	33°59′ E	1 375
Nyankunde	DRC	01°25' N	30°02′ E	1 200 – 1 300
Ogbomosho	Nigeria	08°14′ N	04°15′30″ E	350
Rom Mt.	Uganda	03°24′ N	33°36′ E	1 300 – 2 300
Shai Hills	Ghana	05°55′ N	00°04′ E	200
Sovie Volta	Ghana	06°57′ N	00°17′ E	140
Tonkoui, Mt.	Côte d'Ivoire	07°28′ N	07°32′ W	800