Systena nitentula (Coleoptera: Chrysomelidae), a Flea Beetle Injurious to *Alternanthera philoxeroides* (Amaranthaceae): Redescription, Biology, and Distribution

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ABSTRACT Flea beetles of alligator weed, *Alternanthera philoxeroides* (Martius) Grisebach (Amaranthaceae), were collected in Argentina, Uruguay, Paraguay, and Brazil. Species in the genera *Disonycha* Chevrolat, *Agasicles* Jacoby, and *Systena* Chevrolat were frequently found on this weed. *Systena nitentula* Bechyné 1954 was the most abundant within *Systena*. This species is reported for the first time from Argentina at north of 30° S. The male is described and holotype female is redescribed adding new diagnostic characters: mouthparts, hind wings, metendosternite, and male and female genitalia. *S. nitentula* is recognized by the combined characters of piceous elytra with J-shaped vittae, a small spermatheca pump, and internal median lobe sac with five sclerotized plates. Differences in color patterns between *S. nitentula*, *S. tenuis* Bechyné, and *S. s-littera* L. also are considered. *S. nintentula* presents three instars that can be separated through head width. New biological data based on laboratory rearing and field observations shows that *S. nintentula* could be a monophagous species strongly associated to the alligator weed growing in terrestrial conditions. This information promotes *S. nintentula* as a potential biocontrol agent of this invasive weed.

KEY WORDS Alticinae, *Alternanthera philoxeroides*, *Systena nitentula*, biological control, alligator weed

Alternanthera philoxeroides (Martius) Grisebach (Amaranthaceae), alligator weed, is an amphibious perennial plant, indigenous to southern South America. Two forms of the plant occur in Argentina: *Alternanthera philoxeroides* f. *philoxeroides* (Mart.) Griseb. in the southern range (Buenos Aires Province) and *Alternanthera philoxeroides* f. *angustifolia* Süssenguth in the northern range (northeastern Argentina). The latter is also present in the northwestern Argentina, but it is uncertain whether those are relict or introduced populations (Vogt 1961, Sosa et al. 2004). The forms are not always easily distinguished (Sosa et al. 2004). Alligator weed was introduced into several countries, including the United States and Australia, and it is now considered a serious aquatic and terrestrial weed. Three biological agents from Argentina were released in the United States to control this weed [the flea beetle *Agasicles hygrophila* Selman and Vogt (Coleoptera: Chrysomelidae), the moth *Arcola malloi* (Pastrana) (Lepdidoptera: Pyralidae), and the thrips *Amynothrips andersoni* O'Neill (Spencer & Coulson 1976) (Tysanoptera: Phaelothripidae)]. The flea beetle and the moth were subsequently released in Australia and controlled the weed in warm temperate aquatic habitats (Julien and Griffiths 1999). However, terrestrial growth of the weed and aquatic growth in cooler regions of Australia continue to cause serious concern (Julien and Bourne 1988), so new agents are needed to control the weed in such circumstances.

We have recently conducted surveys in Argentina, Uruguay, Paraguay, and Brazil to detect the native range of alligator weed and its natural enemies. Specimens of flea beetles in the genera *Disonycha* Chevrolat, *Agasicles* Jacoby, and *Systena* Chevrolat were frequently found on this weed. Because *Agasicles* does not control the weed in all its habitats, and *Disonycha* failed to establish in Australia, current efforts are concentrating on the potential of *Systena* for the control of alligator weed. Vogt (1961) suggested three species of *Systena* as possible suppressants of alligator weed, but they were not identified and their biologies, and host ranges, were not reported.

The genus *Systena* comprises ≈100 species widespread throughout the New World (Jolivet and Hawkeswood 1995). It is represented in Argentina by a total of 11 species and subspecies, distributed mainly in temperate and subtropical areas (Cabrera and Roig-Juñent): *Systena testaceovittata* Clark 1865, *Systena*

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ustulata Harold 1875, *Systena punctatissima* Jacoby 1902, *Systena argentinensis* Jacoby 1905, *Systena s-littera colligata* Weise 1921, *Systena simeona* Bechyné 1955, *Systena bonariensis* Bechyné 1956, *Systena caprai* Bechyné 1957, *Systena silvestrii* Bechyné 1957, *Systena tenuis* Bechyné 1958, and *Systena vogti* Bechyné 1961.

Our field studies focused mainly on the flea beetle *Systena nitentula* Bechyné 1954, which was the most abundant species of *Systena* on *A. philoxeroides.* This species, collected from Mato Grosso (Brazil), was described using color pattern and few external morphological characters by Bechyné (1954). Because those characters exhibit considerable homoplasy, we studied other morphological features including, mouthparts, hind wings, metendosternite, and details of male and female genitalia. In another study on *Systena,* Lingafelter et al. (1998) elucidated the relationships between *Systena* and its closely related genera. They proposed diagnostic characters for *Systena* that provided the context and the morphological characters for this study. Because Lingafelter et al. (1998) was based mostly on Neartic species, we have attempted to clarify the status of South American *Systena.*

In this article, we report the presence of *S. nitentula* in Argentina, redescribe the holotype female, and describe the male. Additionally, biology, including field and laboratory host range, and geographical distribution is presented.

Materials and Methods

Morphology. Surveys were conducted in Argentina, southern Paraguay, Uruguay, and southern Brazil (30 – 40° S, 65–50° W) from October 2001 to May 2004. At every location, alligator weed and surrounding plants were checked. Thus, adults of *S. nintentula* were collected directly from plants and preserved in 70% ethanol.

Morphological descriptions were based on the female holotype and field-collected and laboratory-reared specimens. Although Bechyné normally used the word "Type" or "Holotype" on his identification label to indicate the holotype, he labeled the *S. nitentula* female specimen as follows: Matto Grosso, Rio Caraguatá, 3-53, Plaumann typeface/ Type ♀, *Systena nitentula* m., handwriting, J. Bechyné det., 1953 typeface. This specimen is deposited at the Naturhistorisches Museum, Basel, Switzerland (NHMB). Other specimens that we studied belong to the collections of the following institutions: Museu de Zoologia, Universidade São Paulo, São Paulo, Brazil (MZSP), and the USDA-ARS-South American Biological Control Laboratory collection (SABCL).

Morphological descriptions are complementary; the shared features between male and female are not repeated after being mentioned for the first time. Morphological terminology generally follows Lingafelter et al. (1998), mouthparts (Cabrera and Durante 2001), hind wing (Kukalová-Peck and Lawrence 1993), metendosternite (Lingafelter and Konstantinov 2000) and metafemoral spring (Furth 1982), male genitalia (Lindroth and Palmén 1970, Mann 1985), and female genitalia (Konstantinov 1998, 2002). The abbreviations used to mention the venational scheme are SC, subcosta; RA, radial anterior; RP, radial posterior; r4, radial cross vein 4; MP, medial posterior; RP-MP2, radio-medial cross-vein 2; CuA, cubital anterior; and AA, anal anterior.

Measurements, taken using an ocular micrometer on a Wild dissecting microscope at 25× magnification, are indicated in millimeters as the range, with the average and standard error in brackets. Measurements and abbreviations used in the text are eye length (eL), length of antennomeres (A1, A2-A11), length of pronotum (PL), pronotum width (PW), humeral width (HW), elytral length (EL), and elytral width (EW) as defined by Cabrera and Cabrera Walsh (2004). Other measurements include eye width (eW), i.e., the maximum distance across the eyes between the inner margins; interocular distance (OD), measured across the vertex between the eyes; and interantenal distance (AD), the distance between the inner margins of the antennal sockets. Body length was measured from the posterior margin of the eyes to the apex of the longest elytron. Relative proportions of the above-mentioned measurements for eL/eW, AD/eW, AD/OD, PW/PL, HW/PW, and EW/HW were computed.

Drawings were made using a camera lucida on a Leitz compound microscope and a Wild dissecting microscope. Electron micrographs of head and binding sites of the elytra were taken with a scanning electron microscope (SEM) Jeol-JSM-T100. These structures were previously mounted on metal studs and coated with gold-palladium.

Voucher specimens have been deposited at Museo de La Plata, (MLP), USDA–ARS–South American Biological Control Laboratory (SABCL) and U.S. National Museum of Natural History, WA (NMNH).

Biological Studies. To study the biology of this flea beetle several surveys were conducted. They were carried out several times a year in northeastern Argentina and Buenos Aires Province for a 3-yr period (2002–2004) and only twice in northwestern Argentina (May 2002 and February 2004). In those surveys the field host range of *S. nitentula* was recorded. In every location visited, several plant species were checked to register the presence of *S. nitentula* and its associated host plant.

Rearing. To develop a rearing technique adults collected in 2003 at two sites, [Rt. 11, 22 km southwest of Reconquista, Santa Fe, Argentina (29° 16′ 51″ S, 59° 19′ 59.8″ W), and Rt. 16, access to Isla del Cerrito, Chaco, Argentina (27° 26′ 27.8″ S, 58° 53′ 59.6″ W)] (northeastern Argentina) were kept individually in containers and taken to the USDA, South American Biological Control Laboratory. Females were held to obtain eggs and lines from each female were maintained. The eggs were separated and after hatching larvae were placed one per container with a piece of stem (nodes with leaves and internodes) and either damp peat moss or a piece of damp cloth to provide humidity. Plants were replaced as needed. The ensuing adults were held for oviposition in plastic tubes (25 cm in height and 10 cm in diameter) that con-

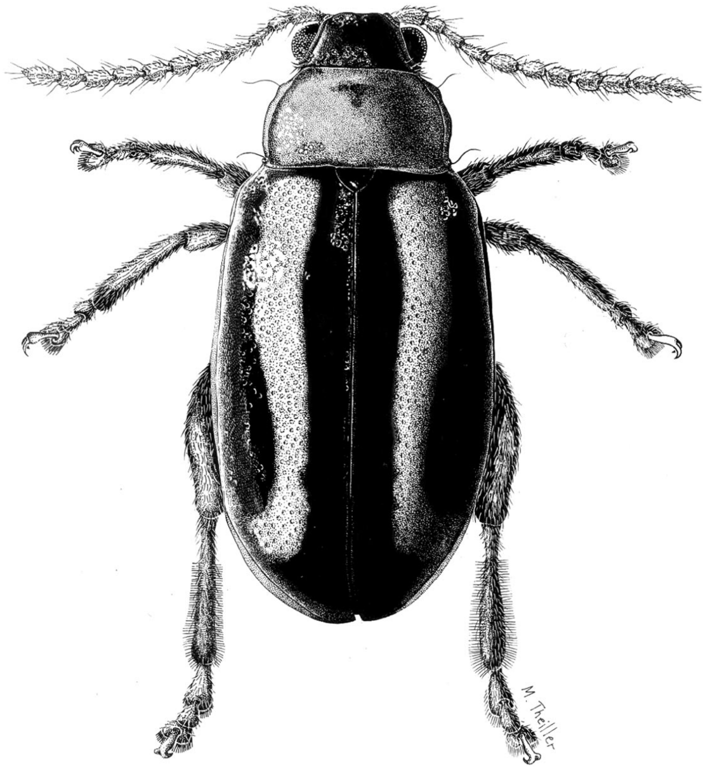

Fig. 1. *S. nitentula* Bechyné, female, dorsal.

tained plants from Santa Fé. Biological studies were conducted with the second laboratory generation, and the duration of immature stages and head widths of larvae were recorded.

A second attempt to improve rearing was carried out in 2004 using specimens from Santiago del Estero, Tucumán y Salta (northwestern Argentina). Adults were taken to the laboratory for oviposition and eggs were collected and placed in containers with wet peat moss and tuberous alligator weed roots from plants grown in soil. Those containers (20 cm in height, 10 cm in diameter) were placed in a rearing chamber at 25°C and roots were not replaced until adults emerged. The larvae were observed periodically, but no biological information was recorded from this culture.

Host Specificity. Two experiments were conducted to evaluate the feeding preference of adults of *S. nitentula:* multiple-choice and paired-choice tests. Two multiple-choice tests were conducted. In the first, alligator weed was included, whereas in the second it was not. Each test was replicated seven times. Plants used were *A. philoxeroides, Beta vulgaris* L. Cicla group (leaf beet), *Alternanthera kurtzii* Schinz ex Pedersen, *Alternanthera* cfr. *bettzickiana* (Regel), and *Lycopersicum esculentum* Mill. (tomato). They were selected according their taxonomic relatedness to alligator weed, their economic importance, and because they share the same habitat. Field-collected adults from Chaco Province (27° 26′ 27.8″ S, 58° 53′ 39.6″ W) were reared in the laboratory for 2 wk before the experiment. The insect were fed with greenhouse grown alligator weed and starved for 24 h before the tests began. Two disks of leaf material, each 0.7 mm in diameter, from each test plant were placed in petri dishes at random within a 5-cm-diameter circle. One adult was placed in each petri dish. To estimate feeding preference the remaining area of each disk was measured and compared after 24 h. Results were analyzed with Friedman analysis, and Dunn's test were used to compare medians.

The paired-choice test consisted of a small potted plant of alligator weed and one of *B. vulgaris* and two adults placed in plastic containers (8 cm in height by 11 cm in diameter) for 48 h. Consumed area of each plant was measured and analyzed with Wilcoxon matched pairs test. The experiment was replicated six times.

All tests were performed using STATISTICA 5.0 software (StatSoft 1995).

Results and Discussion

Systena nitentula Bechyné, 1954

(Figs. 1–5.)

Systena nitentula Bechyné, 1954. Ent. Arb. Mus. G. Frey 5: 126.

Female (Fig. 1). Body oval to elongate, slightly convex, length 3.98 mm, width 2.31 mm. *Color.* Head capsule piceous, distal margin of labrum yellowish brown, mouth parts yellowish, the apical one-third of

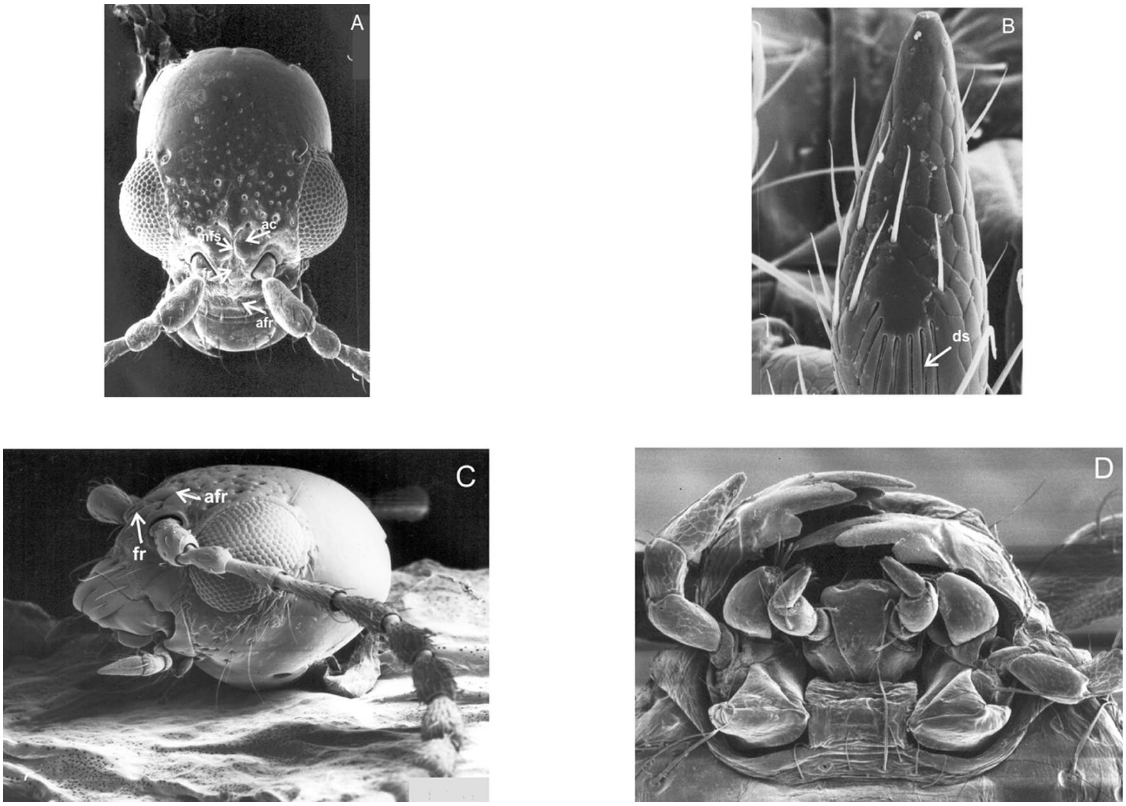

Fig. 2. (A) *S. nitentula* Bechyné head, frontal view (100×). (B) Maxilla, detail of digitiform sensillum (750×). (C) Head, lateral view (75×). (D) Mouthparts, ventral view (100×). ac, antenal callus; afr, anterofrontal ridge; ds, digitiform sensillum; fr, frontal ridge; mfs, midfrontal sulcus; sgs, subgenal suture. Scale bars, 1000 μm (A, C, and D) and 100 μm (B).

mandibles and apex of palpomeres brown, antennomeres 1–4 flavous, outer margin light brown, antennomeres 5–11 dark brown, antennomeres five and six yellowish at base. Pronotum yellow with a piceous central vitta anteriorly. Scutellum, elytra, and elytropleura piceous; each elytra with a yellow J-shaped vitta, extending from basal margin to approximately three-fourths length of elytra, becoming transverse toward lateral margin. Coxae yellowish tinged with brown; femora and tibiae piceous, basal one-third of profemora yellowish brown, metatibiae yellow on inner face; tarsi dark brown. *Venter.* Prosternum yellow; meso-metasternum dark brown; abdomen brown tinged with yellow on distal margin of each tergite.

Head (Fig. 2A and C). Vertex smooth, finely and sparsely punctate centrally; interocular space with large and well impressed punctures; antennal calli strongly convex, roundish, as wide as the antennal sockets; supracallinal sulcus and midfrontal sulcus deeply impressed; supra-antennal sulcus slightly distinct; antennal sockets close to the anterior margin of eyes; interantennal space 0.62 times as wide as transverse diameter of antennal sockets and 0.31 as wide as transverse diameter of eye. Eyes convex, eL/eW 1.62 mm, supraorbital pore near the longitudinal middle line of the eye; subgenal suture impressed. Frontal ridge barely raised, long, thin setae situated below and laterally to the external ocular margin; anterofrontal ridge not separated from frontal ridge, as high as frontal ridge in lateral view. Antennae 11-segmented, inserted below midline of eyes, extending beyond humeral calli; antennomere 2 shorter than 3, antennomeres 4–10 elongate, similar in length, antennomere 11 apically acuminate. Antennomeres 1–4 scarcely setose, antennomeres 5–11 densely setose throughout, all antennomeres with erect, sparse setae at apex. Clypeus with eight preapical setae. Labrum (Fig. 3A and B) approximately rectangular, lateral margins rounded, with a row of four long setae, ventrally 10 thick setae in apical margin. Mandibles (Fig. 3C) five-toothed, teeth 3–5 visible on external face, tooth 3 acute, 2.0 times longer than 4; tooth 4 acute, almost 2.0 times the length of 5; tooth 5, small, blunt at apex; teeth 1–2 visible on internal face, acute; tooth 1 shorter than 5; tooth 2 subequal to 4; mola absent. Maxillae (Fig. 3D) with cardo apically broadened, with two long setae centrally and two setae on outer margin; basistipes with three setae; inner margin of dististipes finely striate, with three small setae closed to lacinia; galea and lacinia well developed, with a fringe-like pilosity apically; apex of galea rounded, narrower than base. Maxillary palpi well developed, surpassing the galea; palpomere 1 subquadrangular; palpomeres 2 and 3

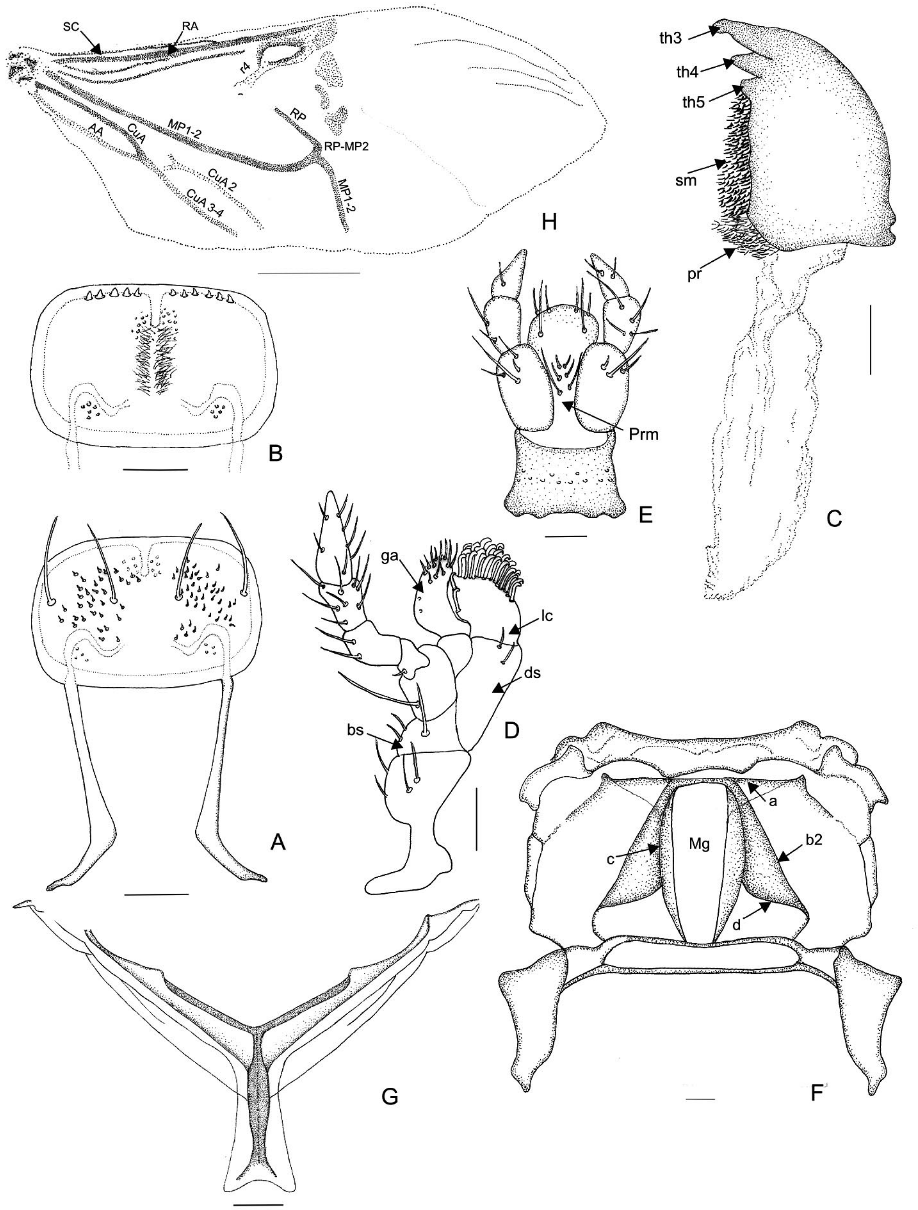

Fig. 3. (A) *S. nitentula* Bechyné labrum, dorsal view. (B) Labrum, ventral view. (C) Mandible, external face. (D) Maxilla, ventral view. (E) Labium, ventral view. (F) Metanotum. (G) Metendosternite, dorsal view. (H) Hind wing. a, metanotal ridge a; AA, anal anterior vein; b2, metanotal ridge b2; bs, basistipes; c, metanotal ridge c; CuA, cubitoanal vein; CuA2, cubital anal vein 2; CuA 3 + 4, cubito anal vein 3 + 4; d, metanotal ridge d; ds, ditistipes; ga, galea; lc, lacinia; mg, median groove; MP 1–2, medial posterior vein 1–2; mo, mola; pr, prostheca; prm, prementon; RA, radial anterior vein; RP, radial posterior vein; RP-MP2, radial posterior-medial posterior vein 2; SC, subcostal vein; sm, setose membrane; th3, tooth 3; th4, tooth 4; th5, tooth 5. Scale bars, 0.1 mm.

subcylindrical; palpomere 4, subconical, longer than the two former; tapering strongly apically, digitiform sensillum patch (Fig. 2B) on the externo-basal corner, subrectangular, formed by seven embedded sensilla. Labium (Figs. 2D and 3E) with four setae between bases of palps, ligula rectangular, bearing five setae. Labial palp with palpomere one rectangular; palpomere two subconical, 2.0 times longer than 1; palpomere three subconical with narrow base, 1.5 times longer than 2.

Thorax. Pronotum slightly convex, rectangular, 1.93 times wider than long, widest at middle, PW 1.28 mm; surface shiny, densely covered by minute punctures; anterior margin almost straight, lateral sides slightly expanded anteriorly, posterior margin arched; anterior callosity well produced, rounded; posterior cal-

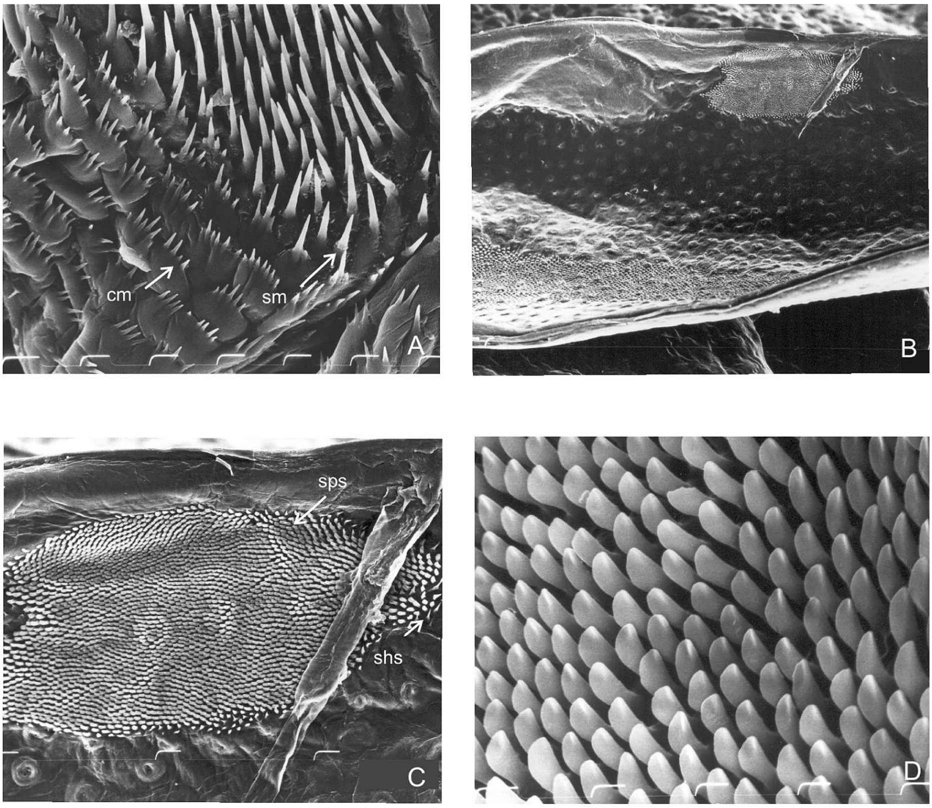

Fig. 4. (A) *S. nitentula* Bechyné tergite 7 female, detail (1500×). (B) Elytron ventral view, detail of binding patch (100×). (C) Binding patch, surface covered with spoonbill shaped spicules and sharktooth-shaped spicules on distal area (350×). (D) Detail of binding patch, spoonbill-shaped spicules (2000×). cm, compound microtrichia; shs, sharktooth spicule; sm, spiniform microtrichia; sps, spoonbill spicule. Scale bars, 1000 μm (B), 100 μm (C), and 10 μm (A and D).

losity poorly developed, dentiform; each one bearing a long seta. Prosternum convex; intercoxal prosternal process thin, strongly widened between procoxae; procoxal cavities closed, oval. Scutellum triangular, rounded at apex. Mesosternum short, intercoxal mesosternal process strongly bilobed, reaching more than half the length of mesocoxae. Metanotum transverse, wider than long; metanotal ridged (Fig. 3F) intersecting c anteriorly to midpoint of c, ridge b1 intersecting below the median groove. Metasternum transverse, slightly concave centrally, with a small bidentate projection between inner margin of metacoxae; metacoxal cavities inserted at posterior margin, narrowly separated. Metendosternite (Fig. 3G) with stalk longer than wide; lateral arms, thin, apically slightly deflexed, tappering toward apex; mesofurcal-metafurcal tendons poorly developed, inserted near middle of lateral arms; ventral process poorly developed. Hind wings (Fig. 3H) with veins RA, MP, CuA well sclerotized whereas veins CuA2, RP-MP2 and AA scarcely sclerotized. Vein SC connected to RA more than half its length; radial cell darkly pigmented, elongate, subtriangular; RP-MP2 not reaching r4; vein AA unbranched and connected to CuA3 + 4 at about half the distance from the origin of CuA; CuA2 not attached to CuA, cubital anal cell closed, elongate; cubital anal cell two absent. Elytra oval, convex, surface densely, uniformly punctate; punctures somewhat coarser than on pronotum; more finely punctate on longitudinal vittae; elytra slightly wider than pronotum, HW/PW 1.39, humeral calli rounded, slightly prominent, EW/HW 1.29; greatest width near apical one thirds of elytra; epipleura subvertical, basally broad, gradually narrowed apically; basal inner surface of elytra with an oval binding patch (Fig. 4B) covered with spoonbill-shaped spicules and surface close to the biding patch covered with few microspicules (Fig. 4C and D). All legs similar; metafemora moderately enlarged, tibiae with apical spurs, thin in pro- and mesotibiae, thick, curved in metatibiae; tarsomere one of metalegs longer than tarsomeres 2 + 3 together; tarsal claws appendiculate. Metafemoral spring with a thick ventral lobe, recurved flange well developed, extended arm of dorsal lobe more than the half of the ventral lobe.

Abdomen. Tergite 7 (Fig. 5A and B) triangular, covered with long setae evenly distributed, six long, curved setae on each lateral margin, and two rows of four curved setae. Base densely covered with spiniform microtrichia centrally and compound microtrichia laterally (Fig. 4A); sternite 7 with four curved

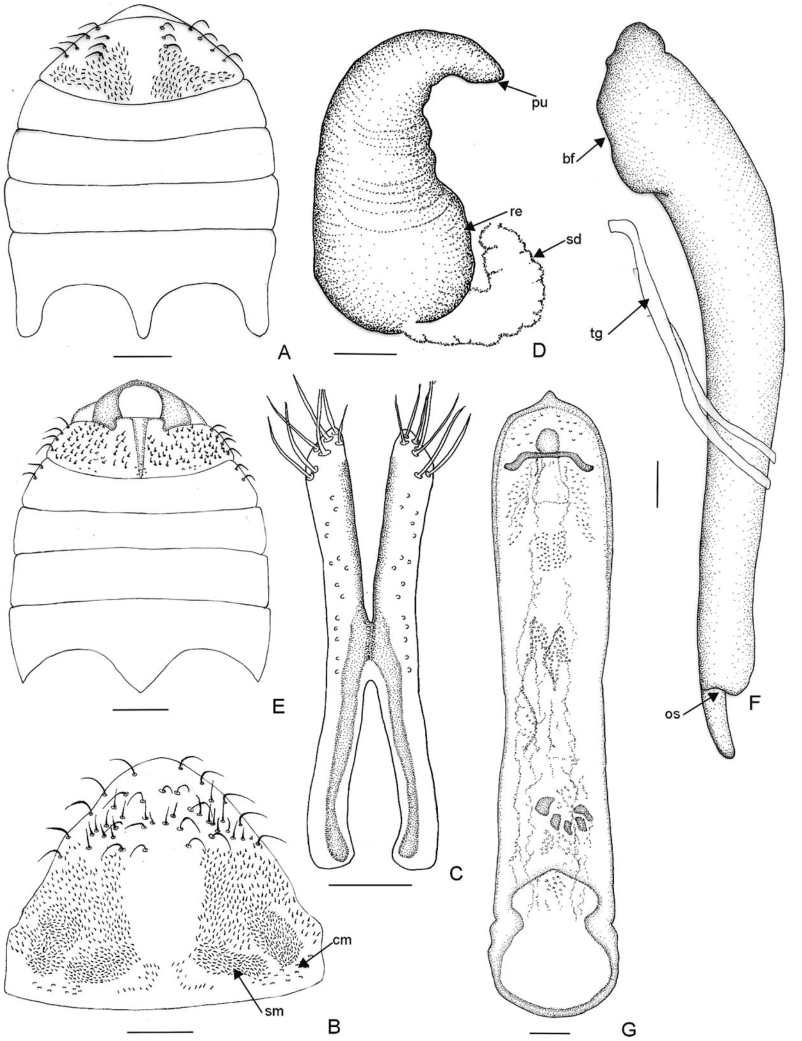

Fig. 5. (A) *S. nitentula* Bechyné abdomen, female, ventral view. (B) Abdomen, female, detail of tergite 7. (C) Vaginal palpi. (D) Spermatheca. (E) Abdomen, male, ventral view. (F) Median lobe, lateral view. (G) Median lobe, dorsal view. bf, basal foramen; cm, compound microtrichia; os, ostium; pu, pump; re, receptacle; SD, spermathecal duct; sm, spiniform microtrichia; tg, tegmen. Scale bars, 1 mm (A–D, F and J) and 0.1 mm (G–I). Scale bars, 0.1 mm.

setae on lateral sides, and sternite 6 with two lateral, curved setae.

Genitalia. Tignum long, slender, curved posteriorly, membranous part only sclerotized laterally, nine short setae on apical margin; vaginal palpi (Fig. 5C) divergent, apex rounded with 14 setae. Receptacle of spermatheca (Fig. 5D) ovate, maximum width near duct, pump smaller than receptacle, rounded at apex, bent to receptacle, horizontal part of pump not clearly separated from vertical.

Measurements (*n* = 30). Body length 3.46–4.58 mm = 4.10 ± 0.24), eL 0.36–0.49 mm $\bar{x}$ = 0.40 ± 0.04), eW 0.19–0.36 mm $\bar{x}$ = 0.23 ± 0.17), OD 0.42–0.52 mm $\bar{x}$ = 0.48 ± 0.03), AD 0.09–0.19 mm $\bar{x}$ = 0.15 ± 0.03), A1 0.19–0.26 mm $\bar{x}$ = 0.23 ± 0.04), A2 0.09–0.13 mm $\bar{x}$ = 0.12 ± 0.04), A3 0.16–0.23 mm $\bar{x}$ = 0.18 ± 0.02), A4 0.16–0.26 mm $\bar{x}$ = 0.19 ± 0.05), A5 0.19–0.36 mm $\bar{x}$ = 0.19 ± 0.05), PL 0.66–0.82 mm $\bar{x}$ = 0.74 ± 0.05), PW 1.05–1.38 mm $\bar{x}$ = 1.21 ± 0.09), EL 2.57–3.46 mm $\bar{x}$ = 3.08 ± 0.21), EW 1.68–2.14 mm $\bar{x}$ = 1.96 ± 0.17), PW/PL 1.49–1.77 $\bar{x}$ = 1.64 ± 0.05), HW/PW 1.22–1.41 $\bar{x}$ = 1.11 ± 0.05), EW/HW 1.14–1.25 $\bar{x}$ = 1.18 ± 0.1), AD/eW 0.31–0.88 $\bar{x}$ = 0.60 ± 0.08), AD/OD 0.19–0.45 $\bar{x}$ = 0.31 ± 0.05), eL/eW 1.08–2.21 $\bar{x}$ = 1.49 ± 0.08).

Male. The specimens examined were similar in color and sculpturing to the females, smaller and narrower, length 3.23–3.99 mm $\bar{x}$ = 3.66 ± 0.17), width 1.58–1.84 mm $\bar{x}$ = 1.71 ± 0.07).

Thorax with coarser punctation than in female. Elytra narrower than female. All legs with a ventral adhesive patch covering surface of tarsomere 1.

On abdomen, apical margin of tergite 7 with ≈10 long curved setae, base with few scattered microtrichia, indistinct under low magnification; apical mar-

Table 1. Mean ± 1 SE life parameters of *S. nitentula* (fed with stems)

	Instar I	Instar II	Instar III
Head width (mm)	0.22 ± 0.01 (n = 45)	0.29 ± 0.01 (n = 105)	0.40 ± 0.01 (n = 62)
Stage duration (d)	6.7 ± 2.0 (n = 20)	9.7 ± 0.34 (n = 15)	12.7 ± 3.0 (n = 15)

gin of sternite seven (Fig. 5E) truncate, lateral margin with four curved setae.

Genitalia. Median lobe (Fig. 5F) slightly curved in lateral view, apex bent dorsally. In dorsal view (Fig. 5G), lateral sides nearly parallel, apex with a small central projection, apical end with a small transverse impression; ventral surface with a narrow median impression, basal foramen rounded, internal sac with five rounded sclerotized plates; arms of tegmen longer than stem.

Measurements. (n = 30). eL 0.33–0.46 mm $\bar{x}$ = 0.40 ± 0.03), eW 0.19–0.33 mm $\bar{x}$ = 0.26 ± 0.1), OD 0.36–0.52 mm $\bar{x}$ = 0.45 ± 0.1), AD 0.09–0.26 mm $\bar{x}$ = 0.16 ± 0.05), A1 0.23–0.26 mm $\bar{x}$ = 0.24 ± 0.02), A2 0.13–0.19 mm $\bar{x}$ = 0.13 ± 0.01), A3 0.16–0.23 mm $\bar{x}$ = 0.18 ± 0.03), A4 0.16–0.23 mm $\bar{x}$ = 0.20 ± 0.03), A5 0.16–0.26 mm ($\bar{x}$ = 0.19 ± 0.04), PL 0.59–0.75 mm $\bar{x}$ = 0.69 ± 0.05), PW 0.09–1.22 mm $\bar{x}$ = 1.14 ± 0.06), EL 2.24–3.03 mm $\bar{x}$ = 2.71 ± 0.11), PW/PL 1.50–1.89 $\bar{x}$ = 1.64 ± 0.11), HW/PW 1.09–1.38 $\bar{x}$ = 1.30 ± 0.08), EW/HW 1.10–1.21 $\bar{x}$ = 1.14 ± 0.04), AD/eW 0.34–0.88 $\bar{x}$ = 0.64 ± 0.15), AD/OD 0.19–0.53 $\bar{x}$ = 0.43 ± 0.17), eL/eW 1.09–2.05 ($\bar{x}$ = 1.59 ± 0.17).

Variability. Among the material examined we noted that the color pattern varies across the geographical range and also between males and females. Individuals from the northwest of its range are darker than those from Brazil and eastern Argentina; this is especially noticeable in males. In specimens from northwest areas (Salta, Tucumán, and Santiago del Estero provinces) labrum and mouthparts are darker than head, basal antennomeres vary from fulvous to dark brown, in which case the color of these antennomeres are similar to the rest of the antennae. The color of the thorax varies from yellow to brown tinged with yellow, the anterior band is barely distinguished or absent in some males. The basic pattern of elytral vittae is similar in all specimens, elytropleura varies from piceous to yellowish. Femora vary from only the basal one-third or two-thirds yellow to entirely piceous, to pro- and mesotibiae only one-third yellowish. Ventral surface may be dark brown to piceous, proesternum yellow. Specimens from eastern Argentina are similar in color and morphology to the holotype.

Remarks. *S. nitentula* is closely related to *S. tenuis* and *S. s-littera* Linné, both collected on *Alternanthera.* They have similar color patterns, however, *S. nitentula* differs from them by the presence of piceous elytra, with J-shaped vittae, a smaller spermatheca pump in comparison with the receptacle, and an internal median lobe sac with five sclerotized plates.

Distribution. This species was previously known only from Mato Grosso, Brazil, this is the first citation for Argentina. The range of *Systena* includes, according to the biogeographic scheme proposed by Cabrera and Willink (1980), the following biogeographical regions: 1) Chacoan, constituted by a matrix of wetlands with patches of xeric woodlands (provinces of Formosa, Chaco, Santiago del Estero, part of Corrientes, and Santa Fé); 2) Paranaense, subtropical rain forest (Misiones and northeast of Corrientes Province); 3) Yungas, subtropical mountain rain forest (eastern mountains slopes of Tucumán, Salta, and Jujuy provinces); and 4) Cerrado (Amazonian Domain, southeastern Brazil). *S. nitentula* was found north of 30° S on *A. philoxeroides* (only on the *angustifolia* form) and once on *Alternanthera aquatica* (Parodi) Chodat growing mixed with alligator weed [Rt. 16, access to Isla del Cerrito, Chaco, Argentina (27° 26′ 27.8″ S, 58° 53′ 59.6″ W), November 2003].

It is uncertain whether the absence of records from Western Chaco represents a real gap in the distribution of this species. Interestingly, large populations of *S. nitentula* were never found in the northeastern Argentina despite the considerable surveys carried out in this area, whereas it occurs abundantly in northwestern Argentina. In addition, the coloration differences found between the insects of these two areas suggests that the northwestern populations could have been recently isolated from the northeastern populations.

Biological Aspects. Eggs were cylindrical, 0.78 ± 0.06 mm in length by 0.39 ± 0.04 mm in diameter (n = 51). They were yellow when laid and before hatching the larvae could be seen through the clear chorion.

Larvae emerged after 8–10 d and fed externally on the stems, and then ate internally making galleries mostly in the nodes but also in the internodes. They had high mobility and could get out of the galleries, make new ones or go to the substrate. This damage caused was recorded only in the laboratory. Larval development underwent three instars, which were distinguished by head capsule width. Furthermore, the duration of the first and the second instar were similar (Table 1). The developmental time from egg to adult was, for the first generation, of 32.18 ± 2.5 d (n = 11) and, for the second generation, of 39.66 ± 5.3 d (n = 12) at 25°C. Pupation occurred in the substrate and occasionally in the stem galleries. Those mature larvae (prepupal stage) that left the plants stayed remained in the substrate for pupation. Pupae were yellow and formed a pupal cell. Adults emerged after 7.0 ± 0.7 d (n = 6). They made irregular feeding holes on the leaf of alligator weed but ate though only one surface of it. They preferred to eat young leaves and often killed the growing bud. They did not eat flowers when offered them along with leaves in the containers. Adult damage in the lab was similar to that observed in the field.

Table 2. Mean ± 1 SE areas of leaf disks consumed during 24 h by *S. nitentula* in multiple choice tests with and without alligator weed

Test plant	Consumed area (mm^2) with Alligator weed	Consumed area (mm^2) without Alligator weed
A. philoxeroides	6.42 ± 1.82a	
B. vulgaris (L. Cicla group)	16.36 ± 4.57a	19.92 ± 7.45a
A. kurtzii	0.37 ± 0.18b	0.95 ± 0.52b
A. bettzickiana	0	0.24 ± 0.22b
Lycopersicum Esculentum	0	0

Means in columns shearing the same letters are not significantly different (Friedman $P > 0.05$).

Adults lived 73.5 ± 3.8 d ($n = 16$) in the rearing chamber. Females laid 21.53 ± 3.77 eggs per oviposition event ($n = 20$), singly on the substrate. They laid around 100 eggs per month, of which in >85% hatched. The premating time was between 4 and 6 d and mating in cages lasted up to 33 min.

The initial rearing was not successful and few adults were obtained from many eggs and larvae. Despite this the adults were fertile. Whereas, the second rearing method using roots was more productive; 31.6% of eggs developed to adults. Observation of early instar activity was difficult due to the small size of young larvae. Final instars were observed making feeding holes or galleries in the tuberous roots. Larvae were mobile and moved to the substrate to pupate.

A. philoxeroides is associated with areas that are at least seasonally wet; therefore, it grows in permanently aquatic to seasonally dry situations. In the field, adults of *S. nitentula* were frequently found on plants growing around the edge of ponds. On one occasion they were moderately abundant on the plant growing in a dry pond in Resistencia, Chaco Province (northeastern Argentina). In northwestern Argentina, they were abundant in terrestrial situations. *Systena* was not abundant in places were *Agasicles* was present, that is, in aquatic situations. Other *Systena* spp. were found associated with alligator weed and other plants in terrestrial situation. This observation added to the rearing information suggests that *Systena* is strongly related to plants growing in terrestrial conditions. Nevertheless, no immatures were ever found in the field.

Host Specificity. *S. nitentula* fed more on leaf beet than on alligator weed when alligator weed was included in the multiple choice test (Friedman analysis of variance [ANOVA], $\chi^2 = 23.5$, df = 4, $P < 0.0001$) (Table 2), whereas in multiple choice without alligator weed, this flea beetle preferred leaf beat to any other plant (Friedman ANOVA, $\chi^2 = 12.0$, df = 2, $P < 0.003$) (Table 2). However, in paired choice tests, there were no statistical evidences to support that *S. nitentula* consumption on leaf beat (25.93 ± 16.66 mm^2) was higher than consumption on alligator weed (15.61 ± 11.91 mm^2) (Wilcoxon matched pairs test, $P = 0.1729$, df = 5, statistical power = 0.2071), probably due to the low numbers of replicates.

In the field, *S. nitentula* was always found on alligator weed and never on other plant species, suggesting that it is monophagous (Table 3). The considerable larval damage observed in the laboratory and feeding damage observed by adults in the field promotes *S. nitentula* as a potential candidate for the biological control of alligator weed. Further research is required to determine whether leaf beet is a suitable or preferred host or whether the results reported here are artifacts of the experimental conditions.

Table 3. Plant species that grew in the field near alligator weed and the observed presence or absence of *S. nitentula* on them

Plant	Family	*S. nintetula* record
Alternathera philoxeroides f. *angustifolia* Suez	Amaranthaceae	Present
Alternathera philoxeroides f. *philoxeroides* (Martius) Grisebach	Amaranthaceae	Absent
Alternathera aquatica (Parodi) Chodat	Amaranthaceae	Present
Alternanthera ficoidea (L.) Beauv	Amaranthaceae	Absent
Amaranthus blitum L.	Amaranthaceae	Absent
Amaranthus quitensis Kunth	Amaranthaceae	Absent
Gomphrena elegans Mart.	Amaranthaceae	Absent
Gomphrena perennis L.	Amaranthaceae	Absent
Pfaffia glomerata (Spreng.) Pedersen	Amaranthaceae	Absent
Acalypha multicaulis Müll. Arg.	Euphorbiaceae	Absent
Cleome sp.	Capparaceae	Absent
Hygrophila guianensis Nees	Acanthaceae	Absent
Heliotropium indicum L.	Boraginaceae	Absent
Polygonum sp.	Polygonaceae	Absent
Ludwigia spp.	Onagraceae	Absent
Enydra anagllis Gardners	Asteraceae	Absent
Gymnocoronis spilanthoides	Asteraceae	Absent
Amaranthus spp.	Amaranthaceae	Absent
Chenopodium quinoa Willd.	Chenopodiaceae	Absent
Hydrocotile bonariensis Lam.	Apiaceae	Absent
Eichornia crassipes (Mart) Solm-Laub.	Pontederiaceae	Absent
E. azurea (Sw.) Kunth	Pontederiaceae	Absent
Pontederia cordata L.	Pontederiaceae	Absent
P. rotundifolia L.f.	Pontederiaceae	Absent

Observations were made on each species at least two times over different seasons between 2002 and 2004.

Material Examined. HOLOTYPE. 1 ♀, BRAZIL: Matto Grosso, Matto Grosso, Rio Caraguatá (NHMB). Other material examined: ARGENTINA: Jujuy, 2 ♂♂, 3 ♀, Rt 34, km 1164, 20-V-02, Sosa col. (MLP); Salta, 1H, Metán, Rt 34, 22-V-02, Sosal. (SABCL); Tucumán, 6 ♂♂, 3 ♀♀, Rt 380 to Lules, 12-II-04, Sosa and Jara col. (MLP); 15 ♂♂, 23 ♀♀, Rt 34 to Tafi del Valle, 12-II-04, Sosa and Jara col. (MLP); 1♂, 1♀, Cerro San Javier, road to Villa Nogués, 12-II-04, Sosa and Jara col. (USNM); Santiago del Estero, 9 ♂, 9 ♀♀, Dique Río Hondo; 11-II-04, Sosa and Jara col (MLP); Misiones, 4 ♂♂, San Ignacio, 6-XI-03, Sosa and Dorado col. (SABCL), 3 ♂♂, Puerto Posadas, 7-XI-03, Sosa and Dorado col. (MLP) Chaco, 3 ♂♂, 9 ♀♀, Resistencia, 23-III-75, Vogt col. (SABCL), 1♀, Puerto Velela, Resistencia, 20-XI-02, Sosa and Dorado col. (MLP), 3 ♀♀, Rt 90 southern San Martín, 18-XI-02, Sosa, Cabrera Walsh and Julien col. (MLP), 1 ♂ Isla del Cerrito, 20-XI-02, Sosa and Dorado col. (MLP). Corrientes, 2 ♂♂, 2 ♀♀, San Cosme, Lag. Tótora, 14-III-75, Vogt col. (SABCL), 1H, 35 km NE Goya, Vogt col. (SABCL), 2 ♀♀, Goya, Rt 12, 2-XI-02, Sosa and Dorado col. (MLP). Santa Fe, 3 ♂♂, 1 ♀, Rt 11, 22 km SW Reconquista, 22-XI-02, Sosa, Cabrera Walsh and Julien col. (USNM), 1 ♂, Rt 11, Arroyo Espín closer to Vera, 22-XI-02, Sosa-Dorado col. (MLP), 3 ♀♀ 17-V-02, Sosa, Cabrera Walsh and-Julien col. (MLP). BRAZIL: Rio Grande do Sul, 5 ♀♀, Lago Sombrío,V-04, Sosa, and Schooler col. (MLP), São Paulo, 2 ♀♀, III-1944, Pires Sununga, N. Santos col. (MZSP).

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