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(Mesostigmata: Gamasina: Macronyssidae)**

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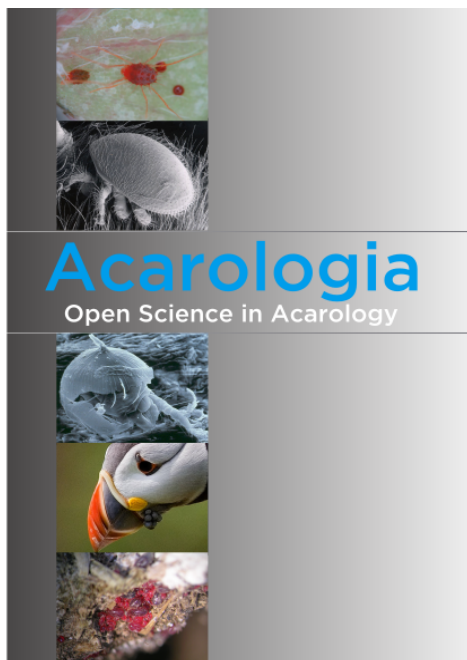
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New geographical and host record of bat ectoparasite *Steatonyssus* (*Steatonyssus*) *afer* Radovsky and Yunker, 1963 (Mesostigmata: Gamasina: Macronyssidae)

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Original research

ABSTRACT

Steatonyssus afer is recorded for the first time from Namibia and for the first time from *Cistugo seabrae* (Chiroptera: Cistugidae). Our finding is the southernmost locality for *S. afer*, expanding the geographical distribution range of this ectoparasite. We give diagnostic illustrations and measurements of the species.

Keywords *Steatonyssus afer*; Macronyssidae; Namibia; *Cistugo seabrae*

Introduction

Steatonyssus is the largest genus in the family Macronyssidae and has been recorded from every major zoogeographic region (limited in the Australasian to one Australian species) (Radovsky, 1967, 2010). Radovsky (2010) recognized 53 species both in *Steatonyssus* (52) and *Steatonyssella* (1) subgenera. Mites of genus *Steatonyssus* parasitize bats (Chiroptera: Vespertilionidae, Molossidae, Rhinolophidae, Hipposideridae, Nycteridae, Emballonuridae, and Pteropodidae), some rodents (Rodentia: Myoxidae), and elephant shrews (Macroscelidea: Macroscelididae).

According to Coffee (1973), for the Afrotropical (Ethiopian) region, 16 species belonging to the genus *Steatonyssus* have been recorded: *Steatonyssus periblepharus* Kolenati, 1858, *Steatonyssus* (*Steatonyssus*) *aelleni* Radovsky and Yunker, 1963; *Steatonyssus* (*Steatonyssus*) *afer* Radovsky and Yunker, 1963; *Steatonyssus* (*Steatonyssus*) *benoitii* Till and Evans, 1964; *Steatonyssus* (*Steatonyssus*) *brucei* Lavoipierre, 1956; *Steatonyssus* (*Steatonyssus*) *calcaratus* Radovsky and Yunker, 1963; *Steatonyssus* (*Steatonyssus*) *crassisetosus* Till and Evans, 1964; *Steatonyssus* (*Steatonyssus*) *eos* Zumpt and Till, 1954; *Steatonyssus* (*Steatonyssus*) *hipposideros* Till, 1958; *Steatonyssus* (*Steatonyssus*) *mutatus* Coffee, 1973; *Steatonyssus* (*Steatonyssus*) *natalensis* Zumpt and Patterson, 1951; *Steatonyssus* (*Steatonyssus*) *nyassae* Hirst, 1922; *Steatonyssus* (*Steatonyssus*) *roeri* Coffee, 1973; *Steatonyssus* (*Steatonyssus*) *sudanensis* Hirst, 1923; *Steatonyssus* (*Steatonyssus*) *tibialis* Till and Evans, 1964; and *Steatonyssus* (*Steatonyssus*) *javensis brevisetosus* Till and Evans, 1964. Most of them are known only by the first description and, in some cases, scattered records. *Steatonyssus afer* is known by the findings in Angola from mixed collection of hosts [(the banana pipistrelle *Neoromicia nana* Peters, 1852, the

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Figure 1 Map of Africa, showing previous (triangles) and new (circle) record sites for the bat ectoparasitic mite *Steatonyssus (Steatonyssus) afer*.

white-winged serotine *Neoromicia tenuipinnis* Peters, 1872 (Chiroptera: Vespertilionidae), and the large-eared slit-faced bat *Nycteris macrotis* Dobson, 1876 (Chiroptera: Nycteridae)] (Radovsky and Yunker, 1963), in Sierra Leone (host was determined as a “small bat”) (Till, Evans, 1964, and in Afghanistan from the serotine bat *Eptesicus serotinus* and the mouse-tailed bat *Rhinopoma* sp. (Dusbábek, 1970) (Fig. 1). Here, we report *S. afer*, including a brief description of adult females, in Namibia and associated with the Angolan wing-gland bat *Cistugo seabrae* Thomas, 1912 (Chiroptera: Cistugidae), including a brief redescription of female.

Materials and methods

We conducted research on Namib Desert bats and their ectoparasites in the Kunene Region of northwestern Namibia (Fig. 1). This region is comprised of pastoralist communal conservancies and tourism concessions bordering Skeleton Coast Park, and receives ~30 to 100 mm of rainfall, on average, between January and April each year (Jacobson and Jacobson, 2013).

From 6 December 2016 to 4 April 2017, we intensively examined captured bats for ectoparasites. We captured bats by deploying mist nets (2 m high by 4 to 12 m in length) above bodies of water for 1 to 3 hr after sunset for a total of 120.37 hr over 37 nights. We removed bats from mist nets within 1 to 5 min of capture and placed them in cloth bags until they could be processed 0 to 15 min later. Bats were morphologically identified using taxonomic descriptions

by Monadjem *et al.* (2010) and we recorded the following data for each bat: sex, age (juvenile or adult), forearm length (mm), body mass (g), and reproductive status (non-reproductive, reproductive, pregnant, or lactating). The body (front, back, tail, wings, ears, uropatagium, etc.) of all bats were thoroughly and systematically surveyed in hand and examined for ectoparasites using an LED headlamp.

All ectoparasites were removed with forceps, pooled into one sample for each individual bat, and preserved in 95% ethanol before the bats were released. For each ectoparasite sample, we transferred the mites into a new vial containing 70% ethanol and sent all mites to the Institute X-bio of Tyumen State University (Russia) for species identification. After clearing, the mites were mounted on permanent slides with Faure-Berlese's mounting medium (Whitaker, 1988). Morphological identification of mites was done by the first author (MO), according to the keys by Till and Evans (1964). The morphological terminology generally follows Evans and Till (1979). Dorsal and ventral setae were labelled according to the systems of Lindquist and Evans (1965). Photographs were taken with a digital camera AxioCam ICc5 (Zeiss, Germany) via a compound microscope AxioImager A2 (Zeiss, Germany) with a phase-contrast and DIC objectives. All measurements are given in micrometers (μm).

The specimens mounted on five slides were deposited at the collection of the Tyumen State University's Museum of Zoology, Tyumen Province, Russia.

Results and discussion

Five specimens of macronyssid mites (Mesotigmata: Gamasina: Macronyssidae) were obtained from adult females of the Angolan wing-gland bat *C. seabrae*, in two localities of Namibia: Okongwe (18°59'S 13°9'E) (one bat) and the junction of the Hoanib and Mudorib Rivers (19°19'S 13°14'E) (one bat). Mites (five females) were morphologically identified as *S. afer*. Measurement information from the present study and previous ones is provided in Table 1.

Family Macronyssidae

Genus *Steatonyssus* Kolenati, 1858

Type species: *Steatonyssus periblepharus* Kolenati, 1858, by designation of Till and Evans, 1964

Steatonyssus (Steatonyssus) afer Radovsky and Yunker, 1963

Figures 2–3

Differential diagnosis (female) — *Steatonyssus afer* is morphologically closest to *S. roeri*. The anterior margin of the sternal plate can hardly be detected in *S. afer* (vs. well defined in *S. roeri*). In *S. afer*, the peritreme starts ventral and bends over to the dorsal surface for most of its length, while the peritrematal plate is interrupted with a leaf-like portion lying over coxae I and II (vs. not interrupted plate in *S. roeri*). The setae on the opisthonotal and podonotal shields are considerably longer and thicker in *S. afer* than in *S. roeri* (54–71 vs. 40–47, respectively).

Brief description of female — Five specimens from Namibia were measured (Table 1).

Idiosoma: ovoid, light brown colour. Dorsum (Fig. 2A–D), podonotal shield clearly reticulated, with 11 pairs of setae, *j*2 present; setae *z*2 – 3, *s*3 – 4 longest; posterior margin of shield flat (Fig. 2A, C); opisthonotal shield concave anteriorly with pronounced reticulate pattern, bearing 7 setal pairs, *J*1 – 3 long, *S*5 short, *J*5 microseta (Figs. 2B, D). Venter, sternal shield, not sharply demarcated from reticulate presternal area, posterior region heavily sclerotized (Fig. 3), with 2 pairs of pores and 3 setal pairs. Epigynial shield triangular, anterior flap has slender sclerotized median projection. Anal shield obovate, with 3 setae. Idiosomal unsclerotized integument with about 102–110 pairs of smooth setae (64–69 on dorsal side, and 38–41 on ventral side); peritremes end over coxa III; peritrematal shield interrupted, separated anterior leaf-like part situated over coxa I (Fig. 4).

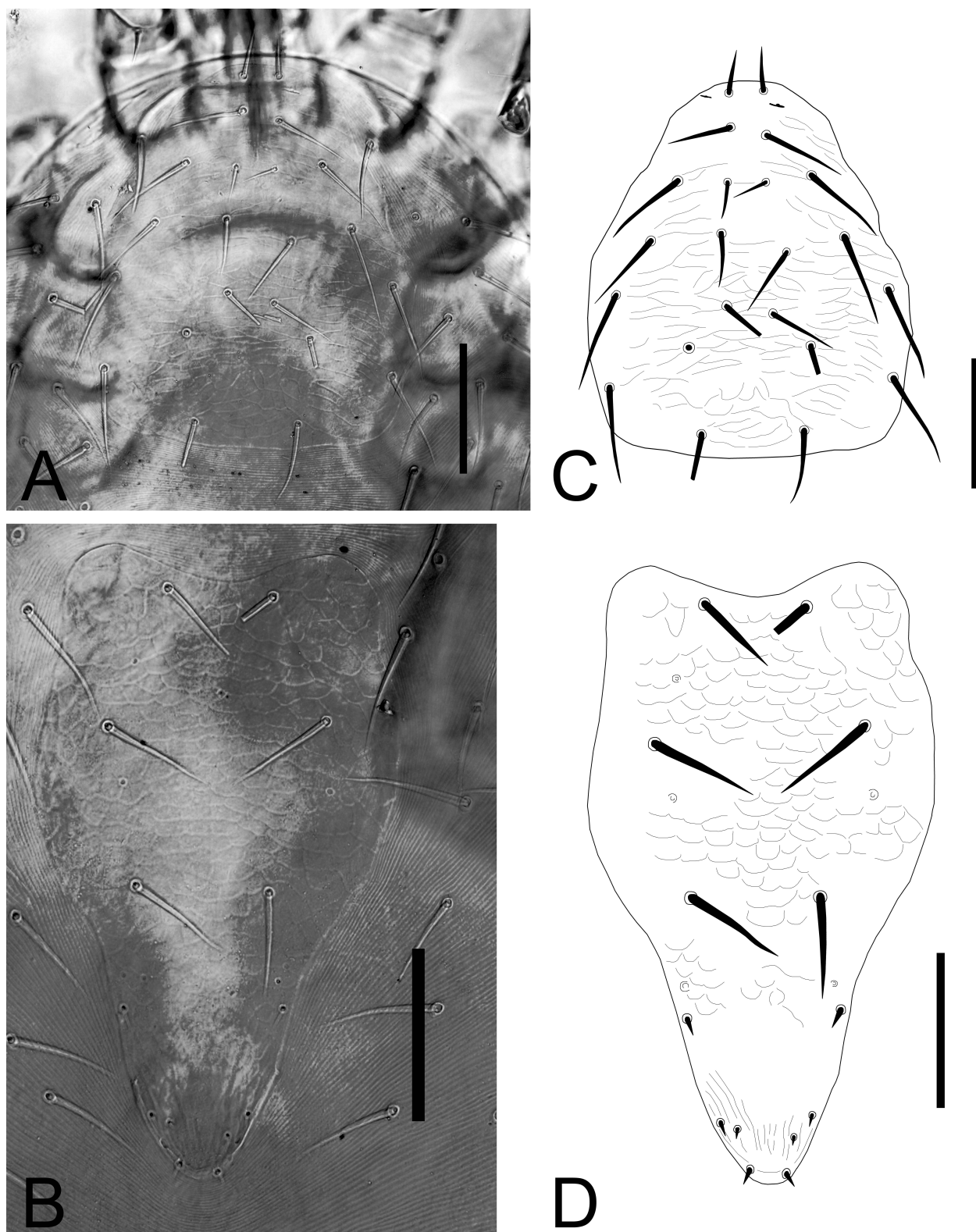


Figure 2 Female of *Steatonyssus afer*. A, C. Podonotal shield (scale bar 100 μm); B, D. Opisthonotal shield (scale bar 100 μm).

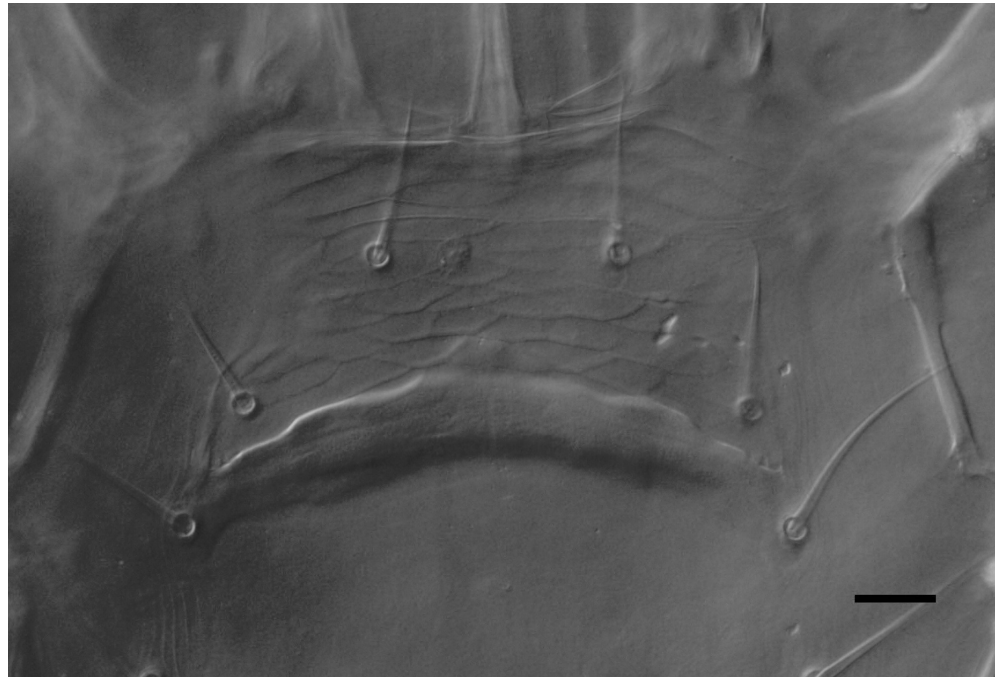


Figure 3 Female of *Steatonyssus afer*. Sternal shield (scale bar 20 μ m).

Gnathosoma: deutosternum with 7 teeth arranged in single file (Fig. 5).

Legs: coxae II bears pronounced anterodorsal spur; in a single specimen from Mudorib River its tip divided into four denticles. Chaetotaxy of the legs typical for the genus (Fig. 6).

Material examined — One female sampled from *C. seabrae* in Okongwe (18°59'S 13°9'E) (4 I 2017; coll. T. Lavery) and four females from *C. seabrae* close to the Mudorib River (19°19'S 13°14'E) (6 XII 2016; coll. T. Lavery) (Kunene Region, Namibia).

Distribution — Angola (type locality) (Radovsky, Yunker, 1963), Sierra Leone (Till, Evans, 1964), Afghanistan (Dusbábek, 1970), Namibia (our data, first record).

Hosts — *Neoromicia nana* (as *Pipistrellus nanus* – Radovsky, Yunker, 1963), *Neoromicia*

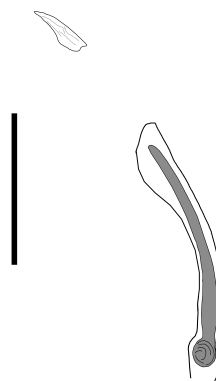


Figure 4 Female of *Steatonyssus afer*. Peritreme and peritremal shields (scale bar 100 μ m).

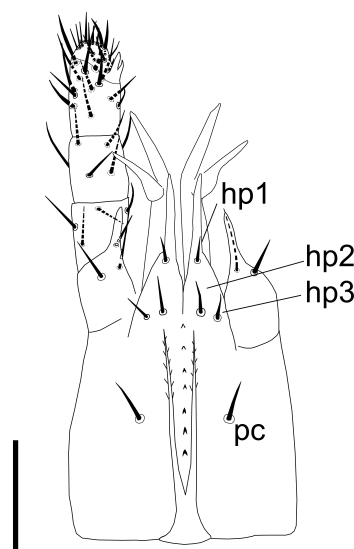


Figure 5 Female of *Steatonyssus afer*. Gnathosoma (scale bar 20 μ m).

tenuipinnis (Chiroptera: Vespertilionidae) (as *Eptesicus tenuipinnis* – Radovsky, Yunker, 1963), *Nycteris macrotis* (Chiroptera: Nycteridae) (Radovsky, Yunker, 1963), *Eptesicus serotinus* (Chiroptera: Vespertilionidae) (Dusbábek, 1970), *Rhinopoma* sp. (Chiroptera: Rhinopomatidae) (Dusbábek, 1970), *Cistugo seabrae* (Chiroptera: Cistugidae) (our data, first record).

Remarks — We note that there is a fairly large variation in size among the mites recorded so far (in Namibia in this study and in different regions in the literature; Table 1). Since we were only able to examine five specimens from Namibia (from five bats in two distant localities) and could not standardize our measurements by performing them in parallel on the types, we cannot conclude about possible crypticism within the species *S. afer*. However, we suggest that

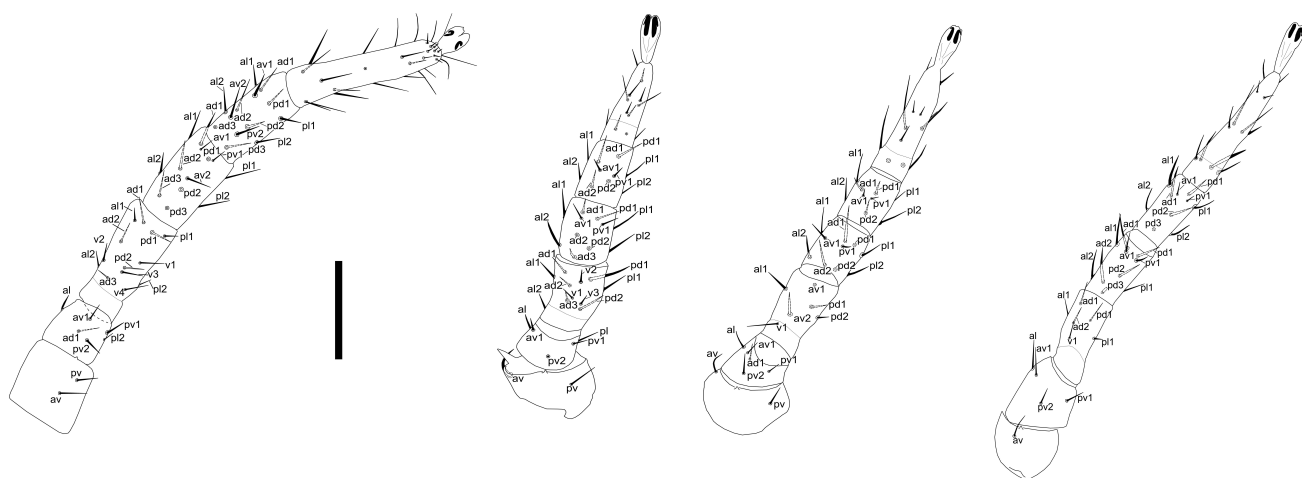


Figure 6 Female of *Steatonyssus afer*. Legs (scale bar 100 μ m).

Table 1 Comparison of metric data of body parts between *Steatonyssus afer* adult female from Namibia and those described in Angola. All measurements are given in micrometers (μm).

	<i>Steatonyssus afer</i> Angola (Radovsky, Yunker, 1963; Till, Evans, 1964)	<i>Steatonyssus afer</i> Namibia (this paper)	<i>Steatonyssus roeri</i> Namibia (Coffee, 1973)
Body part			
Idiosoma, length	849	≈1000	-
Idiosoma, width	503	≈700	-
Podonotal shield, length	276	297.0±6.6 (289-304)	288
Podonotal shield, width	-	250.8±6.9 (242-258)	278
<i>j</i> 2	-	28.5±2.7 (26-32)	24-26
<i>z</i> 2 – 3, <i>s</i> 3 – 4	67-76	74.9± 3.2 (71-80)	-
Opistonotal shield, length	308-338	357.2±7.3 (347-367)	365-403
Opistonotal shield, width	180-195	204.4±9.4 (194-213)	202
<i>J</i> 1 – 3	64-71	59.5±5.5 (52-66)	40-47
<i>S</i> 5	-	10.3±0.8	14
Sternal shield, length	57	57.2±3.8 (51-60)	54-59
Sternal shield, width	-	155.8±2.7 (153-160)	127-137
<i>St</i> 1	39-43	39	-
<i>St</i> 3	67-72	71, 72	-
<i>St</i> 1 – <i>St</i> 1	47	61±2.5 (59-64)	61-64
Epigynial shield, length	-	313.8±15.0 (296-329)	-
Epigynial shield, width	-	111.8±5.4 (106-119)	-
Anal shield, length	150-165	186.8±5.2 (181-194)	125-137
Anal shield, width	74-82	90.8±2.2 (88-93)	85-96
Dorsal opistosomal setae, length	-	74.5±2.6 (71-78)	-
Ventral opistosomal setae, length	-	50.5±8.0 (39-60)	-
Tibia I	87	94, 101	-
Tarsal I	157-160	177, 182	-
Tibia IV	80	99, 103	-
Tarsal IV	168-180	208	-

it would be useful to explore the genetic structure of this taxon by morphological comparisons on a larger and more representative sample and, if possible, by adding a molecular analysis to the morphological analysis.

The individuals present the first record of *S. afer* for Namibia and the southernmost locality for the species to date. Also, *C. seabrae* is recorded as another host of the parasite.

Given the poor knowledge of genus *Steatonyssus* in Africa, there is a need for further research on *Steatonyssus* species throughout Africa to establish complete host lists and geographical ranges of these ectoparasites.

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Ethical approval

All applicable institutional, national and international guidelines for the care and use of animals were followed. Fieldwork was conducted with in accordance with the guidelines of Colorado State University's Institutional Animal Care and Use Committee (Protocol #15-6140A) and the Ministry of Environment and Tourism, Republic of Namibia (research/collecting permits #2122/2016 and #2225/16).

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