Redescription of *Gyropus parvus* (Ewing, 1924) (Insecta: Phthiraptera: Amblycera: Gyropidae) from Tucos-Tucos (Rodentia: Ctenomyidae: *Ctenomys*) in Patagonia, Argentina

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REDESCRIPTION OF *GYROPUS PARVUS* (EWING, 1924) (INSECTA: PHTHIRAPTERA: AMBLYCERA: GYROPIDAE) FROM TUCOS-TUCOS (RODENTIA: CTENOMYIDAE: *CTENOMYS*) IN PATAGONIA, ARGENTINA

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ABSTRACT: A detailed redescription of *Gyropus parvus* (Insecta: Phthiraptera: Amblycera: Gyropidae) is given based on specimens collected from the type host, *Ctenomys colburni* Allen 1903, and the type locality, Estancia Huanuluán, Provincia de Rio Negro, Argentina. We expand and provide new chaetotaxy. New scanning electron microscopy images showing microstructural details of adults and eggs of *G. parvus* obtained from topotype specimens are included. Sexual dimorphism was mainly shown by differences in body size and abdominal chaetotaxy, with females being 17.5% larger than males and with more setae in each cluster. Significant differences between males and females were also observed in sternal plate measurements. Features described here show homogeneity within type host population. This information contributes to our knowledge of intra- and inter-specific variability for parasite populations. Our investigation constitutes the first collection of *G. parvus* from the type host and locality since it was described.

Gyropus parvus was originally described as a species of *Monogyropus* by Ewing (1924), based on a single male collected from *Ctenomys colburni* Allen, 1903 at Estancia Huanuluán, Río Negro Province, Argentina. Further descriptions of the male and female were made by Werneck (1936, 1948). In addition to the redescription of the male, which was based on specimens collected from *Ctenomys magellanicus* Bennett, 1836 at Gregory Bay, Straits of Magellan, Werneck (1936) transferred *Monogyropus parvus* to *Gyropus*.

The first description of the female was by Werneck (1948), with specimens collected from *Ctenomys sericeus* Allen 1903. This *Ctenomys* species was also mentioned by Ewing (1924) as a host of *M. parvus*. Later contributions were based on lice from different *Ctenomys* species and localities (Werneck, 1951; Cicchino, 1978; Castro et al., 1987; Cicchino and Castro, 1994; Cicchino et al., 2000; Castro and Cicchino, 2002; Martino, 2005).

The original host range and geographical distribution of *G. parvus* was increased from 3 host species (*C. colburni*, *C. sericeus*, and C. *magellanicus*) to a much greater number of *Ctenomys* species (see Cicchino and Castro, 1994, 1998; Cicchino et al., 2000; Price et al., 2003). Species of *Ctenomys* are solitary, fossorial rodents of low vagility. Therefore, the probability of cross-infestations by lice among different *Ctenomys* populations is very low, and would not favor an extensive distribution of the same louse species. In systematic research of ectoparasites from fossorial rodents, the geographical distributions of the type hosts are important parameters to consider. Detailed studies have been made on fossorial rodents of the Geomyidae and their trichodectid lice in North America, with surprising results (Hellenthal and Price, 1991).

Taxonomic, molecular, evolution rates, host–parasite cophylogeny studies, phylogenetic trees, and others have been made in order to understand the louse–host relationship and the evolution of this assemblage (Timm and Price, 1980; Hafner and Nadler, 1988, 1990; Hafner and Page, 1995; Reed and Hafner, 1997; Morand et al., 2000; Reed et al., 2000). These investigations provide an important framework to contrast to the tuco-tucos system and their chewing lice.

Since the original description of *G. parvus*, no other work had been done based on topotypic specimens; therefore, information about intraspecific morphological variation of *G. parvus* sensu stricto is non-existent. This information is essential to describe patterns of morphological variation in this taxon. A detailed redescription is

TABLE I. Collection number, sex, and host collection number for all *Gyropus parvus* louse specimens used in this study.

Louse collection number	Sex	Host
MMPPa 951	♂	MMPMa 5000
MMPPa 952	♂	MMPMa 5000
MMPPa 953	♀	MMPMa 5000
MMPPa 954	♀	MMPMa 5005
MMPPa 955	♀	MMPMa 5000
MMPPa 956	♀	MMPMa 5000
MMPPa 957	♂	MMPMa 5000
MMPPa 958	♂	MMPMa 5005
MMPPa 959	♂	MMPMa 5005
MMPPa 960	♀	MMPMa 5005
MMPPa 961	♂	MMPMa 5005
MMPPa 962	♀	MMPMa 5005
MMPPa 963	♀	MMPMa 5005
MMPPa 964	♂	MMPMa 5005
MMPPa 965	♂	MMPMa 5005
MMPPa 966	♀	MMPMa 5005
MMPPa 967	♀	MMPMa 5005
MMPPa 968	♀	MMPMa 5005
MMPPa 969	♀	MMPMa 5003
MMPPa 970	♂	MMPMa 5001
MMPPa 971	♀	MMPMa 5003
MMPPa 972	♂	MMPMa 5001
MMPPa 973	♂	MMPMa 5000
MMPPa 974	♀	MMPMa 5003
MMPPa 975	♂	MMPMa 5001
MMPPa 976	♀	MMPMa 5001
MMPPa 977	♂	MMPMa 5003
MMPPa 978	♀	MMPMa 5003
MMPPa 979	♂	MMPMa 5003
MMPPa 980	♂	MMPMa 5003
MMPPa 981	♀	MMPMa 5001
MMPPa 982	♀	MMPMa 5005
MMPPa 983	♂	MMPMa 5005

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TABLE II. Collection number, sex, and geoposition for all *Ctenomys colburni* hosts specimens used in this study.

Mammal collection number	Sex	Latitude S	Longitude W
MMPMa 5000	♀	41°22′07.1″	69°48′46.9″
MMPMa 5001	♀	41°22′04.8″	69°48′41.4″
MMPMa 5002	♀	41°22′05.5″	69°48′41.9″
MMPMa 5003	♂	41°22′08.5″	69°48′43.5″
MMPMa 5004	♂	41°22′05.1″	69°48′51.5″
MMPMa 5005	♂	41°21′55.9″	69°48′51.5″

given in the present study, which focuses on intraspecific variability, new chaetotaxy, and morphological data that are provided by specimens obtained at the type locality of *G. parvus*.

MATERIALS AND METHODS

Six tuco-tuco (*C. colburni*) were captured at the type locality of *G. parvus*, i.e., Estancia Huanuluán, Departmento 25 de Mayo, Río Negro Province, Argentina (41°22′07.1″S, 69°48′46.9″W), according to approved guidelines for the capture, handling, and care of mammals (Animal Care and Use Committee, 1998). The hosts were processed and ultimately deposited in the Collection of Mammals of the Museo Municipal de Ciencias Naturales Lorenzo Scaglia (MMPMa) Mar del Plata, Argentina (Table I).

Lice were obtained by brushing the host skins; they were then fixed in increasing ethanol solutions (10–70%) and cleared in 10% KOH. Finally, lice were mounted on permanent slides using the traditional Canada balsam technique for microscopic studies as described by Palma (1978).

Voucher specimens were deposited in the Parasitological Collection of the Museo Municipal de Ciencias Naturales Lorenzo Scaglia (MMPPa), Mar del Plata, Argentina (Table II). The illustrations were made using a camera lucida. Measurements were taken with a graduated eye piece and are expressed in micrometers. For genitalia nomenclature, we use Yoshizawa and Johnson (2006).

Scanning electronic microscopy (SEM) was used to add information about external micromorphology. For SEM, lice and eggs were fixed, dehydrated by passage in increasing ethanol solutions (10–100%), and coated with gold palladium using JEOL Fine Coat Ion Sputter JFC 1100 (JEOL Ltd., Tokyo, Japan). Observations were made and microphotographs were taken with a SEM Jeol®/EO JSM-6360 (JEOL Ltd., Tokyo, Japan). SEM measurements were taken with a multi-point measurement tool from microscope software at the Electronic Microscopy Service at Universidad Nacional de La Plata (UNLP) and are expressed in micrometers. Statistical analyses were carried out using XLStat© 7.5 (Addinsoft SARL Company, Paris, France). Mann–Whitney *U*-tests were used to test whether there were significant differences between male and female measurements.

Specimens identified as *G. parvus*, held in the collection of the Instituto Oswaldo Cruz, Rio de Janeiro, Brazil (IOCB), were examined (Slide 1225: *Monogyropus parvus* on *Ctenomys magellanicus*. Gregory Bay Estrech Magallanes. Det: F. L. Werneck; Slide 2968: *Gyropus parvus* on *Ctenomys sericeus*. Alto Rio Chico Santa Cruz, Patagonia Argentina. Det: Ferris). Considering that previous studies included hosts from others localities, the following redescriptions of both sexes are based only on new specimens collected from the type host and locality.

REDESCRIPTION

Gyropus parvus (Ewing 1924)

(Figs. 1–21)

Diagnosis: Similar in both sexes, with an elongated abdomen and irregular edge aspect due to paratergal plates (Figs. 1, 2). Body measurements in Table III. Head similar in both sexes, subtriangular shaped, wider than long, with rounded anterior edge. Four-segmented maxillary palpi do not extend further than anterior margin of head; basal segment widest, with remainder gradually narrowing, with last one longer than wide. One-segmented labial palpi, short, with terminal short setae (58–96 long). Prominent temple lobes, antennal fossae short and deep, large enough to contain antennae (sensu Marshall, 2002), on ventro-lateral surface. Four-segmented antennae, scape smallest, pedicel larger than latter, with a depression in distal zone where it articulates with first segment of flagellum (flagelomere I); pedunculated and cone-shaped (Fig. 3). Flagelomere II, largest segment globular shaped, with scaled surface and truncated distal tip and several very short (<58 long) conical setae. Sensory organs appeared as 4 cavities adjacent to distal setae; 2 of them large with peg-like seta in center surrounded by small tube-like setae (Fig. 4). Small labial palpi usually with 5 small setae in apical portion (Figs. 5, 6).

TABLE III. Measurements of *Gyropus parvus* (all measurements were significantly different between males and females).

Body measurements	Males (n = 16) Mean	Males (n = 16) SD	Females (n = 17) Mean	Females (n = 17) SD
Total length	1,277.34	15.89	1,497.79	12.48
Abdomen length	665.63	10.48	857.65	8.75
Thorax length	381.59	4.90	397.79	6.23
Head length	230.13	2.06	242.35	1.14
Head width	286.35	1.96	303.53	1.38
Width between antennal fosa	136.13	1.87	145.20	1.74

Head dorsal setae (sensu Clay 1969, 1970) generally as paired setae, with same pattern in both sexes. Anterior margin of head with several very short setae, not always visible using compound microscopy. Very short setae on anterior edge of clypeal region and 2 very short setae on each side at level of maxillary palpi. Mid-dorsal head setae (sensu Clay 1969, 1970) of medium length (96–135 long) and arranged in inverted "V" shape. Ocular setae (sensu Clay 1969, 1970) present. Four long (135–173 long), cylindrical occipital setae situated equidistant from each other and 2 very long (>173 long) temporal setae. Short lanceolate setae on margin of temporal lobe, and short spine-like seta on posterior margin below a row of occipital setae. Group of several medium-length setae on ventral side arranged in double rows forming an inverted "V." Setae on ventral–occipital region of medium length and thicker than mid-central setae. Two groups of short setae in central area, triangular in shape. Two conspicuous depressions at level of antennal fossae in mid-head region.

Prothorax quadrangular, wider than long. Anterior margin straight, approximately three-quarters width of head. Protuberance on mid-line of each lateral margin, with medium length seta on each side. Posterior margin convex. Pair of medium-length setae situated submarginally on mid-dorsal transverse line and 4 long setae arranged in straight line on distal zone. Spiracle situated on membranous area of each side of prothorax. Subtriangular prothoracic plate, longer than wide, 4–5 marginal setae on each side and 2 short spine-like setae on anterior margin (Fig. 7).

Pterothorax trapezoidal. In dorsal view, straight anterior edge, vertexes round, well defined, and narrower than posterior edge; latter not clearly defined. Dorsal chaetotaxy composed of short- and medium-length setae triangular in shape. Mesosternal plate heart-shaped, with 2 thick, medium-length central setae on anterior margin. Sub-oval metasternal plate with pointed posterior end, 5–6 submarginal setae on each side plus single seta on posterior end. Generally well pigmented, showing very conspicuous scaled pattern (Fig. 7). Sternal plates measurements are in Table IV.

Legs: Forelegs with single sharp and curved claw, similar in both sexes. Very poorly developed euplantula, hardly noticeable with compound microscope. Group of lanceolate setae in inner side of tibia (Figs. 8, 9). Middle legs with simple claw, last segment with grooves and marks that coincide with grooves in U-shaped trocanter used for clasping hairs. Distal region of trocanter fused to femur where it continues with tenaculo femoralis (Figs. 10, 11). Hind-legs with single claws, without grooves, subequal to middle-legs (Figs. 12–14). Femur of hind-legs with row of spiniform setae in mid-center of ventral side, and another row on dorsal side, without any structure related to clasping hairs (Fig. 15).

Abdomen: Segments II–VIII well-defined, spiracles noticeable from III (visible 2nd) to VIII. Two parallel rows of planate medium setae on each segment. Setae from anterior row (cluster I) shorter than setae from second row (cluster II) and as long as segment length. Setae from cluster II reached

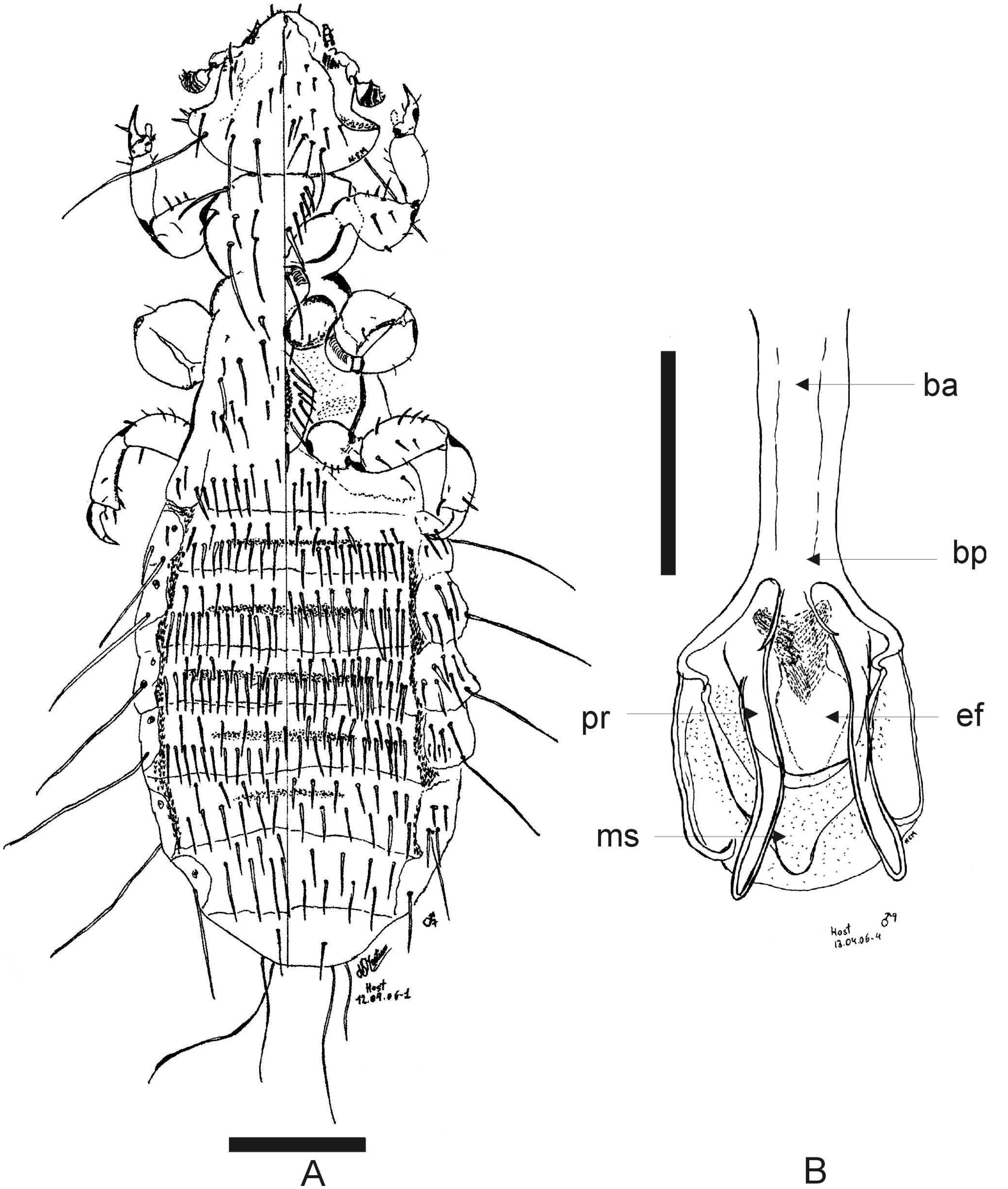


FIGURE 1. *Gyropus parvus* male. (**A**) General morphology, dorsal and ventral views. Bar = 200 μm. (**B**) Genitalia. **ba:** basal apodeme; **bp:** basal plate; **ef:** endophallus; **ms:** mesomere; **pr:** paramere. Bar = 100 μm.

the alveoli of setae in cluster I on following segment. Abdominal setae distributed along segment's width, with membranous area without setae on each side. Abdominal chaetotaxy in Table V. Paratergal plates well defined. Setae on paratergal plates with short, pre-spiracular seta, shorter than paratergal plate, long and cylindrical post-spiracular seta, 2 very short adjacent setae (sensu Clay, 1954), and 2 groups of paratergal setae, cluster I and cluster II, of variable number on each paratergite. Two very short, spine-like setae at base of each post-spiracular setae (Figs. 16, 17).

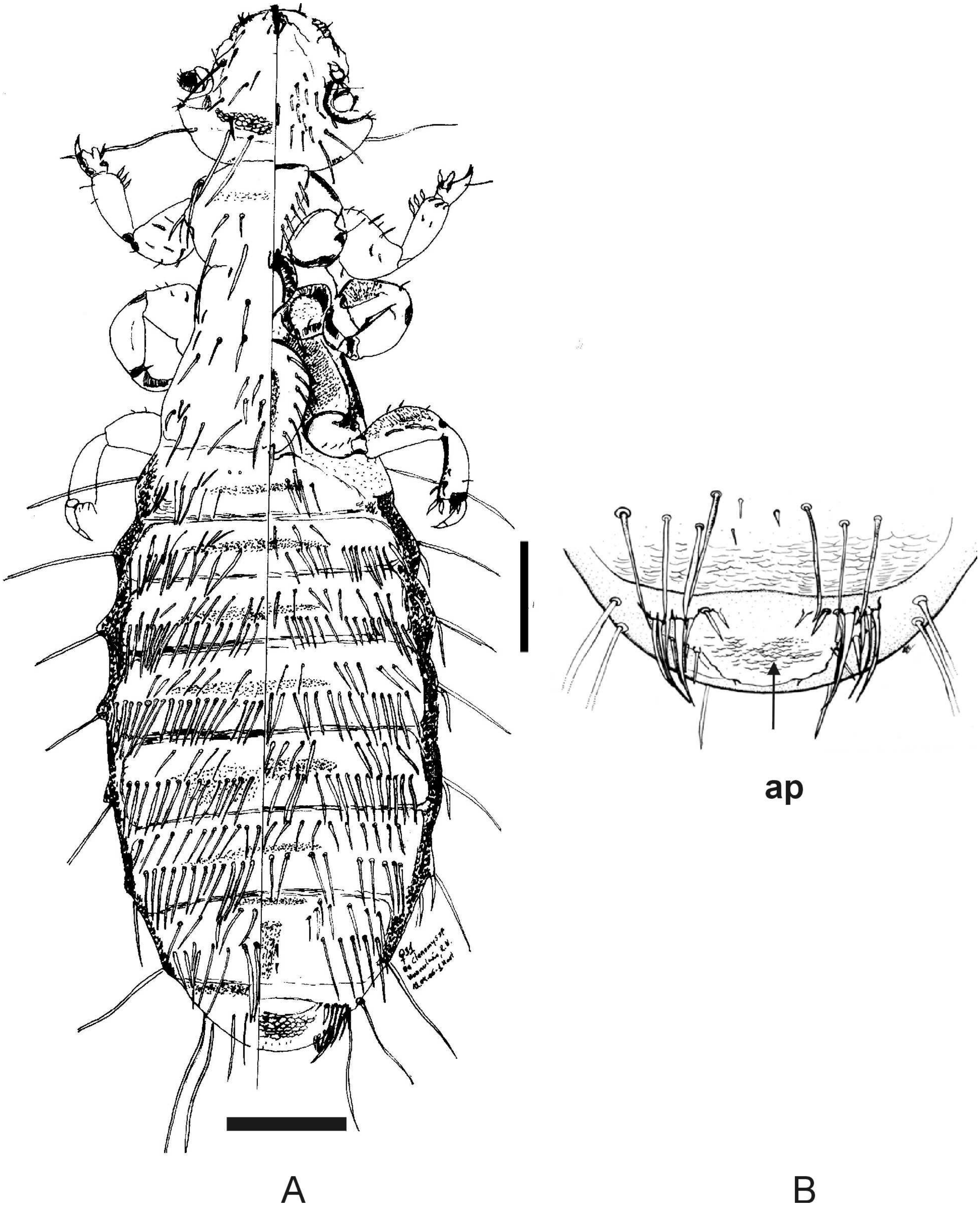
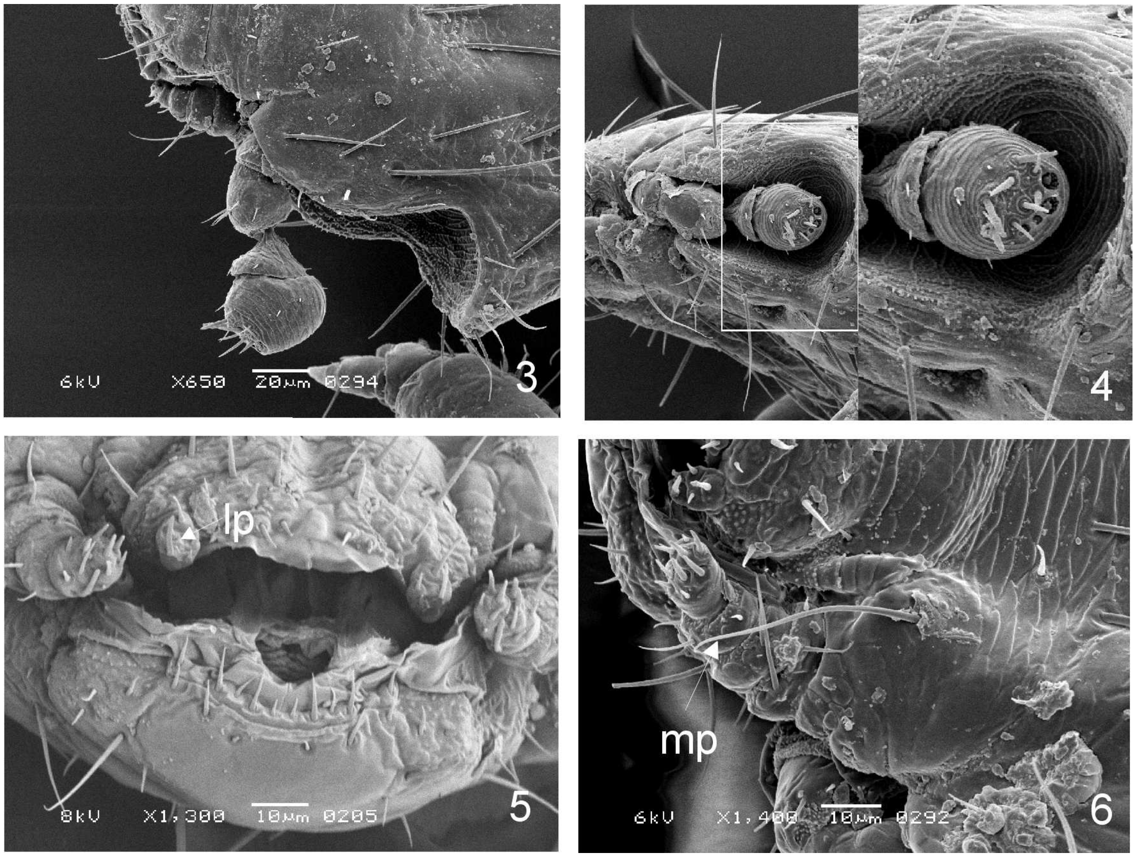


FIGURE 2. *Gyropus parvus* female. (**A**) General morphology, dorsal and ventral view. Bar = 200 µm. (**B**) Terminalia. **ap:** anal plate. Bar = 100 µm.

Male genetalia: As in Figure 1B, wide and long basal apodeme, apex extends to middle of 6th segment and to distal margin of 7th segment, wider proximally than distally, bifurcated (Y-shaped), joining 2 long, blunt parameres that curved outwards. Mesomere well developed with round apex. Aedeagal sac usually in central region.

Female genetalia: As in Figure 2B; oval plate with distinguishable scaled pattern and very short, pointed projections.

Eggs: Chorionic egg shells with porous surface formed by sub-areolar depressions of different sizes. Sculpture only absent at amphora base, where spumalina located. Cap or operculum depressed without typical



FIGURES 3–6. (**3**) Dorsal view of antenna. (**4**) Lateral view of antenna with a detail of distal sensory organs. (**5**) Frontal view of *Gyropus parvus* head. (**6**) Ventral view of maxillary and labial paps. **lp:** labial palpi; **mp:** maxillary palpi.

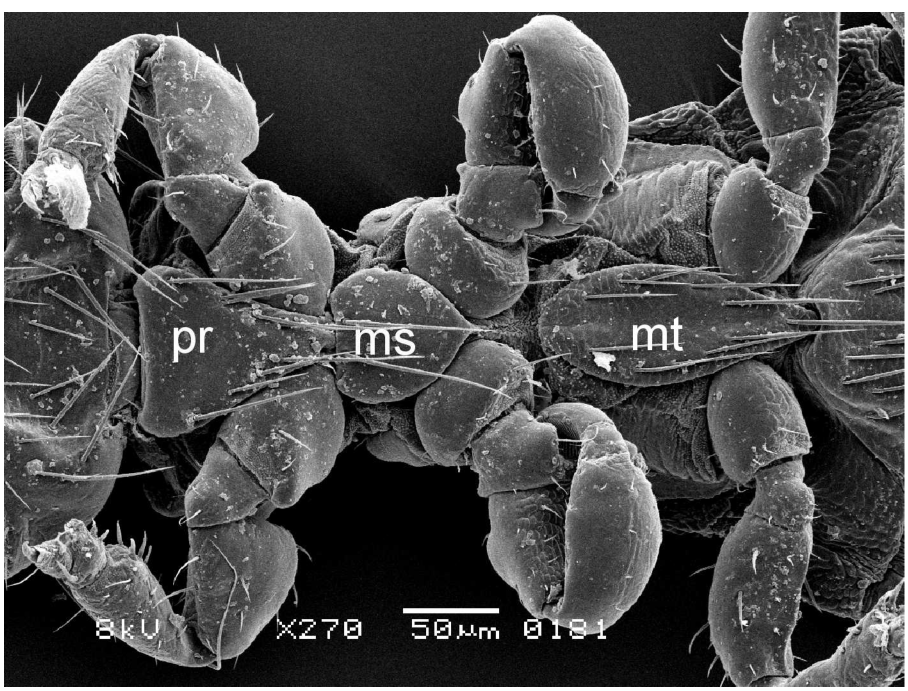
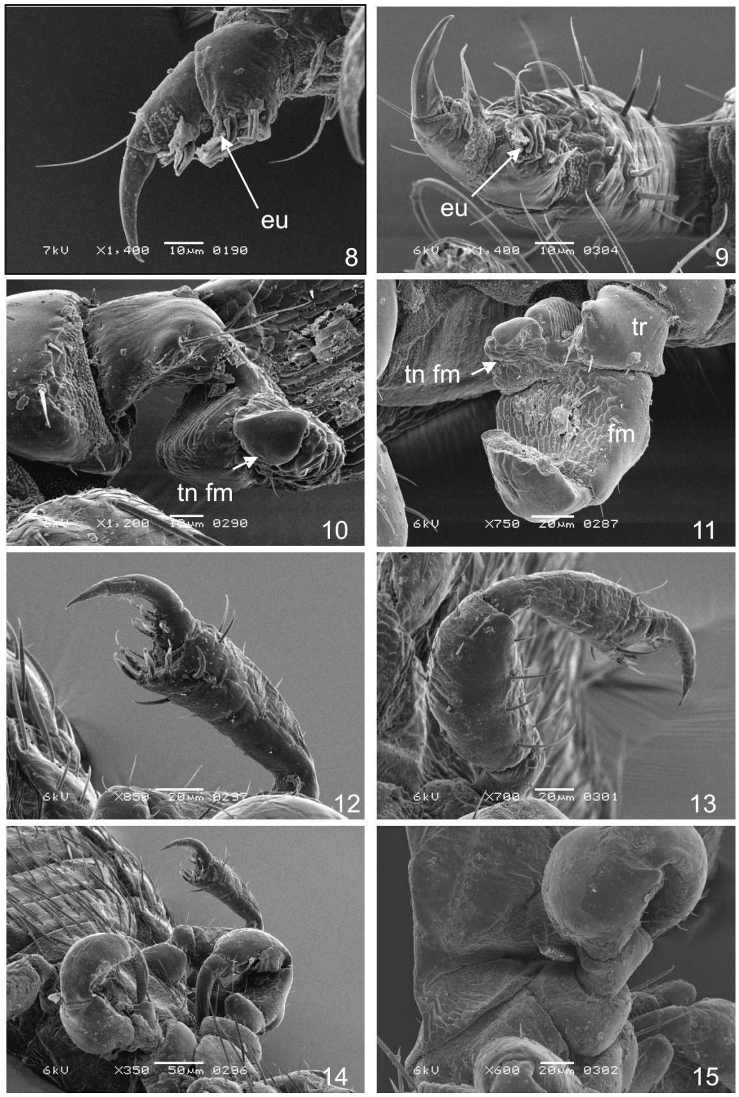


FIGURE 7. Thoracic sternal plates. **pr:** prosternite; **ms:** mesosternite; **mt:** metasternite.



FIGURES 8–15. (**8**) Male first tarsal claw. (**9**) Female first tarsal claw. (**10**) 2nd trocanter showing the U-shaped structure where tarsal claw clasps. (**11**) Frontal view of trocanter and femur (tibia has been cut off for a better view). (**12**) 3rd tibia. (**13**) Lateral view of femur and tibia of 3rd leg. (**14**) General ventral view of legs. (**15**) 2nd leg clasping position with the tarsal claw passing through trocanter. **eu:** euplantula; **tr:** trochanter; **tn fm:** tenaculo femoralis; **fm:** femur; **tb:** tibia.

sculpture of amphora. Striated "sticky-leaf" of spumalina may be present between operculum and hairs. Edge of operculum with soft rugosity. Opercular key clear, sometimes wavy, and forming narrow zone in amphora. Air chambers with excentric micropyles in frontal view. Air chambers usually equidistant to each other (Figs. 18–21).

TABLE IV. Sternal plates measurements of *Gyropus parvus.*

Sternal plates	Measurements	Males (n = 14) mean ± SD	Females (n = 14) mean ± SD
Prosternite	Length*	126.57 ± 8.68	133.23 ± 6.19
	Width	108.57 ± 6.95	112.92 ± 8.51
Mesosternite	Length*	87.86 ± 4.04	93.54 ± 3.07
	Width*	90.71 ± 3.29	96.92 ± 3.33
Metasternite	Length*	162.71 ± 5.95	170.92 ± 7.64
	Width	98.29 ± 9.64	99.38 ± 8.77

* Significant differences between males and females mean values ($P < 0.005$).

Oviposition: In all examined hosts, *G. parvus* eggs were cemented in the same regions of the host body. Eggs usually fixed to group of fine hairs, mainly soft hairs, where amphora is cemented with spread spumalina at base of hair very close to host skin. Oviposition observed on both sacro–caudal and inguinal regions. Eggs were not found in other host body regions.

Taxonomic summary

Type locality: Estancia Huanuluán, Departmento 25 de Mayo, Rio Negro Province, Argentina (Ewing, 1924). This locality is within the phytogeographic Patagonian Province (Cabrera, 1971).

Type host: Ctenomys colburni.

Other hosts: C. sericeus in Ewing (1924) and Werneck (1936); *C. magellanicus* in Werneck (1948).

Remarks

Present specimens can be assigned to *G. parvus* mainly on the basis of the male genitalia (Ewing, 1924). General features on original description are concordant with our observations. Previous contributions regarding

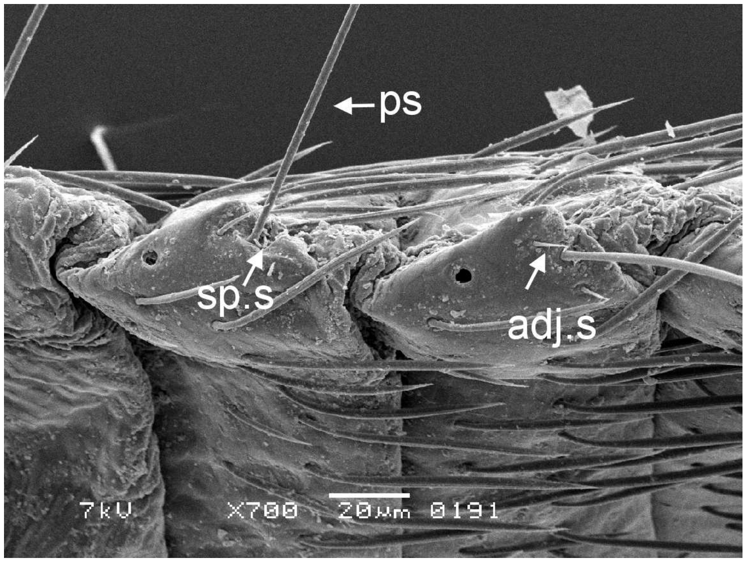


FIGURE 16. Paratergal plates, lateral view. **ps:** post-spiracular setae; **sp. s.:** spine-like setae; **adj.s.**: adjacent setae.

this chewing louse had been based on a few, or poorly preserved, specimens (Ewing, 1924; Werneck, 1948, 1951; Castro and Cicchino, 2002). In the present study, a large number of specimens from both host and locality type were analyzed, allowing for a detailed redescription of the species**.**

The diagnostic features from the original description were confirmed and augmented, except for the length of the third claw, originally described as longer than the second claw. Our observations agreed with those of Werneck (1936) in this case. General morphological information obtained from examined specimens of the IOCB collection agreed with the original description of *G. parvus* and with the general information obtained here, but a greater number of lice from other hosts are needed for statistical comparisons. The chaetotaxy showed a constant pattern in all specimens of *G. parvus* studied. Variation coefficients registered for each cluster of setae were very low in both sexes. Variability coefficients showed a constant pattern in chaetotaxy in males and females. Sexual dimorphism was mainly shown by differences in body size and abdominal chaetotaxy, with females being 17.5 % larger than males and with more setae in each cluster. Males and females also differed significantly in sternal plate measurements. The first pair of legs showed no sexual dimorphism, thereby differing from Werneck's observations (1948), who noted a small difference between males and females in the development of the first pair of legs on specimens collected from *C. sericeus*. Morphometric data presented here showed that variation in females was nearly of the same order as in males.

DISCUSSION

These morphometric data showed differences from previous studies. The micro-topographies of the egg presented in this paper differ from a previous description (Cicchino and Castro, 1998), where the operculum had the same sculptured pattern on its surface as the amphora. Regions selected for louse oviposition may be related to areas of more difficult access by the host to

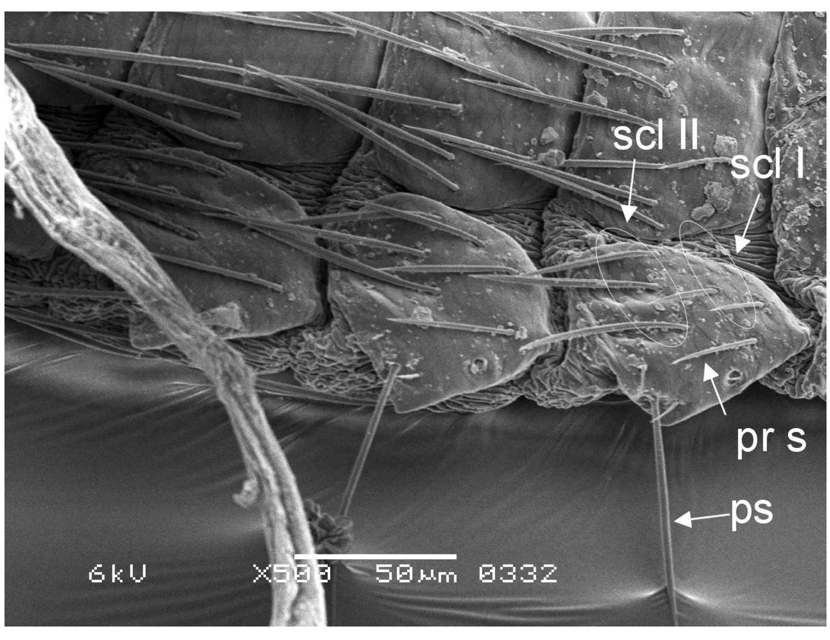
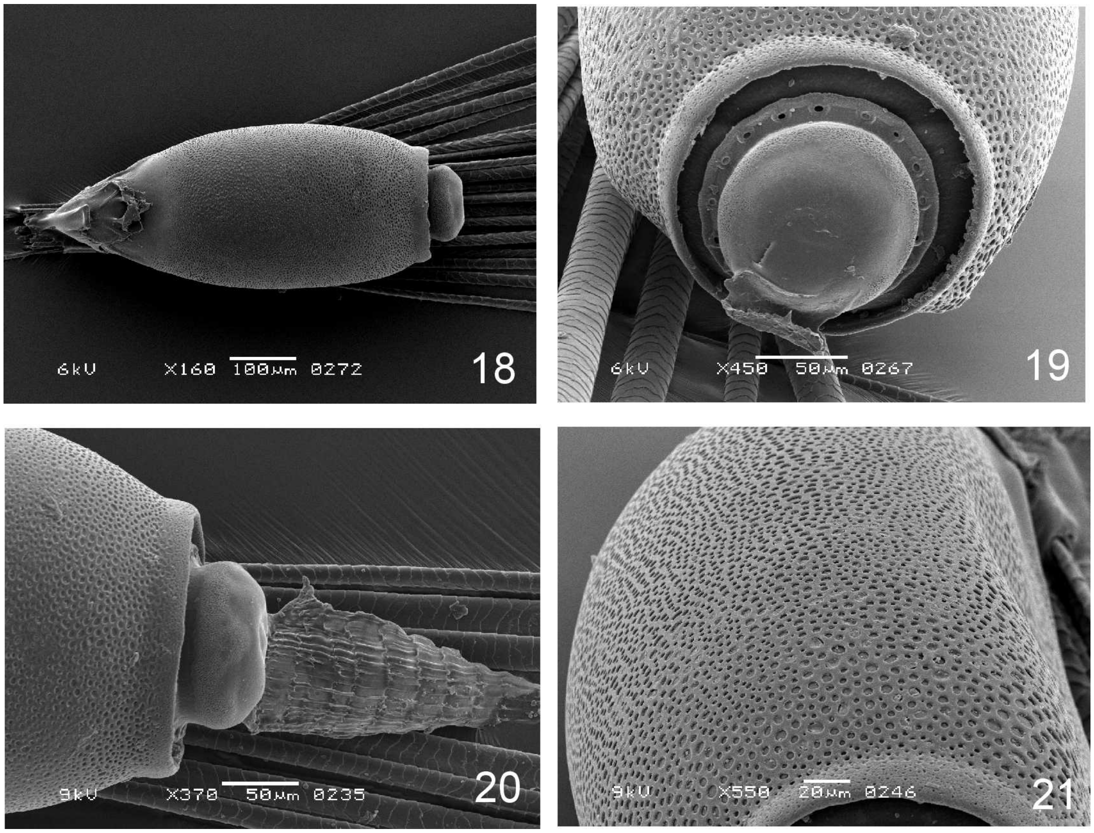


FIGURE 17. Lateral view of paratergal plates. **scl I:** setae cluster I; **scl II:** setae cluster II; **pr s:** pre-spiracular seta; **ps**: post-spiracular setae.



FIGURES 18–21. Eggs of *Gyropus parvus*. (**18**) General view. (**19**) Frontal view of operculum and detail of amphora sculpture. (**20**) Lateral view of operculum with a deposit of spumalina. (**21**) Detail of amphora sculpture.

preen, as suggested by Balter (1968) for some species of ischnoceran lice parasitizing birds.

The morphological differences observed between our voucher specimens and other lice identified as *G. parvus* in several publications (Castro et al., 1987; Cicchino and Castro, 1994, 1998; Castro and Cicchino, 2002) could be due to the different sources of the lice, i.e., host taxa, geographical range, or both. Also, a small number of specimens used in previous contributions could be another possible explanation. However, on each host population or species, *G. parvus* exhibits homogeneity in the features described here. However, when compared across host populations and species, *G. parvus* shows heterogeneity, suggesting that host range, geographic distribution, host specificity, and taxonomy of *G. parvus* sensu stricto should be reconsidered. As mentioned above, the type host of *G. parvus* is, nominally, *C. colburni*. However, the type locality of *C. colburni* is Arroyo Aikén (also known as Eke). This locality is situated approximately 500 km from Estancia Huanuluán. Lice from hosts at the type locality *C. colburni* (Arroyo Aikén) are still unknown. Therefore, it would be very important to investigate if *C. colburni* sensu stricto is parasitized by *G. parvus*. Information regarding intraspecific variation and geographical distribution of *C. colburni* is still scarce.

For these reasons, studies of intra- and inter-population variability of *Ctenomys* spp. hosts and their lice will permit an

TABLE V. Abdominal tergal and sternal chaetotaxy of male and female *Gyropus parvus*, topotypic specimens. The values correspond to ranges of 16 males and 16 females. Variation coefficient (CV) of each setae cluster given within parentheses.

	Tergites				Sternites			
	Males		Females		Males		Females	
Segment	Cluster I	Cluster II	Cluster I	Cluster II	Cluster I	Cluster II	Cluster I	Cluster II
II	6–14 (0.22)	10–13 (0.07)	9–13 (0.11)	13–17 (0.08)	2–4* (0.25)	5–6* (0.04)	2–4* (0.27)	5–7* (0.10)
III	8–13 (0.15)	17–26 (0.12)	9–14 (0.12)	21–31 (0.10)	8–12 (0.10)	18–24 (0.09)	10–15 (0.11)	21–27 (0.06)
IV	7–14 (0.20)	24–30 (0.07)	11–17 (0.13)	24–36 (0.13)	12–15 (0.06)	18–24 (0.09)	13–17 (0.09)	23–29 (0.06)
V	9–28 (0.33)	21–30 (0.10)	12–18 (0.13)	22–38 (0.10)	11–16 (0.12)	18–26 (0.12)	12–18 (0.10)	22–28 (0.08)
VI	10–16 (0.14)	17–30 (0.14)	12–20 (0.12)	26–35 (0.07)	9–15 (0.11)	15–23 (0.13)	11–18 (0.09)	18–26 (0.07)
VII	10–14 (0.10)	14–21 (0.12)	14–19 (0.10)	22–29 (0.10)	10–14 (0.10)	12–19 (0.13)	11–16 (0.12)	14–19 (0.11)
VIII	7–9 (0.09)	6–10 (0.16)	10–13 (0.08)	10–16 (0.13)	7–11 (0.12)	7–9 (0.06)	8–13 (0.15)	8–15 (0.18)
IX	2–2 (0)	—	2–2 (0)	2–2 (0)	2–2 (0)	—	0–0 (0)	—

* No significant differences between male and female for range values of setae (Mann–Whitney *U*-test; $P < 0.005$).

evaluation of ranges in morphological variation for a proper delimitation of taxa and, in turn, will contribute information about host–louse specificity and louse geographical distribution.

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