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Rhinonyssus nenecoi sp. nov. (Mesostigmata: Rhinonyssidae); a new nasal mite from *Daption capense* (Procellariiformes: Procellariidae)

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Abstract

Parasitic nasal mites have been surveyed in a range of vertebrate hosts, but only two species of Rhinonyssidae have been described from procellariiform seabirds. We here describe *Rhinonyssus nenecoi* **sp. nov.**, from Cape petrels, *Daption capense* (Procellariidae), collected in Rio Grande do Sul State, southern Brazil. The new species is morphologically most similar to *R. procellaricus* and *R. pluvialis* differing mainly by a strongly sclerotised podosomal shield with four pairs of setae, covering more than half of the idiosoma; a podosomal shield with a V-shaped posteromedial projection; an irregularly-shaped sternal shield; and a ventral opisthosoma with 3–4 pairs of setae.

Key words: Acari, Cape petrel, nasal mites, seabirds, systematics

Introduction

Avian nasal mites have been surveyed throughout the world, including South Africa (Gretillat 1961; Vanstreels *et al.* 2018), Australia (Domrow 1969), Brazil (Mascarenhas *et al.* 2018; Gastal *et al.* 2022), Canada (Knee & Galloway 2016), Russia (Dimov 2020; De Rojas *et al.* 2020), Japan (Kadosaka *et al.* 1987), and the United States of America (Pence 1975; Spicer 1987), among other localities. The family Rhinonyssidae (Parasitiformes: Mesostigmata) is the most diverse group of nasal mites, including blood-sucking parasites of the respiratory tract of birds (Strandtmann 1948; Pence 1973; Fain 1994). Specimens in the genus *Rhinonyssus* Trouessart, 1894 are the most commonly found nasal mites in waterbirds. Approximately 40 species have been described from various orders of aquatic birds, both marine and freshwater (Beron 2020; Dimov 2020; Gastal *et al.* 2022). Of these, only six species were reported in Brazil (Mascarenhas *et al.* 2018; Gastal *et al.* 2022). In the present study we report on a new species of *Rhinonyssus* from the Cape petrel *Daption capense* Linnaeus, 1758.

Procellariiformes is a large order that comprises 140 species of marine seabirds such as albatrosses, petrels, prions, storm-petrels, diving petrels and shearwaters. A total of 45 species occur in Brazil (Pacheco *et al.* 2021; Billerman *et al.* 2022). The Cape petrel is an austral migrant that breeds around the Antarctic Continent and on most sub-Antarctic islands, and occurs in Brazilian waters during the winter and spring (Bugoni *et al.* 2008; Howell & Zufelt 2019). These birds live at sea, approaching land only for breeding (Schreiber & Burger 2001). The habit of attending fishing vessels to feed on discards can promote intra- and interspecific contact opportunities, in addition to those that occur in colonies, increasing the probability of transmission of parasites.

Two *Rhinonyssus* species have previously been reported in the procellariiform species *Calonectris borealis* Cory, 1881 (Cory's shearwater), *Puffinus puffinus* Brünnich, 1764 (Manx shearwater) and *Ardenna gravis* O'Reilly, 1818 (great shearwater) (Gastal *et al.* 2022). In the current study, a third species of *Rhinonyssus* from procellariiform hosts in Brazil has been discovered and described.

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Material and methods

Three Cape petrels were collected in Rio Grande municipality, Rio Grande do Sul State, Brazil (32°12'41.88"S; 52°10'54.27"W). Two animals were found dead during regular beach surveys and one died under care at the rehabilitation center *Centro de Recuperação de Animais Marinhos da Universidade Federal do Rio Grande* (CRAM-FURG). All carcasses were collected shortly after death (<24 hours) and were frozen for later analysis.

Mites were extracted by dissecting the nasal cavities of hosts: bird heads were placed in a glass dish, dissected with pruning pliers and scissors through transverse sections, dividing the maxilla into three portions to facilitate visualisation, and examined using an Olympus® SZ51 stereomicroscope (Fig. 1). The nasal cavity was then washed with running water over a 150 µm mesh sieve. The resulting content was inspected using a stereomicroscope at 10–100× magnification and mites were collected with a brush (number 0) and stored in 70% ethanol. For microscopic analysis, specimens were cleared in lactophenol and mounted in Hoyer's medium (Krantz & Walter 2009).

Photomicrographs were taken using an Olympus® BX 41 microscope with 10× magnification connected to a digital camera, and figures were prepared using Adobe Photoshop® CS6. Nasal mites were identified with the keys provided by Pence (1975) and Knee & Proctor (2006). Descriptions of the holotype and paratypes followed the format for rhinonyssid mites from the primary literature (Pence 1972; Knee 2008).

Measurements were taken with an ocular micrometer on the lenses, with a calibrated ruler and are given in micrometres (µm); the mean value is followed by the range in parentheses. All structures were measured along the longest or widest portion. The length of the gnathosoma was taken in a ventral view including the palps. Leg measurements were taken including the coxa but excluding the ambulacrum. The leg chaetotaxy formulae are based on the system established by Evans (1963). The holotype and paratypes were deposited in the *Coleção Acarológica do Instituto Butantan* (IBSP), São Paulo, Brazil. Parasitism prevalence, mean abundance and mean intensity were estimated according to Bush *et al.* (1997).

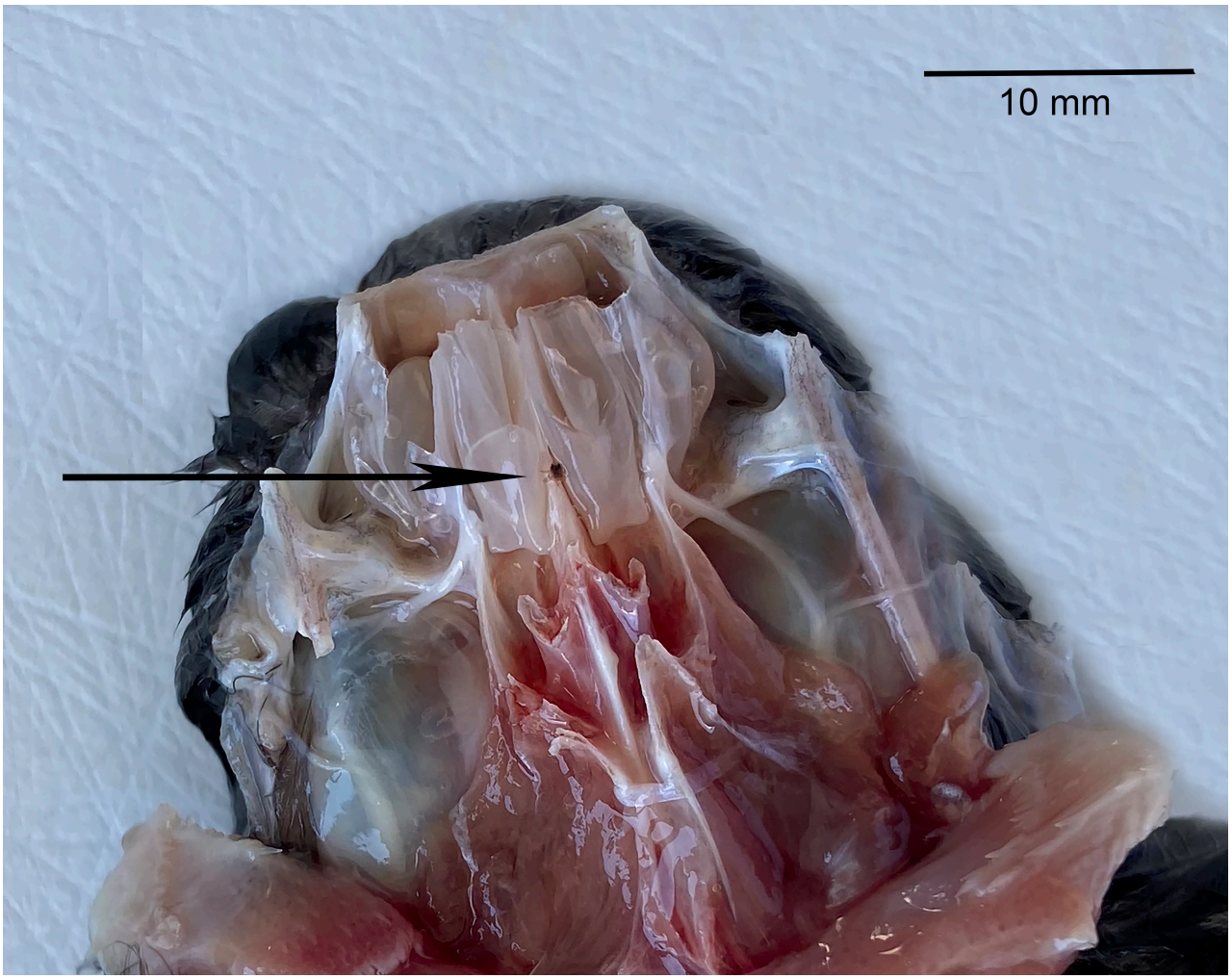

FIGURE 1. *Rhinonyssus nenecoi* **sp. nov.** in the dissected nasal cavity of *Daption capense*.

Family Rhinonyssidae Trouessart, 1895

Genus *Rhinonyssus* Trouessart, 1894

***Rhinonyssus nenecoi* sp. nov.**
(Figs. 1–4)

Type material. Holotype (IBSP 18863) and paratypes (IBSP 18864–18868) (females) from Brazil: Praia do Cassino (Cassino Beach), Rio Grande municipality, Rio Grande do Sul State, 27 May 2020.

Diagnosis. Oval body shape with a strongly sclerotised podosomal shield covering more than half of the dorsal idiosoma; shield with four pairs of minute setae; podosomal shield with gradually tapering posteromedial projection forming a V-like shape; sternal shield sclerotised and irregular in shape; ventral opisthosoma with 7–8 setae.

Description

Female (holotype and five paratypes)

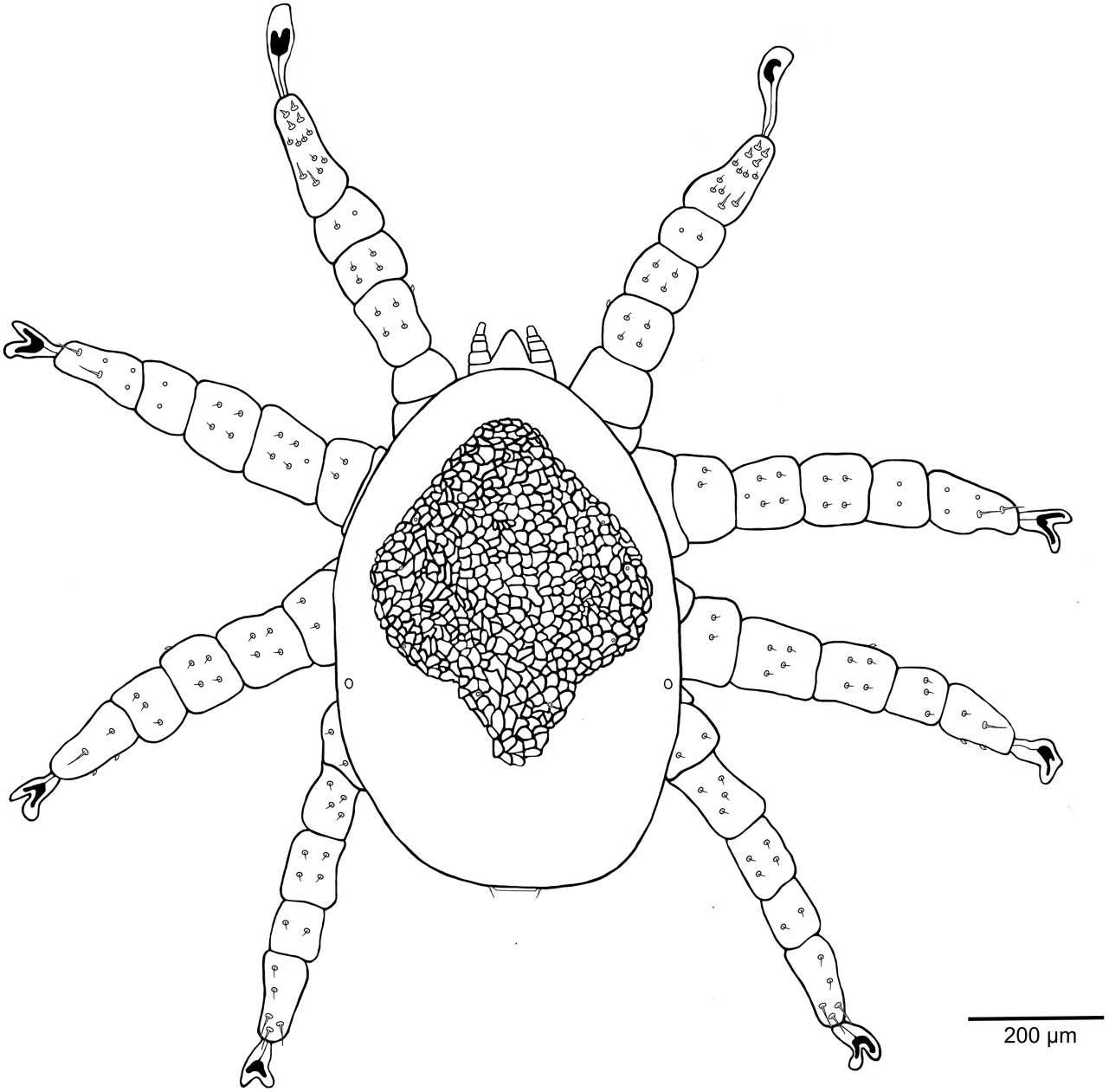

FIGURE 2. Dorsal view of *Rhinonyssus nenecoi* **sp. nov.** female.

Measurements: Length of body including palps (LID) 710 (610−860); width of idiosoma (WID) 504 (460−600); length of podosomal shield 490 (460−530); width of podosomal shield 388 (370−400); length of gnathosoma 203 (188−233); width of gnathosoma 143 (130−153); length of palps 142 (130−150); length of chelicerae 122 (115−125); width of chelicerae 29 (28−33); length of chelicera mobile digit 25 (1 specimen measured); length of genital shield 161 (128−225); width of genital shield 165 (120−235); length of sternal shield 129 (120−148); width of sternal shield 119 (103−125); length of legs: leg I 532 (500−560); leg II 512 (500−530); leg III 512 (500−530); leg IV 508 (500−520).

Dorsal idiosoma: Idiosoma elliptical, podosomal shield reticulated, covering more than half of anterior idiosoma. Podosomal shield strongly sclerotised, with four pairs of minute setae, with prominent posteromedial projection tapering gradually forming a V-like shape. Mesosomal shieldlets absent. Dorsal idiosoma without setae. Stigmata without peritremes, located dorsolaterally at level of coxae IV (Figs. 2 and 4A). Anus situated dorsoterminally, flanked by a pair of para-anal setae (Fig. 4B).

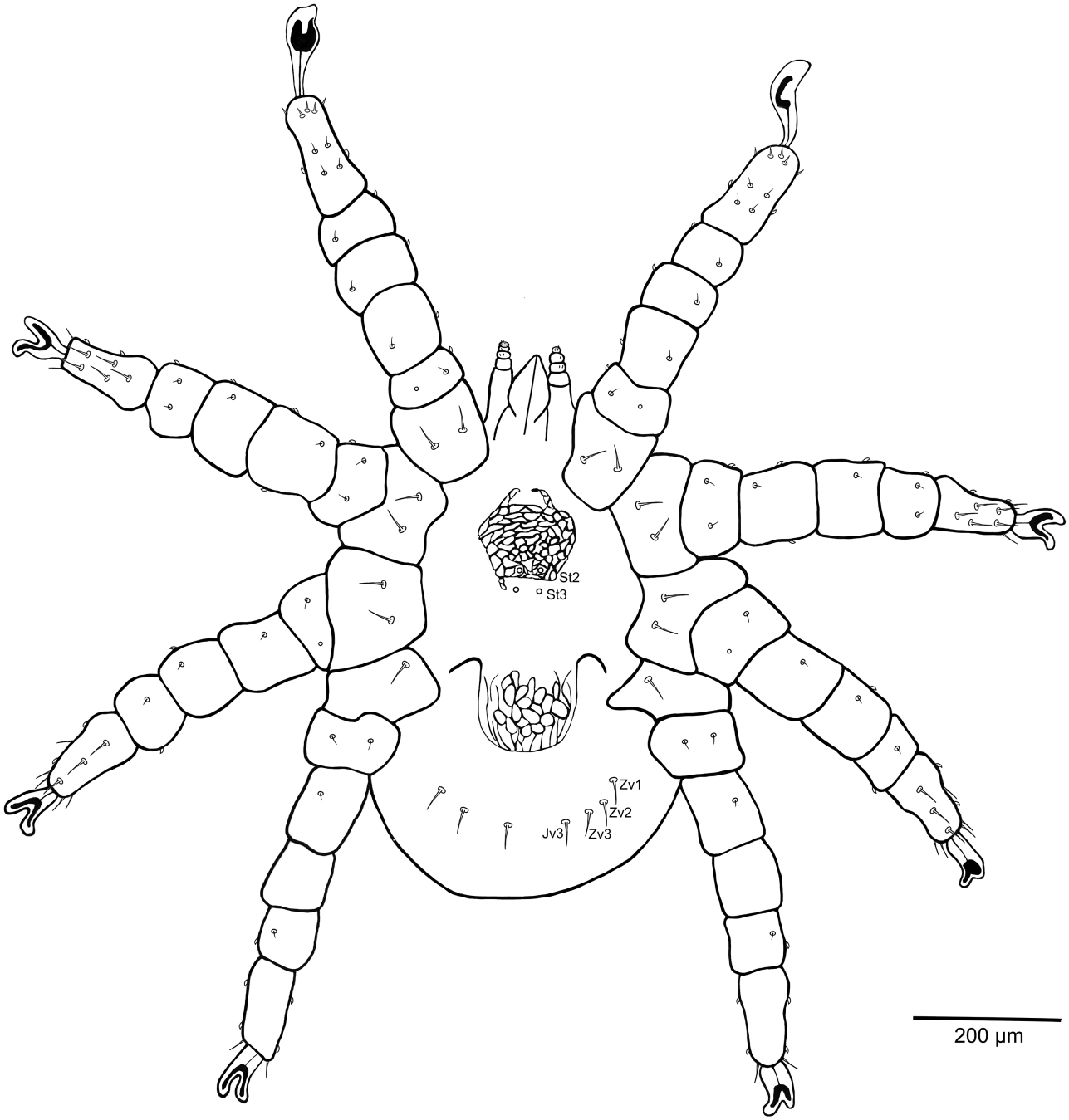

FIGURE 3. Ventral view of *Rhinonyssus nenecoi* **sp. nov.** female.

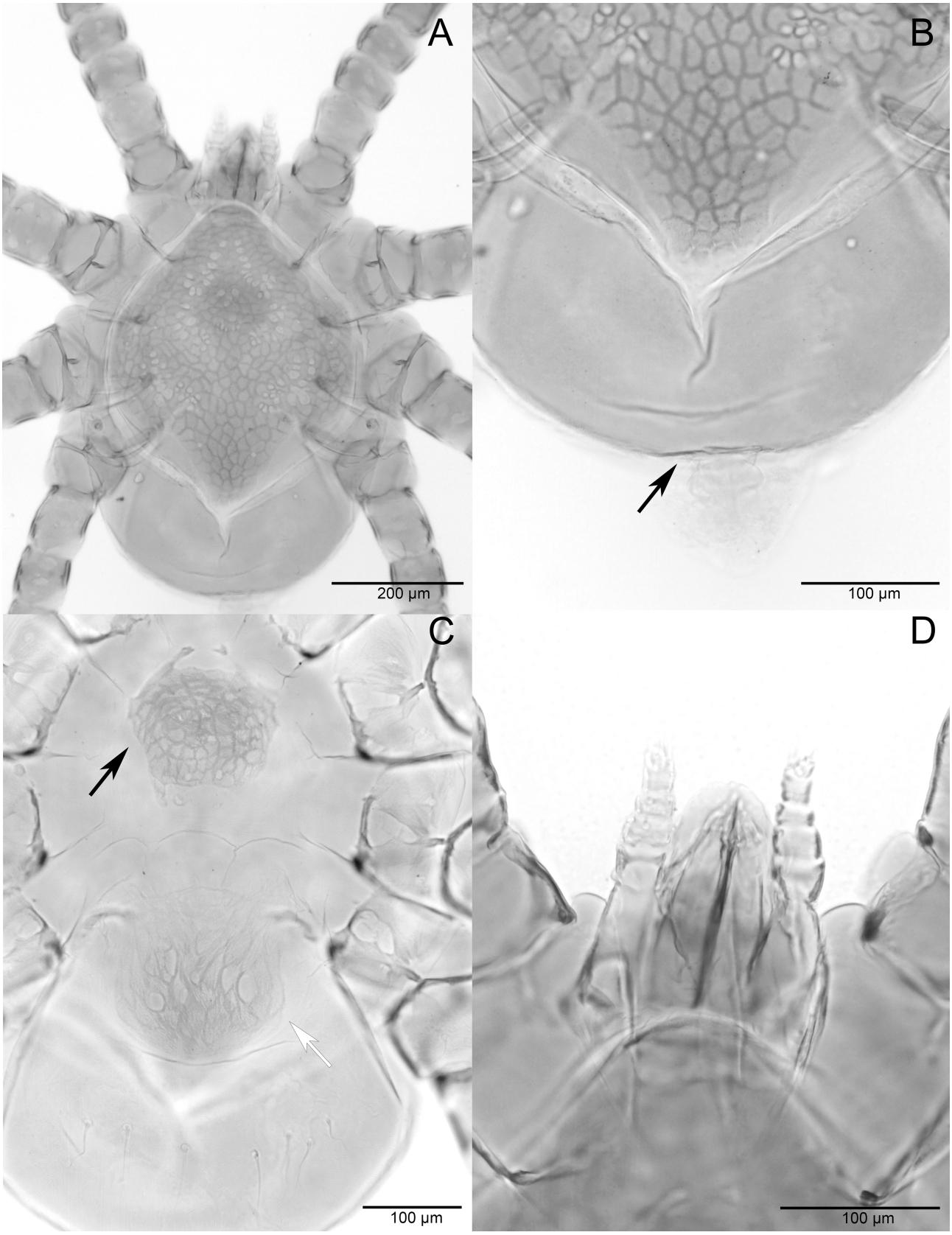

FIGURE 4. *Rhinonyssus nenecoi* **sp. nov.** female. A. dorsal idiosoma with podosomal shield B. anus situated dorsoterminally C. sternal and genital shields D. gnathosoma.

Ventral idiosoma: Reticulate sternal shield sclerotised, irregular in shape and variable in size. Sternal setae strongly reduced and represented by alveoli, one pair of sternal setae on the shield, another pair of setae in soft

cuticle posterior to sternal shield. Genital shield wider than long, rounded posteriorly, surface reticulate and devoid of setae. Ventral opisthosoma with 3–4 pairs of setae (Figs. 3 and 4C).

Gnathosoma (Fig. 4D): Gnathosoma ventral in position. Hypostomal setae and deutosternal teeth absent. Palps four-segmented, chaetotaxy of palps 0–2–1–7. Two apical pairs of setae noticeably longer than other setae of apical palpal segment. Chelicerae widest proximally, tapering distally.

Legs (Figs. 2 and 3): Chaetotaxy of legs I–IV: coxae 2–2–2–1; trochanters 3–5–4–4; femurs 7–8–6–6; genua 6–5–7–4; tibiae 6–5–5–5; tarsi 24–14–14–11. Leg segments with three types of setae: short and thickened; medium length and sharply tipped; and longer filamentous. Short and thickened and medium length and sharply tipped setae situated on trochanters, tibiae and tarsi. Longer filamentous setae situated on ventrolateral portion of coxae and in apical portion of the tarsi. Ambulacrum present in all tarsi, noticeably elongated on leg I. Claws of all legs simply curved, hook-like. Empodium covers bases of claws.

Male and immatures. Unknown.

Parasitological indices. One out of three *D. capense* (33.3%) was parasitised by *R. nenecoi*. Mean abundance was three and the mean intensity was nine mites/host.

Etymology. The specific name, *nenecoi*, is in honour of Rodolfo Pinho da Silva-Filho (Neneco) in recognition of years of work with wildlife rehabilitation including seabirds, and for encouragement with our studies on nasal mites.

Remarks. *Rhinonyssus nenecoi* is most similar to *R. procellaricus* Gastal, Mascarenhas & Bugoni, 2022, described from Manx *Puffinus puffinus* and great *Ardenna gravis* shearwaters (Procellariiformes: Procellariidae). The new species also resembles *R. pluvialis* Fain & Johnston, 1966 found in the golden plover *Pluvialis dominica* Statius Müller, 1776 (Charadriiformes: Charadriidae) (Fain & Johnston 1966), a common shorebird in southern Brazil. The three species are similar in terms of body shape, sternal shield, genital plate and dorsal podosomal plate size and shape.

Rhinonyssus nenecoi differs from the species mentioned above in the podosomal shield size, number of setae and the posteromedial projection shape. The new species is similar in size with *R. procellaricus* (LID: 650−975; WID: 450−625) (Gastal *et al.* 2022) and smaller than *R. pluvialis* (LID: 804–900; WID: 530–600) (Fain & Johnston 1966). *Rhinonyssus nenecoi* has four pairs of setae on the podosomal shield while *R. procellaricus* and *R. pluvialis* podosomal shields are devoid of setae. The posteromedial projection of the podosomal shield gradually tapered forming a "V" shape in *R. nenecoi*, while in *R. procellaricus* the posteromedial projection is relatively narrower and finger-like, and *R. pluvialis* has a dorsal shield similar to a lozenge (*sensu* Fain & Johnston 1966).

Rhinonyssus nenecoi and *R. procellaricus* have a trapezoidal sternal plate, however, in the later species it is smaller in size. The sternal shield in *R. pluvialis* is square. *Rhinonyssus nenecoi* and *R. pluvialis* have two pairs of sternal setae and *R. procellaricus* has three pairs. *Rhinonyssus nenecoi* has three or four pairs of ventral opisthosomal setae, while *R. procellaricus* and *R. pluvialis* have a single pair. Additionally, leg chaetotaxy also differs in the number of setae from the three similar species.

Discussion

The global avifauna comprises more than 11,000 species of birds (BirdLife International 2022). Considering the richness of this group and the lack of acarological studies in most of these potential hosts, it is possible to state that the diversity of mites associated with birds is little known. Mites associated with the respiratory system of birds constitute a group of parasites that are still poorly studied, especially in the southern hemisphere. *Rhinonyssus* is a relatively poorly studied genus, with most species (30 spp.) only being described since the 1990s. In the 21st Century, Butenko & Stanyukovich (2001), Dimov (2013, 2020) and Dimov & Spicer (2013) described eight new species of mites parasitising birds in Russia. In the southern hemisphere, Gastal *et al.* (2022) reported the first two species of *Rhinonyssus* in Procellariiformes. Including *R. nenecoi* there are now only three *Rhinonyssus* species known from petrels and shearwaters, marine birds which, due to their wide distribution and offshore habits, are difficult to sample. Taxonomic, systematic, and pathological studies are needed in order to generate data on parasitology, zoology and ecology of these mites and their parasitic relationships with their hosts.

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