# *Linognathus weisseri* n. sp. (Phthiraptera: Linognathidae) of impalas, *Aepyceros melampus*: description and biology

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**ABSTRACT**

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The adult male and female and first instar nymph of the sucking louse *Linognathus weisseri* n. sp. are described. This louse was collected from impalas, *Aepyceros melampus*, at three localities in Limpopo Province, and at three in Mpumalanga Province, South Africa. Although it usually accounted for only a small proportion of the total louse burden, its overall prevalence exceeded 27 %. Its prevalence on adult male impalas (9 %) was significantly lower ($P = 0.004$) than that on adult females (39 %), but did not differ among age classes. However, the intensity of *L. weisseri* infestation was higher on lambs than on yearlings and adults, and peaked on impalas in late winter to early summer. Five species of lice are now known to parasitize impalas and a key for distinguishing adults of these species is included.

**Keywords**: *Aepyceros melampus*, impalas, lice, *Linognathus weisseri*, Phthiraptera

## INTRODUCTION

A large number of surveys on the arthropod parasites, particularly ticks, of impalas, *Aepyceros melampus*, have been conducted in southern Africa (for review see Horak, Gallivan, Braack, Boomker & De Vos 2003). The collection techniques employed in a number of these surveys were sufficiently sensitive to collect lice and the louse burdens of impalas have been recorded by Horak (1982), Horak, Boomker, Kingsley & De Vos (1983), Van Dyk & McKenzie (1992), Matthee, Horak & Meltzer (1998) and Horak *et al.* (2003). In other surveys the presence of lice has been recorded incidentally. The four louse species (two chewing lice in the genus *Damalinia* and two sucking lice in the genus *Linognathus*) known to infest impalas have been listed by Ledger (1980), and were recovered in most of the surveys, but in some of them an unknown *Linognathus* sp. was encountered.

On examination these lice appeared to be the same as those collected during October 1965 from an impala at Kamazeu, Zimbabwe (then Rhodesia), and those collected by J.A. Ledger during August 1968 from an impala at Skukuza in the Kruger National Park (KNP), South Africa. Weisser (1975) described these lice from an entire female and the terminalia of the male in an unpublished monograph on the Linognathidae. Several thousand specimens of this louse, designated only as *Linognathus* sp., have been collected from impalas in the KNP by Horak *et al.* (2003). The same louse has been collected from impalas examined on a privately owned

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game ranch by Matthee *et al.* (1998). In this paper the adults and first instar nymph of this louse are described and illustrated, and its biology, garnered from Matthee *et al.* (1998) and Horak *et al.* (2003) as well as other sources, outlined.

## MATERIALS AND METHODS

The impalas from which the louse was collected had been processed for ectoparasite recovery as described for greater kudus, *Tragelaphus strepsiceros*, by Horak, Boomker, Spickett & De Vos (1992), and the lice were recovered from the processed material as described by Horak *et al.* (2003). The localities at which *Linognathus weisseri* was collected and its prevalence on impalas at these localities are summarized in tabular format and its seasonal occurrence is graphically illustrated.

### Descriptive format

Taxonomic descriptions follow the format of Musser & Durden (2002) with modifications specific to *Linognathus* used by Weisser (1975) and Weisser & Ledger (1977). Names of setae are from Kim & Ludwig (1978); these names are spelt out when first used (with abbreviations provided in parentheses), and subsequently abbreviated.

## DESCRIPTION

**Male** (Fig. 1): length of holotype, 1.32 mm; mean, 1.32 mm; range, 1.26–1.36 mm ($n$ = 6).

Head, thorax and abdomen moderately sclerotized.

*Head* longer than wide, rounded, with blunt anterior apex. Three Apical Head Setae (ApHS), two Dorsal Pre-antennal Head Setae (DPaHS), two Supra-antennal Head Setae (SpAtHS), two Sutural Head Setae (SHS), two Dorsal Posterior Central Head Setae (DPoCHS), one Dorsal Marginal Head Seta (DMHS), two to three Ventral Pre-antennal Head Setae (VPaHS), and one Ventral Principal Head Seta (VPHS) on each side; VPHS moderate in length. Antennae 5-segmented, relatively long and slender, with basal segment wider than long and wider than second segment.

*Thorax* broader than head with curved margins widening posteriorly; thoracic sternal plate absent; mesothoracic spiracle sub-circular, 0.04 mm in diameter; Dorsal Principal Thoracic Seta (DPTS) fairly short (0.085 mm) with one (rarely two) small Dorsal Mesothoracic Seta (DMsS) between spiracle and DPTS on each side; one short Dorsal Prothoracic Seta (DPtS) on each side. *Legs* long and relatively narrow; mid-legs and associated claws larger and more robust than fore-legs; hind-legs slightly larger than mid-legs; hind coxae sub-triangular; fore and mid coxae as depicted in Fig. 1A.

*Abdomen* wider than thorax with curved margins and fine crenulations on dorsal and ventral surfaces as shown in Fig. 1A. Paratergal plates, tergites and sternites (except sub-genital plate) absent as is typical for *Linognathus*; six moderately-sized spiracles

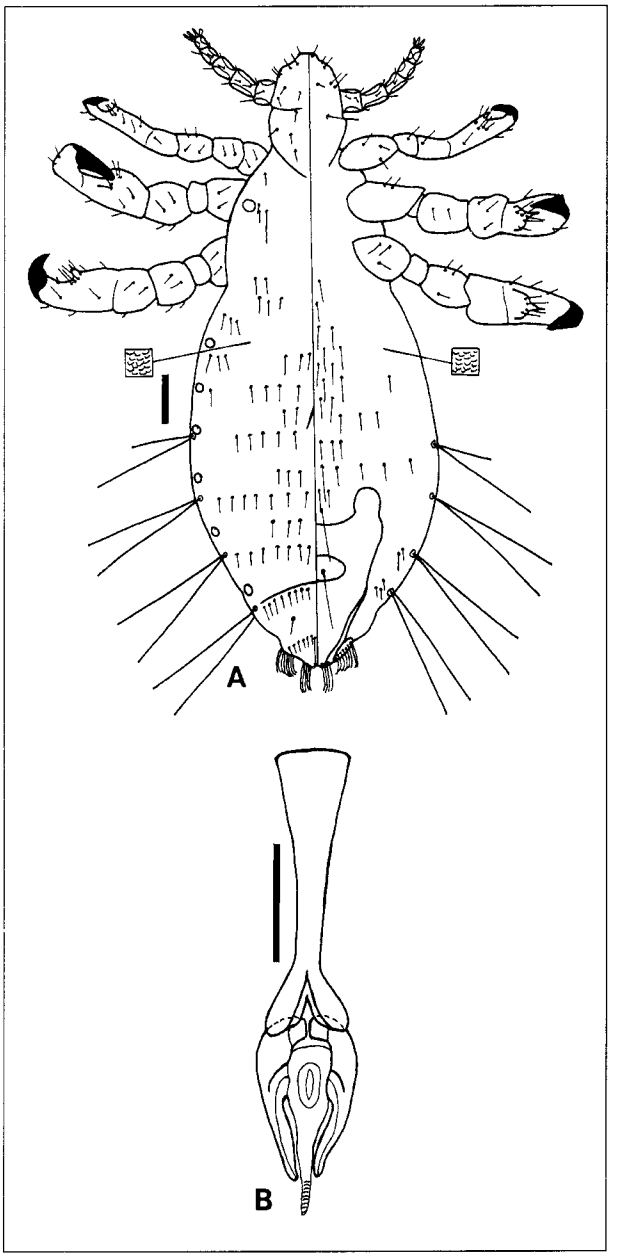


FIG. 1 *Linognathus weisseri*, n. sp., male. A. Dorso-ventral view. B. Genitalia. Both scale bars = 0.1 mm

on each side; Dorsal Marginal Abdominal Setae (DMAS) associated with third spiracle consisting of one long and one moderately long (but clearly shorter) seta; DMAS associated with fourth to sixth spiracles each consisting of two long setae; other abdominal setae short to moderate in length (except for four long posterior setae ventrally) and more or less arranged in 12 ventral rows (anterior to sub-genital plate) and 14 dorsal rows. Dorsal setal rows consisting of the following approximate numbers of setae from anterior to posterior: 4, 6, 6, 12, 10, 5, 10, 6, 12–14, 6, 12–14, 16–18, 2, and 14–18. Most dorsal setae are Dorsal Central Abdominal Setae (DCAS), but rows 3–5 also have Dorsal Lateral Abdominal Setae (DLAS) as shown in Fig. 1A. Ventral setal rows anterior to sub-genital plate consisting of the following approximate numbers of setae from anterior to posterior: 2, 2, 4, 4, 4, 6, 4, 6–7, 6, 10–11, 4, and 2. Most ventral abdominal setae are Ventral Central Abdominal Setae (VCAS) but some in rows 6, 8 and 10, are Ventral Lateral Abdominal Setae (VLAS) as shown in Fig. 1A. Two groups of two to three short DLAS lateral to sub-genital plate on each side.

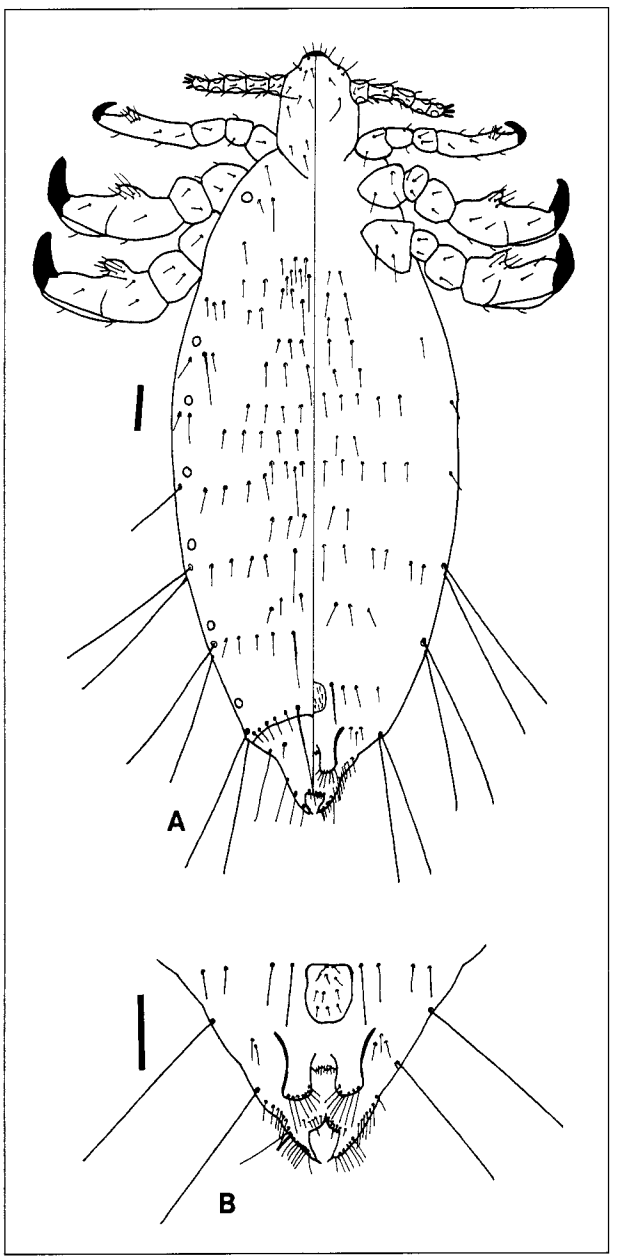


FIG. 2 *Linognathus weisseri*, n. sp., female. A. Dorso-ventral view. B. Genitalia. Both scale bars = 0.1 mm

*Genitalia*: V-shaped sub-genital plate with irregular anterior and lateral margins, and central elliptical lacuna enclosing two elongate setae (Fig. 1A). Basal apodeme about twice as long as parameres, well sclerotized, constricted medio-laterally, and with posterior fork (Fig. 1B); parameres curved, broad anteriorly and tapering posteriorly, with distinct surface patterning (Fig. 1B); endomere large and elliptical; pseudopenis relatively long, distinctly extending beyond apices of parameres. A pair of lateral sclerites bearing numerous setae is present near the apex on segment IX.

**Female** (Fig. 2): length of allotype, 1.68 mm; mean, 1.75 mm; range, 1.60–1.88 mm ($n$ = 10).

Head, thorax and abdomen as in male with the following exceptions:

*Head* with lateral margins relatively straight and parallel; two Dorsal Anterior Head Setae (DAnHS) on each side.

*Thorax* less constricted than in male at junction with abdomen giving the overall body an elliptical shape (Fig. 2A). DPTS length, 0.128 mm.

*Abdomen*: DMAS associated with third spiracle consisting of one short seta and one of moderate length; abdominal setae more or less arranged in 12 rows ventrally (anterior to gonopods) and 17 rows dorsally although anterior dorsal rows are difficult to distinguish (Fig. 2A). Dorsal setal rows consisting of the following approximate numbers of setae from anterior to posterior: 2, 6, 12, 10, 6, 12, 6, 12, 10, 6, 10, 6, 10, 6, 10, 12–14; most dorsal setae are DCAS but rows 4, 6, 8, 11, 13, and 15 also have DLAS as shown in Fig. 2A. A few DCAS and DLAS are elongate (Fig. 2A). Ventral setal rows anterior to gonopods consisting of the following approximate numbers of setae from anterior to posterior: 4, 4, 4, 6, 4, 12, 4, 12, 4, 12, 6, 8, 6. Most ventral setae are VCAS but rows 4, 6, 8, and 10

also have VLAS as shown in Fig. 2A. Two to four short VLAS on each side at base of gonopods on segment VIII.

*Genitalia* (Fig. 2B): sub-genital plate sub-rectangular and bearing 10–16 small setae; gonopods on abdominal segment VIII finger-like with sclerotized lateral margins and rounded apices, each bearing seven to nine setae that are short medially and increase to moderate length postero- laterally; row of tiny setae situated medially between bases of these gonopods; gonopods on abdominal segment IX situated terminally and tapering to form forficulate apical lobes each bearing a row (possibly two separate rows) of hair-like setae.

**First instar nymph** (Fig. 3): mean length, 1.09 mm; range, 1.02–1.20 mm ($n$ = 3).

Head moderately sclerotized; thorax and abdomen lightly sclerotized and with surface sculpting as shown for abdomen of male (Fig. 1A).

*Head* shaped as in male but with small, pointed, antero-lateral projection immediately posterior to antennal insertion on each side. Dorsal head setae as in male. Ventral head with three ApHS and one VPHS on each side.

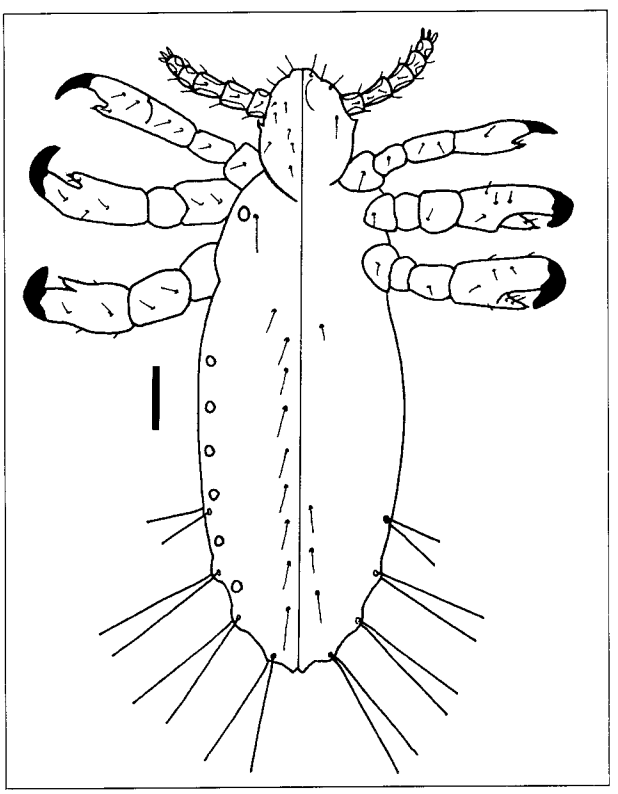

FIG. 3 *Linognathus weisseri*, n. sp., first instar nymph. Dorsoventral view. Scale bar = 0.1 mm

*Thorax* distinctly wider than head, with mesothoracic spiracle (0.03 mm in diameter) and one VPTS (0.084 mm in length) on each side.

*Abdomen* at widest point slightly wider than thorax; six moderately-sized spiracles, three pairs of long DMAS posteriorly (each pair borne on a protruding area of integument), and one pair of moderately long DMAS anterior to these on each side. Dorsally, with nine pairs of DCAS of moderate length; ventrally, with one pair of short anterior VCAS and three pairs of posterior VCAS of moderate length.

## Specimens examined

Holotype male, allotype female and 17 paratypes (five males, nine females, three first instar nymphs) ex adult female *Aepyceros melampus* (Lichtenstein), Nwaswitshaka River Bridge, Skukuza (24°58'S, 31°36'E), Kruger National Park, Mpumalanga Province, South Africa; 24 November 1982; Coll.: I. G. Horak.

## Deposition of types

Holotype male, allotype female and one paratype nymph (Accession number TM 2031126) deposited in the U.S. National Museum of Natural History, Washington DC. Paratypes will also be deposited in the Natural History Museum, London.

## Etymology

We have pleasure in naming this species after Dr Christian F. Weisser who first described the entire female and the male genitalia of this species in his dissertation but did not publish the description. We greatly appreciate Dr Weisser's encouragement to proceed with this description.

## Synonymy

*Linognathus melampi* Weisser, 1975; this is an unpublished manuscript name. Weisser (1975) stated that a female holotype, a male allotype (two slides) and another four females and two males (four slides) of *L. melampi* had been deposited in the South African Institute of Medical Research (SAIMR) Collection under "Rev. (*sic*) No. L 232" and "L 231" respectively, but we have been unable to locate these specimens.

## Diagnosis

*Linognathus weisseri* is a fairly small and distinct member of its genus. It can be easily distinguished

from *Linognathus elblae, Linognathus breviceps* and *Linognathus nesotragi* by the absence of hook-shaped sclerotized margins on the forehead. It can be distinguished from other sucking lice on impalas by the absence of a thoracic sternal plate (which is present in *Linognathus aepycerus*), the almost parallel post-antennal margins of the head (which are distinctly bulging in *L. aepycerus*), the slender body shape (which is globular in *Linognathus nevilli*) and the relatively small spiracles (which are large in *L. nevilli*). The shape of the subgenital plates and genitalia in both sexes further distinguish *L. weisseri* from other described species of *Linognathus* including those found on impalas.

## KEY TO ADULT LICE PARASITIZING IMPALAS

1A. Head wider than thorax (chewing lice, *Damalinia* spp.) . .2

1B. Head narrower than thorax (sucking lice, *Linognathus* spp.) .....3

2A. Head sub-triangular and elongate (about twice as long as wide) with small apical notch .....*Damalinia elongata*

2B. Head squarish and short (about 1.2 times long as wide) with tapering anterior and posterior lateral margins and large apical notch .....*Damalinia aepyceros*

3A. Body slender (abdomen not more than twice as wide as thorax at widest point), abdominal spiracles small .....4

3B. Body globular (abdomen 2.5–3 times as wide as thorax at widest point), abdominal spiracles large ..... *Linognathus nevilli*

4A. Thoracic sternal plate present, post-antennal head margin distinctly convex .....*Linognathus aepycerus*

4B. Thoracic sternal plate absent, post-antennal head margin nearly straight or mildly convex ....*Linognathus weisseri*

## RESULTS AND DISCUSSION

*Linognathus weisseri* was collected from impalas at five of the six localities at which impalas were examined within the Kruger National Park (KNP), and was also present on impalas on Letaba Ranch, a private game farm in north-eastern Limpopo Province, South Africa (Table 1).

Although *L. weisseri* usually accounted for only a small percentage of the total number of lice collected, it was common on impalas, with an overall prevalence of 28.8 % on animals examined in the KNP and 17.8 % on animals on Letaba Ranch. In contrast *L. aepycerus* and *L. nevilli* were present in all localities in the Limpopo and Mpumalanga Provinces at which impalas were examined, with the former having an overall prevalence rate of 79.4 % and the latter 55.9 %.

The prevalence and intensity of infestation of *L. weisseri* on impalas in the KNP did not differ between the Skukuza and Mbiyamiti regions in 1980/81, or between Skukuza and Pafuri in 1992/93 ($P$ = 0.35). At Skukuza the prevalence did not differ between 1980/81 and 1992/93 ($P$ = 0.74) but the intensity of infestation was higher in 1980/81 than in 1992/93 ($P$ = 0.01). The prevalence was considerably lower ($P$ = 0.004) on adult male impalas (9 %) than on adult females (39 %), and none were collected from the adult males at Crocodile Bridge. The prevalence and intensity of infestation of *L. aepycerus* on the same animals did not differ significantly between the sexes ($P > 0.16$), whereas those of *L. nevilli* did ($P \leq 0.006$) (Horak *et al.* 2003).

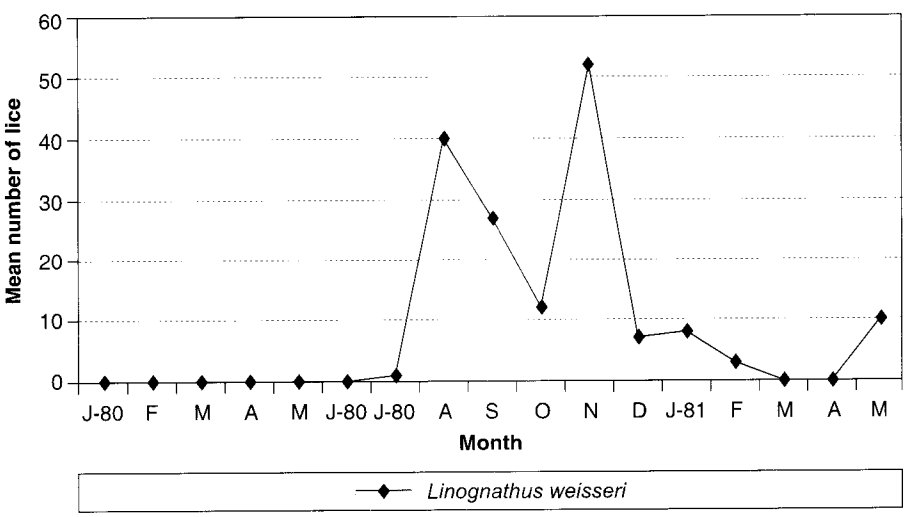


FIG. 4 Seasonal pattern of intensity of infestation of *Linognathus weisseri* on impalas at Skukuza and in the Mbiyamiti regions, Kruger National Park, South Africa during 1980/81. The monthly sample ranged from 4–13 impalas

TABLE 1 *Linognathus weisseri* collected from impalas at various localities in South Africa

| Locality | Coordinates | Province | Period | No. examined (No. infested) | No. of *L. weisseri* collected | | | Proportion of total louse burden (%) |
|---|---|---|---|---|---|---|---|---|
| | | | | | Nymphs | Adults | Total | |
| Nylsvley | 24°29'S, 28°42'E | Limpopo | 1975/76 | 36 (0) | 0 | 0 | 0 | 0 |
| Letaba Ranch | 23°40'S, 31°04'E | Limpopo | 1994/95 | 45 (8) | 25 | 4 | 29 | 0.58 |
| Pafuri | 22°27'S, 31°19'E | Limpopo (KNP) | 1980–1993 | 25 (5) | 40 | 30 | 70 | 1.3 |
| Ntomeni Pans | 23°26'S, 31°14'E | Limpopo (KNP) | July 1982 | 2 (2) | 10 | 4 | 14 | 16.28 |
| Skukuza | 24°58'S, 31°36'E | Mpumalanga (KNP) | 1980–1993 | 139 (50) | 1 964 | 1 569 | 3 533 | 3.46 |
| Mbiyamiti | 25°17'S, 31°32'E | Mpumalanga (KNP) | 1980/81 | 60 (11) | 240 | 172 | 412 | 3.81 |
| Crocodile Bridge | 25°22'S, 31°54'E | Mpumalanga (KNP) | 1980/81 | 12 (0) | 0 | 0 | 0 | 0 |
| Lower Sabie | 25°06'S, 31°55'E | Mpumalanga (KNP) | October 1982 | 1 (1) | 80 | 0 | 80 | 5.43 |
| St Lucia Game Park | 28°23'S, 32°30'E | KwaZulu-Natal | May 1984 | 2 (0) | 0 | 0 | 0 | 0 |

TABLE 2 Distribution of *Linognathus* spp. on the bodies of impalas

| Louse species | No. of impalas examined | Total number (proportion %) of lice recovered | | |
|---|---|---|---|---|
| | | Head and ears | Neck, trunk, upper legs and tail | Lower legs and feet |
| *Linognathus weisseri* | 40 | 104 (3.2 %) | 3 147 (96.6 %) | 8 (0.2 %) |
| *Linognathus aepycerus** | 45 | 349 (18.5 %) | 1 041 (55.1 %) ** | 498 (26.4 %) *** |
| *Linognathus nevilli** | 45 | 15 (0.6 %) | 224 (9.5 %) ** | 2 130 (89.9 %) *** |

* Adapted from Matthee *et al.* (1998)

** Neck, trunk and tail

*** Legs and feet

The prevalence of *L. weisseri* did not differ among age classes ($P = 0.44$), but the intensity of infestation was higher on lambs than on yearlings and adults ($P = 0.01$). Two impala lambs, less than 2 weeks of age were examined, and one was already infested with *L. weisseri*. Both month-old lambs examined were infested.

The distribution of *L. weisseri* on the bodies of 40 impalas, on which it could be determined, is summarized in Table 2. Most lice were present on the necks, trunks, upper legs and tails of the impalas. Unfortunately the collecting procedure followed by Horak *et al.* (2003) did not allow for the determination of a more accurately defined distribution pattern. Although the collection procedure of Matthee *et al.* (1998) does permit for such a determination, they collected too few *L. weisseri* to ascertain its preferred body surface locality. In contrast *L. aepycerus* is present on the head, neck, body, legs and tail of impalas, with no specific preferred locality, whereas *L. nevilli* has a pronounced preference for the hind legs (Matthee *et al.* 1998).

The intensity of infestation of *L. weisseri*, determined from the burdens of the 123 impalas examined in sets of 4–13 animals at monthly intervals at Skukuza and in the Mbiyamiti region, peaked from August to November (Fig. 4). That of *L. aepycerus* on the same animals peaked from July to October, and although there was no clear pattern of seasonality for *L. nevilli*, most were collected during March, April, August, October and November (Horak *et al.* 2003).

Although no *L. weisseri* were collected from January to June 1980, it was present on impalas examined during some of these months in 1981 and in 1992/93.

Not only does the morphology of *L. weisseri* differ from that of *L. aepycerus* and *L. nevilli*, the two other anopluran lice that infest impalas, but its biology also differs, thus confirming its identity as a valid separate species.

## ACKNOWLEDGEMENTS

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## REFERENCES

HORAK, I.G. 1982. Parasites of domestic and wild animals in South Africa. XV. The seasonal prevalence of ectoparasites on impala and cattle in the northern Transvaal. *Onderstepoort Journal of Veterinary Research,* 49:85–93.

HORAK, I.G., BOOMKER, J., KINGSLEY, SHIRLEY A. & DE VOS, V. 1983. The efficacy of ivermectin against helminth and arthropod parasites of impala. *Journal of the South African Veterinary Association*, 54:251–253.

HORAK, I.G., BOOMKER, J., SPICKETT, A.M. & DE VOS, V. 1992. Parasites of domestic and wild animals in South Africa. XXX. Ectoparasites of kudus in the eastern Transvaal Lowveld and the eastern Cape Province. *Onderstepoort Journal of Veterinary Research,* 59:259–273.

HORAK, I.G., GALLIVAN, G.J., BRAACK, L.E.O., BOOMKER, J. & DE VOS, V. 2003. Parasites of domestic and wild animals in South Africa. XLI. Arthropod parasites of impalas, *Aepyceros melampus* in the Kruger National Park. *Onderstepoort Journal of Veterinary Research*, 70:131–163.

KIM, K.C. & LUDWIG, H.W. 1978. The family classification of the Anoplura. *Systematic Entomology*, 3:249–284.

LEDGER, J.A. 1980. *The arthropod parasites of vertebrates in Africa south of the Sahara. IV. Phthiraptera (Insecta).* Johannesburg: The South African Institute for Medical Research (Publication no. 56).

MATTHEE, SONJA, HORAK, I.G. & MELTZER, D.G.A. 1998. The distribution and seasonal changes of louse populations on impala *Aepyceros melampus*. *South African Journal of Wildlife Research*, 28:22–25.

MUSSER, G.G. & DURDEN, L.A. 2002. Sulawesi rodents: description of a new genus and species of Murinae (Muridae, Rodentia) and its parasitic new species of sucking louse (Insecta, Anoplura). *American Museum Novitates*, 3368:1–50.

VAN DYK, P.J. & MCKENZIE, A.A. 1992. An evaluation of the effectivity of the scrub technique in quantitative ectoparasite ecology. *Experimental and Applied Acarology*, 15:271–283.

WEISSER, C.F. 1975. A monograph of the Linognathidae, Anoplura, Insecta. (excluding the genus *Prolinognathus*). Unpublished Ph.D. dissertation, University of Heidelberg.

WEISSER, C.F. & LEDGER, J.A. 1977. Two new *Linognathus* (Phthiraptera: Linognathidae) from roan and nyala (Bovidae) in southern Africa. *Journal of the Entomological Society of South Africa*, 40:283–289.