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# Description of the female of *Atherimorpha latipennis* Stuckenberg 1956 (Diptera: Rhagionidae): the first record of brachyptery in Rhagionidae

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## Abstract

The Genus *Atherimorpha* White 1915 is a Gondwanan relic, occurring in South America, Southern Africa and Australia. Females are rarely collected and in more than half of the known species are not described. The female of *Atherimorpha latipennis* Stuckenberg 1956 was collected for the first time in 2021 and is described here, along with a redescription of the male. We describe the differences from the male, with the reduced wings and poorly defined scutellum the most noteworthy. The female of *A. latipennis* represents the first recorded case of brachyptery in the Rhagionidae. Possible drivers of brachyptery in Afrotropical Diptera are briefly discussed.

## Key words

Aptery, snipe flies, taxonomy, Lesotho

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## Introduction

The genus *Atherimorpha* White 1915 (Diptera: Rhagionidae) is a Gondwanan relic (Kerr 2010, Kerr and Sinclair 2017) with 51 species recognised as valid (Kerr and Sinclair 2017). Globally, the genus has received sporadic taxonomic attention, with most revisions only addressing regional faunas (Malloch 1932, Paramonov 1962, Nagatomi and Nagatomi 1990), though acknowledging the link between Australia, Africa and South America. Of the 50 extant species, the male is known in 40 cases and the female in 23. Both sexes are only known in 16 species and in three species, it is not clear which sex was described (see Philippi 1865, González et al. 2020). This pattern is also seen in the 12 Afrotropical species, both sexes are known in only four species, and the female is unknown for seven species.

Many *Atherimorpha* species are known from mountainous regions, usually near streams (Fig. 1), and emerge as adults for a limited time (Nagatomi and Nagatomi 1990, Kerr 2010). Mountain habitats often drive the evolution of specialized morphology, such as dwarfism in plants (Körner 2003), improved insulation and hypoxia resistance in mammals (Withers et al. 2016), macroptery in birds (Mayr 1963, Moore and Khan 2023) and both brachyptery and macroptery in insects (Leihy and Chown 2020, Moore and Khan 2023). Brachyptery and aptery are driven by both the increased cost of flight and by the reduced benefit of flight (Leihy and Chown 2020). Factors increasing the cost of flight including high wind speed, habitat fragmentation, low temperature and low air pressure (Leihy and Chown 2020). These area all present in the Alpine zone of the Lesotho highlands (Partridge et al. 2010, Badger et al. 2015). Predator or competitor release, increased habitat stability or increased habitat complexity can drive decreased benefit from flight. These factors can be harder to measure, but are generally not considered to play a role in alpine environments (Leihy and Chown 2020). In insects, the drivers of evolution of brachyptery and macroptery are the same, with some species evolving to overcome the pressures of these environments (macroptery) while others evolve to avoid them (brachyptery).

We describe the female of *Atherimorpha latipennis* Stuckenberg 1956 for the first time, redescribe the male to modern standards and provide colour photographs for the first time.

## Material and Methods

Specimens were collected using sweep nets at Afriski Mountain Lodge and Resort (Fig. 1, 28°49.37'S; 28°43.68'E) in December 2021 and November 2022 and the nearby tributary of the Malibamatso River (Fig. 2, 28°47.81'S; 28°41.26'E) in November 2022. Specimens were also collected at Afriski Mountain Lodge using a Malaise trap in November 2022. The resort falls within the Alpine zone at 3032m a.s.l., and the vegetation is classified as Drakensberg Afroalpine Heathland (Gd10), which is dominated by Fynbos shrubs and grass (Mucina and Rutherford 2006). The Malibamatso tributary is slightly lower at 2872m a.s.l. but still falls within the Drakensberg Afroalpine Heathland vegetation type.

Specimens were examined using a Leica M80 microscope and photographed using a modified version of the system described by Brecko et al. (2014) and stacked using Helicon Focus 7. Male genitalia were dissected and macerated in lactic acid at 130°C for 20 minutes and photographed using a Canon 400D and also stacked in Helicon Focus 7. Terminology follows (Cumming and Wood 2017) and (Kerr and Sinclair 2017).

Collections codens used in the text are as follows: BMSA – National Museum, Bloemfontein, South Africa; NMSA – KwaZulu-Natal Museum, Pietermaritzburg, South Africa.

## Results

### Taxonomy

***Atherimorpha latipennis* Stuckenberg 1956**

Figs 3–11

*Atherimorpha latipennis* Stuckenberg 1956 144: fig. 1

*Atherimorpha latipennis* Nagatomi & Nagatomi 1990 64: fig. 59

**Material examined.**

Holotype: LESOTHO • 1♂; Thaba-Tseka, nr Sani Pass; L. Bevis leg.; 25 Dec. 1938; NMSA-Dip 053434, NMSA type number 716; (NMSA).
Other material: LESOTHO • 20♂♂ 1♀; Butha-Buthe, Afriski Resort, 28°49,37’S 28°43,683’E; 3–7 Dec. 2021; J. Midgley & B. Muller leg.; sweep net; NMSA-Dip 213161-213181 (NMSA). • 31♂♂; Butha-Buthe, Afriski Resort, 28°49,37’S 28°43,683’E; 3–7 Dec. 2021; J. Midgley & B. Muller leg.; sweep net; BMSA(D)130376–130406 (BMSA). • 15♂♂; Butha-Buthe, Afriski Resort, 28°49,37’S 28°43,683’E; 21–24 Nov. 2021; K. Jordaens, J. Midgley, B. Muller & G. Theron leg.; sweep net; NMSA-Dip 217640–217654 (NMSA). • 24♂♂; Butha-Buthe, Afriski Resort, 28°49,37’S 28°43,683’E; 21–24 Nov. 2021; K. Jordaens, J. Midgley, B. Muller & G. Theron leg.; sweep net; BMSA(D)132356–132379 (BMSA). • 29♂♂; Butha-Buthe, Afriski Resort, 28°49,37’S 28°43,683’E; 21–24 Nov. 2021; K. Jordaens, J. Midgley, B. Muller & G. Theron leg.; Malaise trap; BMSA(D)132380–132408 (BMSA). •1♂; Butha-Buthe, Afriski: Malibamatso tributary, 28°47,8069’S 28°41,2561’E; 23 Nov. 2022; K. Jordaens, J. Midgley, B. Muller & G. Theron leg.; NMSA-Dip 217680 (NMSA).

**Description.**

Male (Figs 3–7).

***Length***: Body 3.7–7.4mm, wing 5.4–7.1mm

***Head*** (Figs 3–5). Overall grey with a slight yellowish white pruinosity; frons and ocellar tubercle browner pruinose. Eyes bare; ommatidia similar in size. Ocelli similar size; ocellar tubercle sharply raised, anterior margin almost 90 degrees to frons, as high as the diameter of the ocelli, posterior margin more gradually sloped, about 45 degrees to frons. Frons with one to three short dark setulae. Upper occiput, vertex and ocellar tubercle with dark setae, lower occiput and gena with pale setulae; proboscis with shorter pale setulae with some interspersed dark setulae; palpus with dark setulae, longer than width of palpus. Gena narrow. Parafacials separated from clypeus by deep longitudinal sulci; parafacials and clypeus of similar width. Palpus and proboscis darker grey and of similar length. Inner eye margin next to frons with a dark mark; lower half of frons with several dark markings. Posterior of head concave medially. Antennal bases with a slight elevated appearance, area surrounding bases with similar colour to parafacials and clypeus; antenna dark-brown, almost appearing black; scape and pedicel with short dark setulae dorsally and laterally; flagellomere 1 bare, style six segmented.

***Thorax*** (Figs 3–4). Scutum greyish brown with three darker-brown vittae, the middle vitta thin and slightly darker, ending before scutellum, the lateral pair ending half way between suture and scutellum; with scattered long dark setulae; scutum and scutellum clearly separated by a suture; scutellum with dark setulae, anterior apical margin with longer pale setulae. Postpronotal lobe grey with whitish pruinosity and dark setulae; pronotum with some scattered pale setulae. Pleura grey with whitish pruinosity, except for propleuron and katatergite that is more yellowish; katatergite with a row of pale setulae, and the propleuron with a patch of pale setulae, other pleurites lacking setulae.

***Legs*** (Figs 3–4). Femur and tarsi of similar length, tibia slightly longer. Coxae grey with whitish pruinosity, fore and mid coxae with long pale setulae on anterior surface, hind coxa with setulae on anterior and postero-lateral surface. Legs overall grey colour, with pale short setulae on most of femora, some dark setulae toward apex; tibia with short and stronger dark setulae; tarsi with a darker appearance than rest of the legs. Pulvilli and empodium of similar size, pulvilli symmetrical;

***Wings*** (Figs 3–4). Overall light brownish suffused with a darker stigma in cell $r_1$; cells *br*, *sc* and base of wing somewhat darker suffused; cell *cua* closed or only very narrowly open; Costa with dark setulae along the anterior margin of the wing, continuing past the apex becoming gradually paler past the apex until whitish on the anal lobe and alula. $R_1$ with a few dark setulae on the dorsal side. Halter with stalk somewhat yellowish grey and knob darker grey, overall almost as long as fore-femur.

***Abdomen*** (Figs 3–4). Overall grey in colour with slight white pruinosity, covered entirely in only long pale setulae (at least half as long dorsal width of abdomen; half to two thirds the height of the thorax at the join. Terminalia (Figs 6–7) gonocoxa grey with orange apex, covered in short pale setulae; gonostylus, cercus and parameral sheath orange, hypandrium grey.

Female (Figs. 8–11)

***Length***: Body 7.3mm, wing 1.1mm

***Head*** (Fig. 8–10).

Overall grey with darker yellow pruinosity than in male. Frons with 13 short dark setulae. Parafacials slightly narrower than clypeus; posterior of head slightly concave to flat medially.

***Thorax*** (Figs 9–11). Overall, appears overly inflated and stretched; suture between scutum and scutellum indistinct. Scutum greyish brown with three darker-brown vittae, the middle vitta thin and slightly darker, ending before scutellum; the lateral pair less distinct, ending half way between suture and scutellum. Scutum with scattered short dark setulae; scutellum with a few dark setulae; postpronotal lobe grey with yellowish pruinosity and dark setulae, longer than on the disc of the scutum. Pleura grey with yellowish pruinosity, except for ventral parts of the katepisternum and meron where it is whitish. Katatergite with three brown setulae, propleuron with a patch of brown setulae, other pleurites lacking setulae.

***Legs*** (Figs 9–10). Tarsus slightly shorter than femur; tibia slightly longer than femur. Legs overall grey-brown colour.

***Wings*** (Figs 9–11). Greatly reduced, about half the length of the thorax. Veins indistinct but present; setulae on veins developed, as in male. Halter with stalk and knob somewhat yellowish grey, reduced in size, overall almost as long as mid coxa is wide.

***Abdomen*** (Figs 9–11). Overall brown in colour with slight white pruinosity on posterior margins of the tergites and sternites, covered entirely in short pale setulae (at most half as long as in the male). Abdomen greatly enlarged, about as high as the thorax at the join. Intersegmental membranes exposed, laterally occupying ⅓ of the height of the abdomen. Tergites and sternites weakly sclerotized, appearing wrinkled (a possible preservation artefact). Terminalia: cerci, small, grey, rounded; with pale pile about half as long as width of cerci. Not dissected, as a single specimen is available.

**Ecology**

Despite collecting material at several high altitude sites (see Midgley et al. in prep), specimens of *A. latipennis* were only found in alpine vegetation, suggesting that it is an alpine adapted species.

**Remarks**

The holotype was published as being at the Durban Natural Science Museum but was donated to the KwaZulu-Natal Museum in the late 20th century. The female will key to brachypterous Hybotidae in the Manual of Afrotropical Diptera adult identification key (Marshall et al. 2017), but can be easily distinguished from it by the enlarged flagellomere 1 and the somewhat narrower, but clearly segmented appearance of flagellomeres 2–7 (Fig. XX) (in the form of an arista-like stylus in the Hybotidae), and having 2 segmented palpi compared to Hybotidae that are one segmented. The female keys correctly to *Atherimorpha* in the Rhagionidae chapter (Kerr and Sinclair 2017), though the wing characters in couplet one are indistinct, and to *A. latipennis* using the key in Nagatomi and Nagatomi (1990), though size should not be used to separate this species from *Atherimorpha longicornu* in couplet eight, as we collected specimens of *A. latipennis* smaller than 5.2mm.

## Discussion

The brachypterous female of *A. latipennis* is remarkable, the first recorded case of brachyptery in the family Rhagionidae. Brachyptery has been recorded in 17 families of Diptera in the Afrotropics (Kirk-Spriggs and Sinclair 2017a), and the collection of the female of *A. latipennis* brings this to 18, slightly more than 15% of the families known from the region. Though the percentage of species showing this trait is much lower, the fact that it has evolved in parallel so many times warrants further discussion.

The evolution of brachyptery is often associated with habitat specialization, though the degree to which this is driven by the increased costs of flight versus the decreased benefit varies between habitats (Leihy and Chown 2020). Alpine areas, coastal dunes and polar regions are associated with increased cost of flight (Darlington 1943), while forests, caves and inquiline or parasitic lifestyles are associated with decreased benefit of flight (Southwood 1962, Roff 1990, Denno et al. 2001). Oceanic islands show attributes of both groups, but the influence of wind (and the associated cost of flight) is the major driver of brachyptery (Leihy and Chown 2020).

In the Afrotropics, both the decreased benefit and increased cost of flight appear to contribute to evolution of brachyptery. Of the families in which it has been recorded, three include vertebrate inquilines or parasites, three invertebrate inquilines or parasites and six are known from forest habitats (Kirk-Spriggs and Sinclair 2017a, 2017b, 2021). As species of Sphaeroceridae occur in both ant nests and forests, there are 11 families where the lack of benefit is the driver of brachyptery. In contrast, one brachypterous family occurs in coastal dunes, four are recorded from oceanic islands and nine from mountains (now including the Rhagionidae), but as the Chloropidae, Limoniidae and Sphaeroceridae are recorded from both mountains and oceanic islands, 12 families show brachyptery driven by the increased cost of flight (Kirk-Spriggs and Sinclair 2017a, 2017b, 2021, van Zuijlen 2021). It is also worth noting that species of Chloropidae, Empididae, Limoniidae and Sphaeroceridae occur in both groups (Kirk-Spriggs and Sinclair 2017b, 2021).

The Afrotropical region is large, about 20% of the world's land surface and ecologically diverse, including eight of the world's 35 terrestrial biodiversity hotspots (Marchese 2015), and largely underexplored biologically. The alpine zone in southern Africa, and particularly Lesotho, has received limited attention to date. Biological surveys of the continent are likely to discover undescribed species, but even the addition of previously undescribed sexes can be remarkable, as shown here. This is particularly true of environments that have been shown to drive atypical morphology. *Atherimorpha* have been collected from mountainous regions in Australia, Southern Africa and South America, yet comparatively few females have been described. Given that alpine or mountainous environments can result in the evolution of brachyptery and that brachypterous Diptera present a collecting challenge, it is possible that other female *Atherimorpha* are also brachypterous. Future collecting effort should include multiple techniques as the usual techniques employed often rely on passive movement by the target individuals (e.g. Malaise traps) or active searching for flying adults. The inclusion of pitfall trapping, bush beating and other techniques usually used for walking insects may result in the discovery of more brachypterous females.

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## Figure captions

**Fig. 1.** Photograph of site where *A. latipennis* was collected. Afriski Mountain Lodge grounds (28°49.37'S; 28°43.68'E), with the first author searching unsuccessfully for additional female specimens. Fifty one males and a single female were collected in 2021 and 68 males in 2022. Photo B. Muller.

**Fig. 2.** Photograph of site where *A. latipennis* was collected. Tributary of Malibamatso River (28°47.81'S; 28°41.26'E), a single male was collected in November 2022. Photo K Jordaens, used with permission.

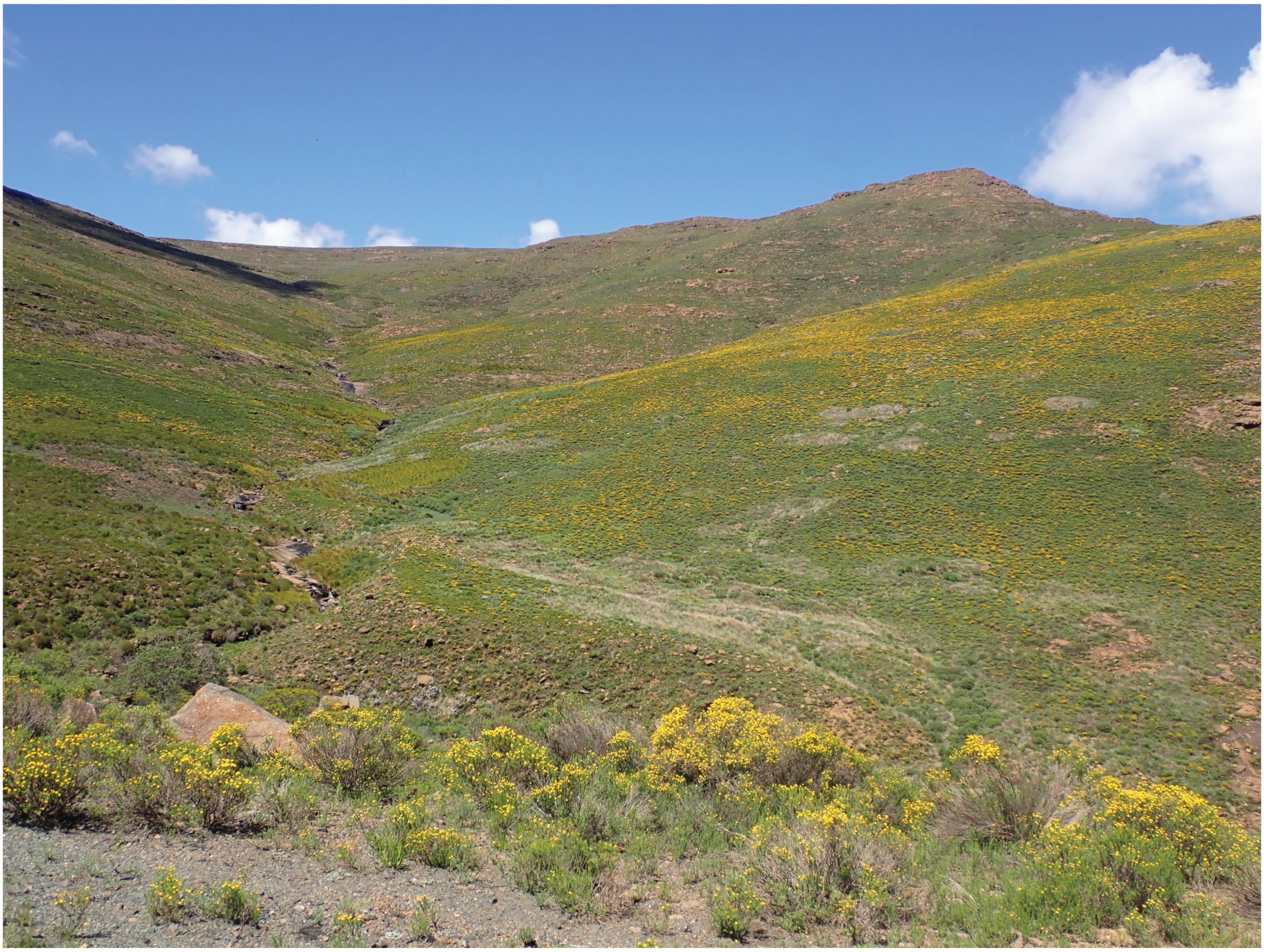
**Figs 3, 4.** Male of *A. latipennis* **3.** Habitus of holotype (NMSA-Dip 053434). **4.** Habitus of male collected at Afriski Mountain Lodge (NMSA-Dip 213176).

**Figs 5, 6.** Male of *A. latipennis* **5.** Dorsal view of male hypandrium (BMSA(D)130380). **6.** Ventral view of male genitalia (BMSA(D)130380).

**Figs 7, 8.** Comparison of the heads of *A. latipennis*. **7.** Anterolateral view of male head (NMSA-DIP 213176). **8.** Anterolateral view of female head (NMSA-Dip 213161)

**Figs 9, 10.** Habitus photographs of female *A. latipennis*. **9.** Dorsal view of female specimen (NMSA-Dip 213161). **10.** Lateral view of female specimen (NMSA-Dip 213161).

**Fig 11.** Detail of the wing and scutellum of *A. latipennis* female (NMSA-Dip 213161), showing the weakly developed wing veins with setulae and the poorly defined scutellum.

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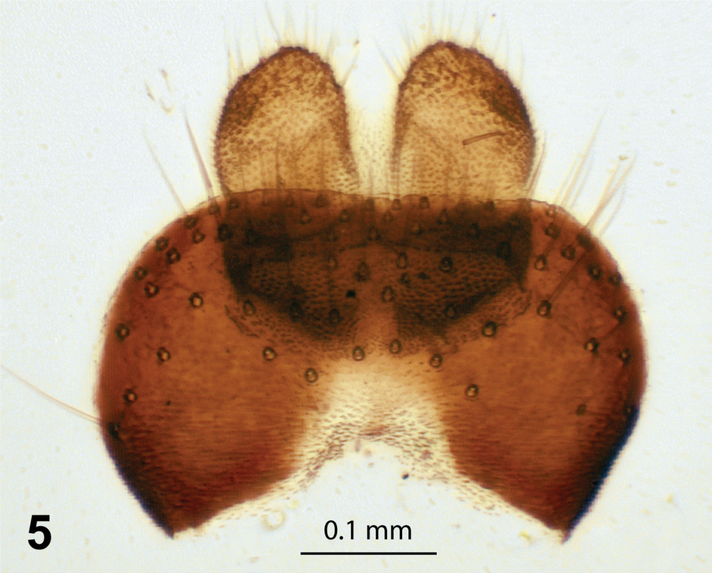
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