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New data on Old World Polyorthini. The genus *Lopharcha* Diakonoff, 1941 recorded from the Canary Islands (Spain) and Tanzania (Lepidoptera: Tortricidae)

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Abstract

Dichelia constanti Rebel, 1894 is transferred to the genus *Lopharcha* Diakonoff, 1941 resulting in the combination *Lopharcha constanti* (Rebel, 1894) comb. n. *Lopharcha africana* Aarvik, sp. n. is described from Tanzania. *Kanaria* Larsen, 2020 is synonymized with *Lopharcha* Diakonoff, 1941, syn. n. These are the first records of *Lopharcha* from the Afrotropical region and the western part of the Palaearctic region.
KEY WORDS: Lepidoptera, Tortricidae, new species, new records DNA-barcodes, new synonym, Canary Islands, Spain, Tanzania.

Nuevos datos sobre los Polyorthini del Viejo Mundo. El género *Lopharcha* Diakonoff, 1941 registrado de las Islas Canarias (España) y Tanzania (Lepidoptera: Tortricidae)

Resumen

Dichelia constanti Rebel, 1894 es transferida al género *Lopharcha* Diakonoff, 1941 resultando la combinación *Lopharcha constanti* (Rebel, 1894) comb. n. Se describe de Tanzania *Lopharcha africana* Aarvik, sp. n. *Kanaria* Larsen, 2020 se sinonimiza con *Lopharcha* Diakonoff, 1941, syn. n. Estos son los primeros registros de *Lopharcha* para la región Afrotropical y el oeste de la región Palaeártica.
PALABRAS CLAVE: Lepidoptera, Tortricidae, nueva especie, nuevos registros del código de barras ADN, nuevas sinonimias, Islas Canarias, España, Tanzania.

Introduction

CLARKE (1955) characterized a small group of Tortricidae genera as follows: "A unique group of the Tortricidae consisting of the four closely related genera *Ardeutica*, *Atteria*, *Polyortha*, and *Pseudatteria* is peculiar in that the harpe [= valva] of the male is split longitudinally along the ventral edge, forming a longitudinal pocket for the reception of an abdominal hair-pencil. The four genera are South American". In his revision of the Neotropical *Pseudatteria* OBRAZTSOV (1966) gave the group formal rank as a tribe, Polyorthini. DIAKONOFF (1974) reported the tribe from the Indo-Australian region and assigned a number of genera and species to Polyorthini. Prior to his revision, many of the species had been misplaced in *Acleris* Hübner, [1825]. RAZOWSKI (1979) realized that the enigmatic Palaearctic (and European) genera *Olindia* Guenée, 1845 and *Isotrias* Meyrick, 1895 also belong to Polyorthini. Together with the tribes Hilarographini and Chlidanotini, the Polyorthini constitute the

subfamily Chlidanotinae (HORAK & BROWN, 1991), and molecular data (REGIER *et al*., 2012) indicate that Polyorthini is the earliest branching group of Tortricidae.

Polyorthini was recorded from the Afrotropical region as late as in 2000 by RAZOWSKI & TUCK (2000) who transferred the genus *Ebodina* Diakonoff, 1968 from Tortricini to Polyorthini. They also described the genus *Xeneboda* Razowski & Tuck, 2000, from West Africa. Currently two species of *Ebodina* and three species of *Xeneboda* are known from Africa and Madagascar (DE PRINS & DE PRINS, 2011-2021).

The largest genus of Polyorthini in the Old World is *Lopharcha* Diakonoff, 1941 with 23 species distributed from India and Nepal in the west to New Zealand and Japan in the east (GILLIGAN, 2003-2019). DIAKONOFF (1974) performed a comprehensive revision of the 17 species known to him and diagnosed the genus. The assignment of the two species dealt with here to *Lopharcha* represents a huge extension of the known geographical range of the genus. Arguments for the assignment are presented below.

Material and methods

Most of the specimens from the Canary Islands were attracted to an 8 watts super actinic light. The specimens from Tanzania were attracted to mercury vapour bulbs run by a portable generator. Genitalia were dissected following ROBINSON (1976). Specimens from the Canary Islands were photographed with a Canon EOS 700D camera equipped with a Canon EF 100 mm objective and the Tanzanian specimen with the Microptics photographic system. The genitalia slides of material from the Canary Islands were photographed using a Soptop CX40T Trinocular microscope in conjunction with a Toup Tek P10500A-E3 / E3ISPM05000KPA-E3 / 5.0MP USB3 camera. Photos of the genitalia of the Tanzanian material were taken through a Leica DM 6000B microscope using a Leica DFC 420 digital camera.

DNA samples were prepared from dried legs according to the prescribed standards and processed at the Canadian Centre for DNA Barcoding (CCDB, Biodiversity Institute of Ontario, University of Guelph) to obtain the 658 base-pair long barcode fragment of the mitochondrial COI gene (cytochrome c oxidase I). Intra- and interspecific distances of DNA barcode fragment were calculated using analytic tools of BOLD with the Kimura 2-parameter model of nucleotide substitution. Genetic clusters are presented with their barcode index number (BIN; cf. RATMNASINGHAM & HERBERT, 2013).

We examined the DNA Barcode from *Lopharcha constanti* (Rebel, 1894) from the islands of Gran Canaria, La Gomera and Tenerife (Canary Islands, Spain).

Abbreviations used

GP	Genitalia preparation
PF	Collection of Per Falck, Neksø, Denmark
MNCN	Collection of Antonio Vives, Museo Nacional de Ciencias Naturales, Madrid, Spain
NHMO	Natural History Museum, University of Oslo, Oslo, Norway
NHMUK	The Natural History Museum, London, United Kingdom
ZMUC	Zoological Museum, Natural History Museum of Denmark, Copenhagen, Denmark

Taxonomy

Genus *Lopharcha* Diakonoff, 1941
Lopharcha Diakonoff, 1941. *Treubia*, **18**: 424
Type species: *Lopharcha quinquestriata* Diakonoff, 1941
Type locality: INDONESIA, Java
= *Canaria* Larsen, 2020, **syn. n.**
Canaria Larsen, 2020a. *SHILAP Revta. lepid*., **48**(190): 325

Type species: *Canaria palmariana* Larsen, 2020
Type locality: SPAIN, La Palma
= *Kanaria* Larsen, 2020, **syn. n.**
Kanaria Larsen, 2020b. *SHILAP Revta. lepid*., **48**(191): 512 (Replacement name for *Canaria* Larsen, 2020 which is a homonym of *Canaria* Partington, 1835)

Lopharcha is characterised externally by the relatively narrow hindwing and the pointed forewing with tufts of raised scales. The male genitalia are typical for the tribe, with long and narrow uncus, gnathos with medial arm, and large, oval, split valva. The phallus is of variable shape. In the female genitalia the signum may be entirely missing or consist of one or two bundles of dense, slender, and diverging spines, or consist of a concave and scobinate sclerite. In the two species treated in the present work, the signum is represented by numerous spines. The ductus bursae is membranous, often with sclerite in posterior part; it varies in length and width. DIAKONOFF (1974) compared *Lopharcha* with *Polylopha* Lower, 1901, a genus with mainly Asian and Australian distribution. This genus has broader hindwing, a spined sacculus in the male genitalia, and in the female genitalia a large signum of unique shape (DIAKONOFF, 1974). *Polylopha* is a compact genus of closely allied species, whereas *Lopharcha* is much more diverse. Future research may show that *Polylopha* is a specialized branch subordinate under *Lopharcha*. In that case the former generic name would have priority. In our view the separation of the Canary Islands taxa from *Lopharcha* at the genus level will make *Lopharcha* polyphyletic and eventually lead to additional splitting. LARSEN (2020a) separated *Kanaria* (as *Canaria*) from *Lopharcha* based on the presence of (1) the spiny bursa in the female, the presence of (2) a cubital pecten in both sexes, and (3) the presence of a blotch of stronger scales on the base of the underside of the forewing. He also mentioned (4) that in the male genitalia *Kanaria* differs from *Lopharcha* in the strongly sclerotized and curved vinculum, the very large phallus without cornuti, the lack of a large coremata tuft on the eight sternite and the lack of the large anellus plate found in the type species of *Lopharcha*. However, the configuration of the sclerites inside the corpus bursae in *Lopharcha* is not uniform. Using the type of signum as a main criterion for generic division, would lead to the splitting of *Lopharcha* into at least three separate genera. The presence or absence of specialized scales on the forewing underside is a character of the species level. The presence of a cubital pecten in *Kanaria* should be confirmed. It is missing in the examined material of *Lopharcha constanti* (Rebel, 1894), a species closely related to the two species described by LARSEN (2020a). The absence of a cubital pecten is universal in the subfamily Chlidanotinae (HORAK & BROWN, 1991). The characters in the male genitalia mentioned by LARSEN (2020a) separating *Kanaria* from the type species of *Lopharcha*, *L. quinquestriata* Diakonoff, 1941, may be correct, but they do not separate *Kanaria* from other species of the genus; compare figures in DIAKONOFF's (1974) work. That the coremata are missing can be considered as a secondary loss. There are several cases in Lepidoptera where secondary sexual characters are present in one and missing in another of two closely related species. It is worth mentioning that Kevin TUCK, former curator of the Tortricidae in NHMUK, London, identified a specimen from La Palma as belonging to the genus *Lopharcha*. Consequently, we consider *Kanaria* Larsen, 2020 as a synonym of *Lopharcha* Diakonoff, 1941, **syn**. **n**.

Lopharcha constanti (Rebel, 1894), **comb. n.** (Figs1-4)
Dichelia constanti Rebel, *in* REBEL & ROGENHOFER, 1894. *Annln naturh. Mus. Wien*, **1894**: 85
Type locality: SPAIN, Tenerife, La Laguna.
Epagoge constanti, WALSINGHAM, 1908. *Proc. zool. Soc. Lond.*, **1907**: 993
Hastula constanti, KLIMESCH, 1987. *Vieraea*, **17**: 300
Avaria constanti, BROWN, 2005. *World Cat. Insects*, **5**: 145; VIVES MORENO, 2014. *Cat. sist. sin. Lep*., **2014**: 230

Material examined: SPAIN, Gran Canaria, Los Tilos de Moya, 500 m, 11 ♂♂, 8 ♀♀, 11-24-VI-2018, leg. P. Falck (PF, MNCN), genitalia slides 3365PF, 3366PF, 3368PF, 3370PF, DNA sample Lepid Phyl 0531PF/CILEP0531-20; same data but, 1 ♀, 17-30-IX-2018, leg. P. Falck (PF), genitalia slide 3546PF; same data but, 2 ♀♀, 4-23-III-2019, leg. P. Falck (PF), DNA samples Lepid Phyl 0529PF/CILEP0528-

20, 0530PF/CILEP0529-20; same data but 2 ♂♂, 8-20-VIII-2020, leg. P. Falck (PF), genitalia slide 3604PF; Barranco de Azuaje, 270 m, 1 ♂, 8-20-VIII-2020, leg. P. Falck (PF); same data but, 1 ♂, 9-22-VI-2021, leg. P. Falck (PF), DNA sample Lepid Phyl 0929PF/CILEP0928-21; La Gomera, El Cedro, 650 m, 1 ♀, 9-12-VIII-2021, leg. P. Falck (PF), genitalia slide 3550PF, DNA sample Lepid Phyl 0930PF/CILEP0929-21; La Palma, Barranco Nogales, 500 m, 1 ♀, leg. P. Stadel Nielsen (ZMUC), genitalia slide KRT/La Palma "Lopharcha sp. det. K. Tuck"; Tenerife, Las Mercedes, 750 m, 8 ♀♀, 13-26-VIII-2019, leg. P. Falck (PF), DNA samples Lepid Phyl 0528PF/CILEP0527-20, 0526PF/CILEP0525-20.

Redescription male (Fig. 1): Wingspan 10-12.5 mm. Head and neck brown to yellowish brown, rough scaled. Labial palps relatively long (approximately 2.5 diameter of the eye) and straight, segment 2 dorsally with long and rough scales, yellowish brown, laterally dark brown, and lighter medially, segment 3 short, brown to yellowish brown, with lighter tip. Antenna slightly shorter than half of forewing length, weakly ringed dark brown and yellowish, with short cilia, before middle with few rough scales at each segment. Tegula and thorax brown to yellowish brown. Forewing narrow, costa evenly curved towards pointed apex, termen very oblique, concave below apex; colour brown with admixture of yellowish brown, black and reddish scales, base dark brown, before 1/3 an oblique lighter brown fascia, slightly widening towards dorsum, medially edged by 3-4 diffuse black spots, with few raised scales, almost forming a transverse line, distally edged by black brown and red scales, distal part of forewing with some indistinct brown and reddish transverse lines, apical spot diffuse black, terminal spots black, diffuse. Fringes of the same colour as the wing; underside yellowish brown. Hindwing quite narrow and pointed, termen oblique and strongly concave, light brown to yellowish brown, towards apex more greyish, at the base a tuft of long hairy scales. Fringes of the same colour as the wing, fringe-line darker brown. Abdomen brown to yellowish brown, apically yellowish. Female (Fig. 2): Wingspan 10-14.5 mm. Generally, much darker blackish brown, and without the characteristic yellowish-brown colour seen in the male. Wing pattern similar to that of male, but the black spots edging the median fascia has many raised scales, the indistinct transverse lines are reddish, and the scale tuft at the base of hindwing is large.

Genitalia male (Fig. 3): Uncus long and slender, slightly tapering towards apex; socii relatively large, rounded, covered by medium long setae; gnathos well developed, heavily sclerotized, subtriangular, hook-shaped in lateral view; tegumen short, rounded posteriorly; valva relatively large, membranous, consists of two layers with a longitudinal slit laterally (genitalia in situ), about 1/3 from costa; medial layer with costa arched towards pointed apex, dorsum almost straight until fl before apex, sparsely covered with setae; lateral layer with less arched costa and covered with medium long setae, especially along costa; vinculum well sclerotized rounded; juxta subrectangular, covered with small spikes; phallus as long as valva, straight. Culcita placed on U-shaped sternit VIII (Fig. 3a) with ventrally long scales (The scales are easily lost during genitalia dissection).

Genitalia female (Fig. 4): Papillae anales elongate, as long as posterior apophysis, densely covered by setae; posterior apophysis slightly longer than anterior apophysis; sterigma rounded posteriorly, funnel-shaped; colliculum narrow and membranous; ductus bursae membranous, slightly widening anteriorly, narrowing just before corpus bursa; corpus bursae round, almost completely covered by short spikes; bulla seminalis large.

DNA barcodes: We obtained full length DNA barcodes (658 bp) from two specimens and DNA barcode fragments of 643bp and 622bp from two specimens from the island of Gran Canaria, full length DNA barcodes (658 bp) from two specimens from the island of Tenerife. The barcodes fall within Barcode Index Number (BIN) BOLD: AEE9965. We also obtained full length DNA barcodes (658 bp) from one specimen from the island of La Gomera, with Barcode Index Number AEN8025. The intraspecific maximum p-distance is 0.48% in the Tenerife/ Gran Canaria population, but the minimum p-distance is 5.76% to the La Gomera specimen. The minimum p-distance to the nearest neighbour, an unidentified Tortricidae species from Asia, is 6.67%, with the Barcode Index Number (BIN) BOLD: ADI6186.

A high intraspecific variation in COI between the specimens from separate islands of the Canary

Islands, in this case La Gomera and Tenerife/Gran Canaria, is quite common (FALCK *et al*., 2021), it has been observed in several families e. g. Tineidae, Scythrididae, Cosmopterigidae, Tortricidae (P. Falck, unpublished).

Remarks: *Dichelia constanti* was described by REBEL (1894) on the basis of three unevenly preserved specimens collected by A. Cabrera at La Laguna, Tenerife. We have not been able to trace the type specimens in the Cabrera collection, in the Museo Nacional de Ciencias Naturales, Madrid, or in the Natural History Museum, Vienna, and the specimens are probably lost. However, thanks to Rebel's detailed and very precise description of the wing-pattern, colour and the characteristic shape of both fore- and hindwings, we are convinced of the identity of this species. Further, a part of the examined material was collected close to the type locality. The host-plant of *L. constanti* is unclear, Rebel wrote "Señor Cabrera, welcher mir mittheilte, dass er diese Art auf Tenerife (Laguna) im Mai und Juni angetroffen habe, wo die Raupe auf *Datura stramonium* lebe". This can be interpreted as the specimens were collected as adult, and larvae were present living on *Datura stramonium* L.- not necessarily larvae of *L. constanti.* This assumption is supported by WALSINGHAM (1908) "This is one of the very few species, recorded from Tenerife, which I was unable to find, although I searched on *Datura stramonium,* at La Laguna, in May and June".

It is necessary to establish the following new combinations:

Lopharcha constanti (Rebel, 1893), **comb. n.**, present in Tenerife and Gran Canaria.
Lopharcha palmariana (Larsen, 2020), **comb. n.**, present in La Palma.
Lopharcha gomeriana (Larsen, 2020), **comb. n.**, present in La Gomera.

***Lopharcha africana* Aarvik, sp. n.** (Figs 5-9)

Type material: Holotype, ♂, TANZANIA: Iringa Reg., Mufindi Distr., Kigogo Forest. 1900 m, 23-25-XI-2005, L. Aarvik, M. Fibiger, A. Kingston, genitalia slide NHMO 1777 (NHMO). Paratypes, 3 ♂♂, 3 ♀♀, same data as holotype, genitalia slide ♂ NHMO 1776, ♀ NHMO 1778 (NHMO); 1 ♀ in MNCN.

Diagnosis: There is no species of Tortricidae known from Africa, with which *L. africana* sp. n., could be confused. It shares with species of the genus *Acleris* (subfamily Tortricinae, tribe Tortricini) the presence of groups of raised scales in the forewing. However, in the latter genus the forewing has a sub-rectangular shape, whereas in *Lopharcha* the forewing is more arched and apically prolonged. Further, the hindwing is narrower in *Lopharcha* than in members of *Acleris*. The genitalia differ profoundly from those of *Acleris*.

Description of male: wingspan 14.5 mm. (n = 4). Antennae brownish grey, with appressed scales and minutely ciliate, each segment basally white. Labial palpi (Fig. 6) 2.4 times diameter of eyes, with white-tipped brownish grey scales, second segment with broad, fan-shaped scale brush, third segment slightly protruding from scale brush of second segment. Head and thorax brownish grey, scales white tipped. Forewing relatively narrow, costa evenly curved towards pointed apex, termen concave below apex; ochreous brown in tornal and sub-terminal third, the same colour forms an oblique band from one third of costa and a small patch at mid costa; remaining part of wing dark grey. Tufts of raised scales present at one third from base, in the middle, and at two thirds from base. Cilia grey, with darker grey base. Hindwing narrow apically pointed; brownish grey, cilia concolorous with wing, with darker basal line. Legs beige, fore- and midleg with grey suffusion on tibiae and tarsus, on tarsus forming rings. Abdomen grey dorsally, beige ventrally, segment VIII with lateral tufts of large, oval scales (Fig. 7).

Description of female: wingspan 17.5-18.0 mm. (n = 4). Apart from larger size and lack of abdominal scale tuft, externally similar to male.

Genitalia male (Fig. 8): Tegumen higher than broad, the pedunculi are strongly developed; uncus long and slender, slightly narrowed medially; socii weak; gnathos with band-like lateral arms, medial process with triangular base and rod-like extension; transtilla laterally broad, narrow and nearly divided in middle; anellus bilobed, set with denticles; juxta a rounded plate, excavated on top; valva broadly

oval, with deep split throughout; phallus cylindrical, with rod-like apical process. Coremata (Fig. 8a) as lateral bundles of hair-like scales are well developed.

Genitalia female (Fig. 9): Papillae anales slender, broadened in posterior half; apophyses posteriores slightly longer than apophyses anteriores; sterigma broad, saddle-shaped, with medial convexity; ductus bursae short and broad, sclerotized in middle; corpus bursae oval, posteriorly with dentate area; ductus seminalis inserted posteriorly into corpus bursae.

Variation: In the forewing the ochreous parts may be more or less replaced by dark grey, making the wing nearly unicolorous.

Remarks: A short and broad phallus in the male genitalia, resembling the one in *Lopharcha africana* n. sp., is present in *L. rapax* (Meyrick, 1908) from Sri Lanka and *L. cryptacantha* Diakonoff, 1974 from India. Judging from DIAKONOFF's (1974: fig. 42a) illustration the phallus in *L. cryptacantha* has a rod-like apical extension which parallels the one present in *L. africana* sp. n. The short and broad ductus bursae in the female genitalia is unlike the one present in other species of the genus. However, the variation is considerable and *L. amethystas* (Meyrick, 1912) has a relatively wide and short ductus approaching the one found in the African species. The male genitalia of *L. africana* sp. n. fit perfectly well in *Lopharcha*, whereas the female genitalia indicate an isolated position.

Discussion: We are not able to decide whether the genus *Lopharcha* consists of one or three species from the Canary Islands. It was not possible for us to study the holotypes of *L. gomeriana* and *L. palmariana,* described from a single male and a single female respectively. Due to the lack of additional specimens from La Gomera and La Palma we hesitate to synonymize these species. However, we did not observe any morphological differences in the females between the populations from Tenerife / Gran Canaria, La Gomera and La Palma.

Lopharcha constanti is probably an endemic species and could be an old relict connected with the occurrence of the Laurisilva forest as stated by LARSEN (2020a: 329). This is supported by the fact that all known specimens are recorded at the edge or near Laurisilva forest and that the first known specimens are recorded more than a hundred years ago, long before the intense international traffic began.

The type locality of *L. africana* sp. n., Kigogo Forest, is situated in the Southern Highlands of Tanzania, which is a part of the Eastern Arc (WASSER & LOVETT, 1993), a disjunct range of ancient mountains in south-eastern Kenya and eastern Tanzania. The forests of these mountains were characterised as a hot-spot by MYERS (1990), indicating that they feature exceptional concentration of endemic species (MYERS, 1988). Today only fragments of these forests remain.

The present records of *Lopharcha* from the Canary Islands and Tanzania represent a huge extension of range for this group of moths. Both species are from isolated high-altitude forests which in periods of the past were much larger than today (BRAMWELL & BRAMWELL, 2001; CLARKE, 2003). Thus, we can assume that the two species described here are remnants of an old lineage which was once more widespread and diverse.

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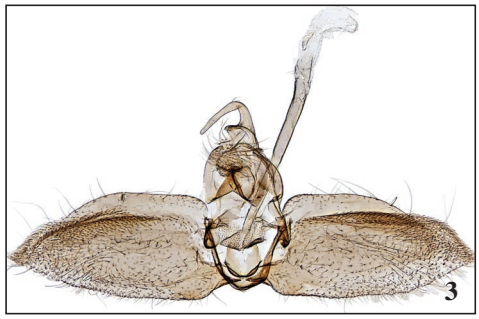
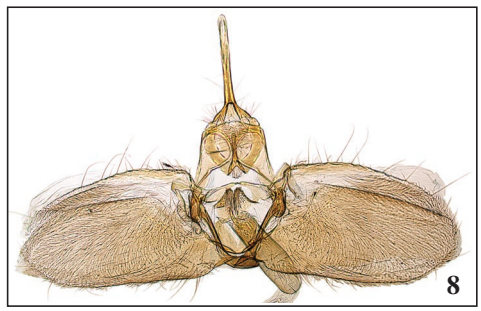
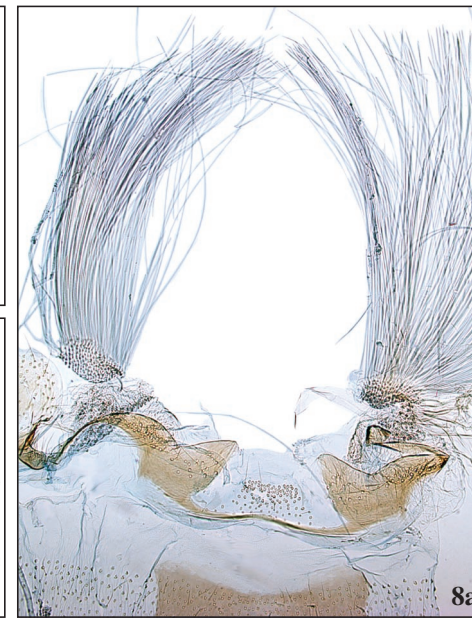


Figs 1-4.– 1. *Lopharcha constanti* (Rebel, 1894), ♂, Gran Canaria, 10.5 mm. **2.** *Lopharcha constanti* (Rebel, 1894), ♀, Gran Canaria, 12.5 mm. **3.** *Lopharcha constanti* (Rebel, 1894), ♂, GP3370PF. **3a.** Coremata, GP3370PF. **4.** *Lopharcha constanti* (Rebel, 1894), ♀, GP3367PF.





Figs 5-9.– 5. *Lopharcha africana* Aarvik, sp. n., Tanzania, 18.0 mm. **6.** *Lopharcha africana* Aarvik, sp. n., head in profile. **7.** *Lopharcha africana* Aarvik, sp. n., tip of male abdomen, dorsal view. **8.** *Lopharcha africana* Aarvik, sp. n., ♂, GP NHMO1776. Scale 1 mm. **8a.** Coremata, GP NHMO1777. Scale 1 mm. **9.** *Lopharcha africana* Aarvik, sp. n., ♀, GP NHMO1778. Scale 1 mm.