Scanning electron microscopical investigation of the waterbuck louse *Bovicola* (syn. *Damalinia*) *hilli* found at the Rietvlei Nature Reserve near Pretoria

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Arthropod ectoparasites have rarely been described under the scanning electron microscope (SEM). The content of this report provides further information on the morphology of *Bovicola hilli*, as previously only described by light microscopy. Live lice were collected and prepared for viewing by scanning electron microscopy. Micromorphological features investigated included aspects of the forehead, mandibles, medial groove, cushion-like pads, antennae, antennae sensillae, legs and claws, abdominal segments and spiracles, as well as the thorax. The total average length (2.2 mm) was also recorded. The forehead was emarginated. The mandibles were notched and serrated. The medial groove was well developed. Beneath the mandibles, two cushion-like pads were described. The antenna showed conical setae on a toothed distal segment. The antennal sensillae consisted of 12 apical pegs, two tuft organs protruding from two pore organs and three radiated plate organs. The mid legs had longer tibiae and claws than the front and hind. The legs showed extended single claws that closed towards fixed apositional but shorter claws. Abdominal segments showed six pairs of spiracles, a wide third segment with tergites and sternites and transverse rows of short setae. The gonopods covering the genital opening displayed only a few short setae. The aedeagus could not be demonstrated however, two parameres protruded from the genital opening. Two large thoracic spiracles were noted. The investigation should facilitate future identifications and possible comparative studies of this louse by biologists, entomologists and veterinarians.

Key words: ectoparasites, *Bovicola*, SEM, waterbuck, *Kobus ellipsiprymnus*.

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Introduction

The superorder Psocodea comprises two orders, one of which is the Phthiraptera. Phthiraptera have no free-living stages and are all obligate ectoparasites found on almost all avians and approximately a quarter of all mammals (Smith 2000; Soler Cruz 1995). Lice are further divided into four groups namely Amblycera, Ischnocera, Rhyncophthirina (a monogeneric group found on elephants and warthog only) and Anoplura. The former three are of the biting (mallophaga) type whilst the latter (Anoplura) are commonly known as the sucking type (Smith 2000). The genus *Damalinia* comprises three subgenera (Soler Cruz & Martin Mateo 1998,): *D. Tricholipeurus*, *D. Cervicola* and *D. Damalinia* (*Bovicola*, Ledger 1980).

According to Ledger (1980), *Bovicola hilli* is a common ectoparasite (Mallophaga) of the waterbuck (ogilby) (*Kobus ellipsiprymnus*). The waterbuck is an important game animal found in many reserves and game farms in South Africa. Few of the species of arthropod parasites have been described under the scanning electron microscope (SEM) and

Fig. 1. A low magnification SEM micrograph of the dorsal view *B. hilli*.

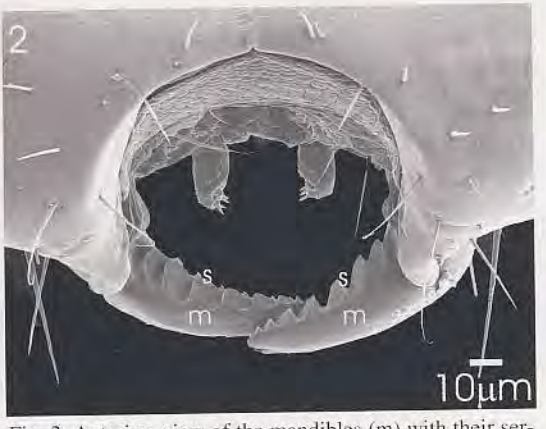

Fig. 2. Anterior view of the mandibles (m) with their serrated (s) blade-like appearance.

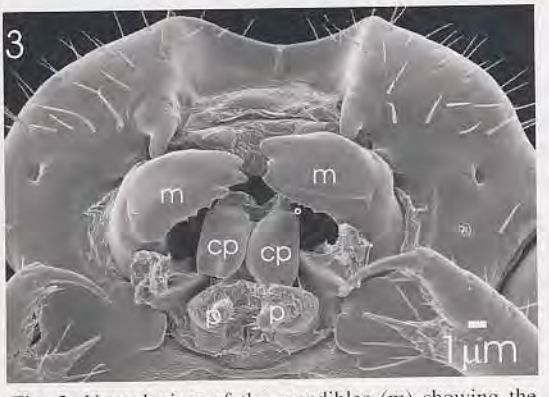

Fig. 3. Ventral view of the mandibles (m) showing the pedipalps (p) and the cushion-like pads (cp)

only line diagrams, drawn from light microscope (LM) images of *B. hilli*, were found in an extensive literature search. It was thus of reasonable concern to discover a paucity in the literature, concerning the scanning electron microscopy of *B. hilli* and other mallophagean lice species found in the mammalian kingdom. This study was performed to serve as an aid in the identification of *B. hilli* and to add to the existing detail found on its morphology.

Materials and methods

Live lice were collected during an organised culling session from a waterbuck in the Rietvlei Nature Reserve situated to the south east of Pretoria. The waterbuck seemed healthy and was not heavily infested, thus only 7 male lice were found in the proximity of the genitalia. The specimens were fixed in 70 % ethanol. Graded alcohol (70 %, 80 %, 96 % and absolute) was used to achieve dehydration of the lice. After dehydration the specimens were sonicated in absolute alcohol for approximately one minute. The lice were dried at the critical point of medical wet carbon dioxide, after which they were mounted and fixed onto standard SEM pin-type aluminium stubs with double-sided tape. The lice were sputter-coated with gold for two minutes at 12 mA under vacuum and in the presence of gaseous argon. The specimens were viewed in a Leica Stereoscan 420 SEM at 6 kV with 3–12 mm working distances. Although the working distances were varied, good resolution and contrast were obtained by optimal beam manipulation. Micrographs were recorded as tagged information files (*.tif) and later printed on thick photographic paper with a Hewlett Packard® 1120C Professional Series printer.

Results

Light microscope recordings by Bedford (1934) showed that the total average length of the males was 2.11 mm whilst the following was also clearly revealed. The forehead was slightly

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emarginated. The first segment of the antennae was long and broad whilst the second was found to be the shortest. The middle legs had longer tibiae and claws than those of the hind and front legs. The lateral margins of the abdomen were crenulated. It was the widest at the third segment. The flap-like gonopods characteristically closed the genital opening. The well-developed tergites and sternites each had a transverse row of short setae.

The SEM investigation revealed several micromorphological specialisations not previously demonstrated in Bedford's (1934) light-microscopically derived line diagrams or sketches of *B. hilli* but some of which were well described in other instances. The following specialisations were revealed when the lice were viewed under the Leica Stereoscan 420 SEM. The total average length of the males was 2.2 mm, a deviation (0.09 mm) that was barely notable to the above mentioned measurement (Fig. 1). This slight deviation could be ascribed to the difference in the resolving power of light and electron microscopes. The forehead (anterior hyalin region) was markedly emarginated whilst the mandibles were notched on the cutting edges and well serrated on the oral surfaces (Fig. 2). The serration probably assists in or facilitates with attachment to the host's hair, especially in extreme circumstances such as when the waterbuck seeks refuge amongst reeds in water during life threatening situations. A well-developed medial groove on the ventral surface of the head between the mandibles was noted. This groove fits snuggly over the host's hairs and also probably facilitates attachment. Situated ventrally beneath the mandibles, anterior to the pedipalps, were two cushion-like pads, described here for the first time in *B. hilli* (Fig. 3). Hypothetically, these pads could exert a force directly opposite to the mandibles leading to even greater clasping pressures around the hair of the host.

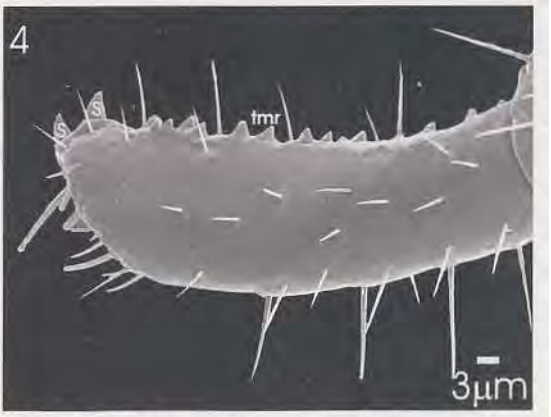

Fig. 4. SEM of the distal segment of the antenna with the toothed medial ridge (tmr) and conical setae (s).

The three segmented antenna showed two short, robust, conical setae situated medially on the tip (apex) of the distal segment, as well as a well-developed, toothed medial ridge (Fig. 4) on the entire length of the segment. The peg organ (sensilla basoconica) on the distal tip of the antennae consisted of 12 apical sensillae that varied considerably in length (Fig. 5). In addition, tuft organs, with their finger-like projections protruded from two pore organs. Adjacent to these, three

Fig. 5. The sensilla basoconica (sb) on the distal tip of the last segment showing the apical sensillae.

Fig. 6. The antennal sensoria included two pore organs each with a protruding tuft organ (to) and three small plate organs (po).

Fig. 7. The distal end of the front leg tibia showing a single extended claw (ec) and shorter apositional claw (ac).

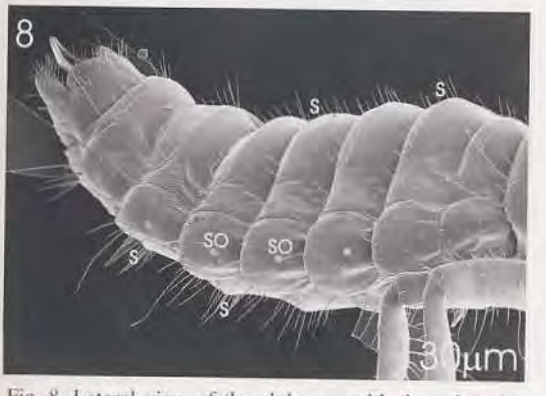

Fig. 8. Lateral view of the abdomen with the spiracular openings (so) and tranverse rows of setae (s).

plate organs, with their characteristic radiating pattern, were noted (Fig. 6).

The mid legs also had longer tibiae and claws than the hind and front legs. All legs showed an extended single claw which closed towards a fixed, apositional, but shorter claw on the distal end of the tibia (Fig. 7).

The abdominal segments showed six pairs of spiracles, the third segment was the widest and displayed well-developed tergites and sternites with transverse rows of short setae situated on the dorsal and ventral surfaces (Fig. 8).

Unlike *Bovicola caprae* (a common goat louse), the gonopods covering the genital opening did not resemble a pincushion (Green *et al.* 2001) and displayed only a few short setae. This would suggest some taxonomic importance in the Bovicolan species. The aedeagus could not be demonstrated in any of the specimens, however, two parameres protruded from the genital opening (Fig. 9).

Two large thoracic spiracles situated laterally on the pro-thorax were noted. Due to debris, the filtering apparatus could not be described (Fig. 10).

This investigation does not purport to be taxonomic in nature but was rather intended to assist biologists and veterinarians in the identification of the species and in further comparative studies.

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Fig. 9. Parameres (p) protruded from the genital opening with short setae on the gonopods.

Fig. 10. The large thoracic spiracle (ts) was clearly demonstrated.

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