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**Phoresy of a sucking louse, *Linognathus* sp. (Phthiraptera: Anoplura: Linognathidae), by *Musca* (*Byomya*) *conducens* Walker (Diptera: Muscidae) in South Africa**

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ABSTRACT

This paper reports the capture of a specimen of *Musca* (*Byomya*) *conducens* Walker, 1859 from Ndumo Game Reserve, South Africa, with two living lice (*Linognathus* sp.) attached to the legs, one to the left fore tarsus and another to the right mid tarsus. Phoresy in the Anoplura as a whole is extremely rare, and this case represents only the tenth record of phoresy of Anoplura on Diptera and only the fifth record on members of the family Muscidae. This case further represents the first recorded case of the same genus of lice being transported phoretically by more than one dipterous family, *i.e.*, Culicidae and Muscidae. A photograph of one of the lice attached to the right mid tarsus is provided and previous records of anopluran phoresy are reviewed and discussed.

**KEY WORDS:** Anoplura, *Linognathus*, Muscidae, *Musca* (*Byomya*) *conducens*, sucking louse, Afrotropical, Ndumo Game Reserve, new record, host fly, phoresy.

INTRODUCTION

Published records of phoresy by anopluran lice are extremely rare (Braack & Emerson 1986; Durden 1990; Hopkins 1949; Marshall 1981; Thompson 1933) and such cases are worthy of note. Cases of phoresy in the ischnoceran chewing lice (formerly Mallophaga *partim*), especially on flies of the families Hippoboscidae and Culicidae, have been well documented and appear to be relatively common occurrences (*e.g.*, Harbison *et al.* 2009; Keirans 1975*a, b*). Durden (1990) noted, however, that except under unusual circumstances, or in special cases, it is assumed that phoresy is not a widespread phenomenon in the Anoplura.

During fieldwork conducted in Ndumo Game Reserve in 2009, a specimen of *Musca* (*Byomya*) *conducens* Walker, 1859 was captured with two living lice clinging to the tarsi; one to the left fore tarsus and another to the right mid tarsus (Fig. 1).

MATERIAL AND METHODS

The fly with the lice still attached was preserved in ethanol, causing the louse attached to the fore leg to become detached. Both lice (two adult females) were cleared in Potassium hydroxide (KOH) and were slide-mounted in Canada balsam. Figure 1 was prepared from an image captured with a Leica EZ4 HD stereo microscope using a built-in digital camera and was photographed using a ring light and dome (Kerr *et al.* 2008). The lice could not be ascribed to any of the 44 described Afrotropical species of *Linognathus* (Pajot 2000) and probably represent an undescribed species (Mey and Kirk-Spriggs, in prep.). The body lengths of the two specimens are 1.50 mm and 1.66 mm respectively. Both the fly (BMSA(D)42276) and the slide with two lice (BMSA(Ph)00001) are de-



Fig. 1. Photograph of the phoretic *Linognathus* sp. (Anoplura, Linognathidae) attached to the right mid-tarsus of *Musca conducens* Walker (Muscidae).

posited in the collections of the National Museum, Bloemfontein (BMSA). The fly was trapped adjacent to the main road of the Reserve (26°54.288'S 32°17.974'E) with a Gressitt & Gressitt-style, 6 meter Malaise trap. The trap was located in sand and broad-leaved deciduous forest and was deployed from 4–8 December 2009. This represents only the tenth record of phoresy of Anoplura by Diptera and the fifth record by Muscidae.

#### DISCUSSION

Durden (1990, table 1) documented six previous studies that report phoresy of Anoplura by Diptera; however, he did not elaborate on the work of Nuttall (1917). Nuttall

did not communicate his own observations, but only commented on Calandrucchio (1890) and referred to Bohne (1915), whose publication he had not seen (see below).

Four records from Durden (1990) are of Muscidae, namely: Mitzmain (1912): *Haematopinus tuberculatus* (Burmeister) (as *H. bituberculatus* Nitzsch) (Haematopinidae) from *Haematobia irritans exigua* de Meijere (as *Lyperosia*) in the Philippines; Allingham (1987): *Haematopinus eurysternus* (Nitzsch) (Haematopinidae) from *Haematobia irritans exigua* (de Meijere), at Popham Bay, Northern Territory, Australia; Bedford (1929: 502): *Linognathus vituli* (L.) from *Musca* (*Byomya*) *lasiophthalma* Thomson, at Camp's Bay, Cape Town, South Africa; and Braack & Emerson (1986): *L. africanus* (Kellogg & Paine) (Linognathidae) from *H. thirouxi* Roubaud, at Kruger National Park, South Africa/Mozambique border.

Worth & Paterson (1960) further reported the capture of *Aedes* (*Neomelanoconion*) *circumluteolus* (Theobald) (Culicidae), with two *Linognathus* sp. attached to the legs, from Ndumo Game Reserve, South Africa. It is interesting to note that the current record, also of a *Linognathus* sp., originates from the same locality, and thus represents the first record of the same genus of lice being transported phoretically by more than one fly family (Culicidae and Muscidae). Worth & Paterson (1960) note that *Linognathus* spp. occur on Red Duiker [or Natal red Duiker], *Cephalophus natalensis* A. Smith and Grey [or Common] Duiker, *Sylvicapra grimmia* (L.) (Bovidae), both of which occur in Ndumo Game Reserve. *Linognathus* spp. are, however, parasites of several ungulates and a few carnivores.

Additional cases not tabulated by Durden (1990) include: Calandrucchio (1890): both subspecies of *Pediculus humanus* L. (as *P. vestimenti* Nitzsch) (Pediculidae) from "mosche" (= *Musca domestica*), in Sicily, Italy; Bohne (1915): *Pediculus* sp. (perhaps *humanus*) from *Musca domestica* in Germany; Anonymous (2006): an unidentified louse ("pig louse", ?*Haematopinus suis* (L.)) attached phoretically to a calliphorid fly in the United States; Pajot and Germain (1971): *Linognathus breviceps* (Piaget) (Linognathidae) from *Eretmapodites* cf. *chrysogaster* Graham (Culicidae) in Cameroon; and Lang's (1975) experimental work on attachment of head lice to different insects.

Although two of the above Muscidae records are non-Afrotropical (*Haematobia irritans exigua* from the Philippines and Australia), all the Muscidae species listed above are recorded as occurring in the Afrotropical Region (Pont 1980). Species of *Haematobia* are blood-sucking flies in the subfamily Stomoxyinae that regularly alight on mammalian hosts for a blood meal. Other muscid flies listed are also associated with man or livestock (Durden 1990). *Musca conducens* is likewise widespread in the Afrotropical Region and also occurs in the Middle East and the Oriental Region to China and Melanesia (Pont 1980: 724).

As is the case with the current record, Durden (1990) reported that in all cases where the means of louse attachment is described, it involves the louse clinging by the tibio-tarsal claws that normally encircle the hair of the mammalian host to one or more fly legs.

Lice phoresy may occur in large numbers. Mitzmain (1912), for example, reported the capture of 620 nymphs of *Haematopinus tuberculatus* from 1,800 *Haematobia irritans exigua* in a collection made over a 5-day period in the Philippines. In the present case, however, a total of 5,879 acalyprate and calyprate flies (1,930 of these

Muscidae) were trapped using Malaise traps at Ndumo Game Reserve over a 14-day period (27 November–10 December 2009). Only one fly had lice attached.

That no adult lice were recorded in Mitzmain's case is understandable, given that the adult body length of *Haematopinus tuberculatus* is recorded as 3.25–5 mm (Stimie & Van der Merwe 1968). Therefore, it can be assumed, that adult lice of this species are too large to be transported by *Haematobia irritans*. The same may also apply to the slightly smaller *Haematopinus euryesternus*, as recorded by Allingham (1987).

Bohne (1915: 358) wrote that during the autumn months of 1914, the accommodation and inhabitants of a hospital ship were "... at times very badly affected by a plague of [house] flies, which seemed to originate in a nearby refuse pit. In the course of egg-laying by these flies, navy senior physician Dr. Zur Verth noted on two occasions that, when a fly was killed by a blow, immediately afterwards lice were seen to leave the dead flies. In both episodes 3–4 lice were involved". As this number of adult lice would represent a heavy burden for a house fly, it must be assumed that the lice concerned were nymphs. The adaptive significance of phoresy by Phthiraptera (both Ischnocera and Anoplura) warrants further study.

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