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RESEARCH ARTICLE - ANTS

Two New *Strumigenys* F. Smith (Hymenoptera: Formicidae: Myrmicinae) from Montane Forests of Ecuador

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Abstract

Two new species from the myrmicine ant genus *Strumigenys* found in cloud forests above 2000 m in southern Ecuador are described and illustrated. *S. lojanensis n. sp.* is a member of the gundlachi complex described from 8 workers and 2 queens. *S. madrigalae* n. sp. is a member of the schulzi group described from 1 worker and 1 queen. Characters that permit separation from closely appearing species are presented. The gundlachi group of *Strumigenys* now has at least 5 species known from andean cloud forests above 2000 m in northern South America.

Introduction

The genus *Strumigenys*, with 836 valid species worldwide (Bolton, 2014), is one of the most species rich ant genera, with the majority concentrated in tropical forests, of which a little under 25% are to be found in the Neotropical region. They are predators of other arthropods and many are trap-jaw hunters specializing in stalking Collembola, a key group in vegetational litter decomposition and formation of soil microstructure (Rusek, 1998). Despite a recent monumental revision (Bolton, 2000) it is clear that the diversity of the group still has much to be discovered. Recent sampling in high altitude forests in southern Ecuador has revealed two unknown species of *Strumigenys*, both of which are presently described.

Materials and Methods

The specimens were studied using a Zeiss Stemi 2000-C stereocope with a 1x objective lens and 10X ocular lens. Images were taken using the same stereoscope fitted with a Zeiss Axiocam Mrc5 camera and the image analysis software Axiovision by Zeiss was used for measuring the specimens. The drawings were made using images taken with the camera plus direct comparison with specimens. For comparative purposes, besides the cited references, images of *Strumigenys* posted on Antweb (www.antweb.org) were extensively consulted. Mandibular denticles are best seen using background lighting and a dorsal-oblique view, especially for *S. lojanensis*. Measurements and indices follow Bolton (2000). The following collections are mentioned in the text as repositories of specimens.

CISEC - Colección de Invertebrados del Sur del Ecuador, Universidad Técnica Particular de Loja, Loja, Ecuador.

DZUP - Coleção Entomológica Padre Jesus Santiago Moure, Departamento de Zoologia, Setor de Ciências Biológicas, Universidade Federal do Paraná, Curitiba, Paraná, Brazil.

ICN - Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá D. C., Colombia

MCZC – Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA.

MZSP - Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil

RBINS - Royal Belgian Institute of Natural Sciences, Recent Invertebrates Collection, Brussels, Belgium.

QCAZ - Quito Catholic Zoology Museum, Pontificia Universidad Católica de Ecuador, Quito, Ecuador.

Results

Descriptions of New Species

Strumigenys lojanensis n. sp.

Figs 1 – 3. *Strumigenys lojanensis* n. sp. Worker. Scale bar = 0.25mm. Pilosity omitted.

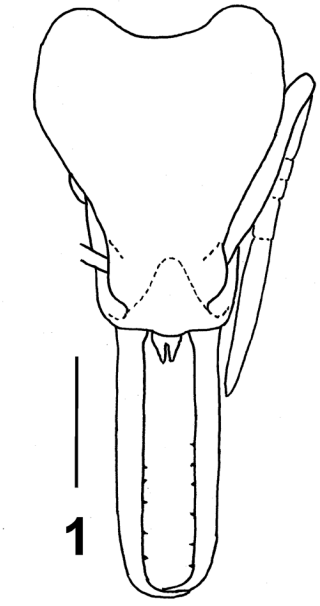

Fig 1. *Strumigenys lojanensis* n. sp., head dorsal view.

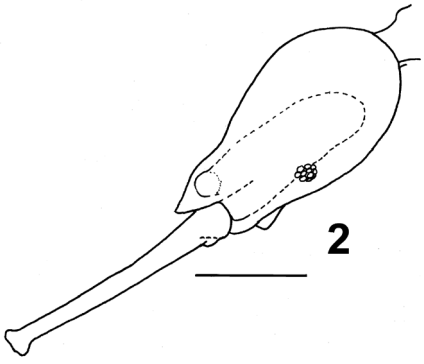

Fig 2. *Strumigenys lojanensis* n. sp., head lateral view.

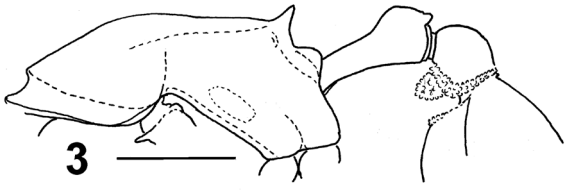

Fig 3. *Strumigenys lojanensis* n. sp., body lateral view. Elongated shape on mesopleuron outlined by broken line defines area of smooth and shining sculpturing.

Diagnosis. Mandibles straight with small relatively same-sized 5-7 preapical denticles along anterior half; mandibular apex with two minute intercalary denticles that appear midway between upper and ventral apical teeth. Disc of postpetiolar dorsum weakly reticulate-punctate, spongiform processes of postpetiole well-developed. Head, most of mesosoma, coxae, femora and tibiae densely reticulate-punctate; katepisternum mostly smooth and shining.

Type Material. Holotype. Ecuador, Loja, Reserva El Madrigal, 4.04655°S 79.17583°W, 6.3 km SSE of Loja, 2350m, 28 August 2014, J. Lattke 3590-14. Holotype (worker) deposited in QCAZ. Paratypes. (1) One worker and one queen from the same sample as the holotype also deposited in QCAZ. (2) Same locality data and date as the holotype: sample Lattke 3590-15 1w in RBINS. (3) Same locality data and date as the holotype: sample Lattke 3590-03 1w in DZUP, 1w in ICN, 1w in MCZC, 1w in MZSP. (4) Ecuador, Loja, Estación Fundación Arco Iris, Loja – Zamora road, km 23, 3.98846°S 79.09326°W, 12.12k E of Loja, 2105m, 18 August 2014, J. Lattke 3573. From sifted leaf litter sample. One dealate queen and 1 worker deposited in CISEC.

Worker description. Holotype (Paratypes, n=4): HL 0.62(0.60-0.63), HW 0.47(0.46-0.50), ML 0.49(0.48-0.50), SL 0.43(0.40-0.43), PW 0.31(0.31-0.34), AL 0.67(0.66-0.69) mm; CI 76(74-79), MI 79(76-82), SI 91(0.82-93). Posterior cephalic margin deeply concave, occipital lobes well developed; surface of cephalic dorsum transversely convex; anterior clypeal margin transverse, slightly sinuate with low median convex lobe. Dorsolateral margin of head with flagellate hair just posterad of eye level; cephalic dorsum with two pairs of slightly spatulate erect hairs, highest pair close to posterior cephalic border whilst shorter pair close to eye level. Leading edge of scape with slender hair at base that arches apicad, followed by 5 thicker, spatulate hairs: second hair from base arches apicad and is more slender than hairs 3-6, hairs 3-4 arch basad and hairs 5-6 usually arch apicad, though some specimens may have hair 6 arching towards base. Apical lobes of labrum clearly visible with mandibles closed, short and converge towards each other, slightly wider at base than at blunt apex; trigger hairs extend anterad to midpoint of mandibular length. Mandible straight, external margin straight to weakly convex, internal margin weakly sinuate, basally convex and apically concave, basal lamella convex; preapical denticles 5-6 on left mandible and 5-7 on right mandible with mandible pointing towards observer; denticles closest to apex usually larger though minute denticles or stubs may be present. Mandibular apex with two minute intercalary denticles that appear midway between upper and ventral apical teeth.

Mesosoma in lateral view with pronotal margin broadly convex, mesonotal to propodeal margin relatively flat. Transverse section of pronotal dorsum broadly convex; pronotal humeral hair fine and flagellate, sometimes forming apical loop; mesonotum with single pair of flagellate hairs; propodeal spiracle separated from posterior edge of propodeal lamella by over single

width; propodeal tooth triangular, apex pointed. Propodeal tooth triangular, sharply pointed and slightly higher than basal length; metapelural lobe bluntly triangular, not higher than propodeal tooth. Petiole lacking spongiform processes, ventrum with low anterior lamella that extends posterad to midlength; spongiform sculpturing well-developed on postpetiolar ventrum and posterolaterally, vestigial strands of spongiform sculpturing usually present along anterior margin of abdominal sternite IV. Postpetiolar tergite with narrow lamella along anterior margin. Dorsum of abdominal segments II – V with series of straight to weakly arched hairs, all semi-erect over cuticular surface. Petiolar node with posterior pair, postpetiole with 3 pairs, two dorsal pairs and a lateral pair. Anterior border of abdominal tergite IV with transverse arched crest that parallels posteriorly projecting lamella of postpetiole, a few brief longitudinal costulae may be present along this crest; most of tergite smooth and shining with 20-24 erect, slightly arched, spatulate hairs and no appressed pubescence.

Head, most of mesosoma, petiole, postpetiole, coxae, femora and tibiae densely reticulate-punctate, sculpturing attenuated on discal area of postpetiolar node and along its anterior margin; katepisternum mostly smooth and shining with strip of reticulate-punctate sculpture along anteroventral and ventral margins, propodeal declivity mostly smooth and shining posteriorly; abdominal tergite IV smooth and shining. Body mostly dark brown, almost black; mandibles, antennae, and legs brown.

Gyne. (Gyne 1 - Gyne 2): HL(0.62-0.64), HW(0.5-0.51), ML(0.51-0.48), SL(0.41-0.41), PW(0.38-0.39), AL(0.77-0.77) mm; CI(81-80), MI(82-75), SI(82-80). Besides the expected morphological differences the gyne is quite comparable to the workers except for the better developed petiolar ventral lamella, although still low it bears more resemblance to spongiform sculpturing whilst in the worker it is simply a brief, low lamella.

Etymology. The specific epithet "lojanensis" is derived from the name of the Ecuadorian state in which the specimens were found, Loja.

Discussion. This species fits quite well within the *gundlachi* complex as defined by Bolton (2000:176) but the spongiform processes of the postpetiole are much more developed in *S. lojanensis*. Within the gundlachi complex, *S. lojanensis* fits comfortably into the gundlachi species cluster, with the only difference consisting in the weaker reticulate sculpturing of the postpetiolar dorsum. Using the key to Neotropical *Pyramica* in Bolton (2000:137) specimens of *S. lojanensis* will flow directly to *S. enopla* (Bolton). Using the description of *S. enopla* (Bolton, 2000: 185) and images of a Paratype from Antweb (CASENT0900177) it was possible to identify a number of discrete differences between the two species: The cephalic subdecumbent pilosity is not as arched and high as in *S. enopla*; the subdecumbent hairs on the mesosomal dorsum are also higher and more arched in *S. enopla*, as well as the standing hairs on petiole, postpetiole and gaster. The mesosomal dorsal margin of *S. lojanensis* is straight in lateral view, whilst in *S. enopla* it is distinctly sinuate and the propodeal denticles are stouter in *S. lojanensis* than in *S. enopla*. There are 2 standing hairs on the petiolar dorsum of *S. lojanensis*, compared with 4 in *S. enopla*. In *S. enopla* the posterior edge of the spongiform sculpturing on the postpetiole is convex, but in *S. lojanensis* there is a distinct low median lobe.

The reticulate-punctate sculpture of the postpetiole is mostly strong and comparable to that of the petiole, covering most of it but weakens posteromedially on the dorsum, so it could be difficult to decide which way to go at couplet 7 of Bolton's key. If the user decides for first option then the specimen will become stranded at couplet 9 due to the number of denticles, exceeding the maximum amount for either option. If the modification of Bolton's key proposed by Rigato and Scupola (2008: 481) is used, then the specimen will key directly to *S. osellai* (Rigato & Scupola). In this case differences in the preapical dentition and metapleural sculpturing will permit easy separation: *S. lojanensis* bears only small denticles and never a large pair of denticles, plus the metapleuron in *S. osellai* is smooth and shining, but not so in *S. lojanensis*.

The Arco Iris site is located within Podocarpus National Park along the road that joins Loja with Zamora within dense montane cloud forest, bearing a canopy not more than 20 m high upon steep slopes. It is within the catchment area of the Río San Francisco, with an estimated average annual rainfall of 3500-4000 mm, relative cloud cover of 70-80% (Richter *et al.* 2013), and an estimated mean annual temperature of 15-16°C (Wilcke et al., 2008). The Reserva Madrigal locality is a private reserve that neighbors Podocarpus National Park approximately 7 km SSE from Loja. It was previously a dairy farm and has been undergoing restoration towards forest during the last ten years. The specimens were taken from several samples along a 200 m long transect in mostly secondary vegetation, ranging from trees approximately 15 m high forming a loose canopy to more open bracken (*Pteridium* sp.) dominated understory with scattered trees and shrubs. Neighboring slopes to the sampling site across the stream bear dense forest with a canopy apparently not more than 15 m high. The area has an estimated average annual rainfall of 3000-2500 mm (Richter *et al*., 2013).

With the discovery of *S. lojanensis* it is possible to discern a group of 5 northern andean species of the gundlachi complex with a preference for cold forests above 2000 m altitude, where the presence of most ants is negligible (Longino, 2014). The other species are *S. enopla*, known from altitudes between 1900 and 2200 m in SW Colombia, *S. nubila* Lattke and Goitía, sampled from altitudes between 2000 and 2500 m in Colombia and Venezuela, *S. vartana* (Bolton), a Colombian species known from altitudes between 1800 and 2530 m and *S. heterodonta* (Rigato & Scupola) which was recently described from 2940 m altitude in Ecuador (Rigato & Scupola, 2008).

Are these cold weather specialists closely related? Do they form a monophyletic group? Bolton recognizes two complexes of species within the *gundlachi*-group based upon the mandibular dentition and the development of the apical lobes of the labrum

and their accompanying trigger hairs: the *crassicornis* complex, and the *gundlachi* complex. Bolton (2000) informally divides the *gundlachi* complex into four clusters of apparently related species using the mandibular index, number and position of intercalary denticles of the mandibular fork, number and position of the preapical mandibular dentition, configuration of the main pilosity, and sculpture of the postpetiolar node. In his scheme both *S. enopla* and *S. lojanensis* fit in the *gundlachi* cluster, where they are the only cloud forest specialists, though widely distributed species such as *S. denticulata* (Mayr), and *S. gundlachi* (Roger) also have broad altitudinal ranges that include cloud forests but none approaching 2000 m (Bolton, 2000; Lattke & Goitia, 1997). *S. vartana* lies in the *laevipleura* cluster, which includes *S. gemella* Kempf recorded from cloud forests in Colombia close to 1700 m (Bolton, 2000). *S. nubila* shares the *nubila* cluster along with *S. lalassa* (Bolton), a species found from sea level to 1500 m from Costa Rica to Ecuador (Bolton, 2000). Rigato and Scupola (2008) described *S. heterodonta* as part of the *gundlachi* complex, and opted for placing it in fifth species cluster as they were not satisfied with its affinities to any of the other species. Nevertheless *S. heterodonta* is quite comparable with the *nubila* cluster as it fits most of the traits used by Bolton, the differences being more of a degree than categorical. Most of the seven species of the *subedentata* cluster are found in low to medium altitudes except for *S. connectens* (Kempf), known from forests close to 1500 m in Ecuador (Bolton, 2000), and *S. paniaguae* (Longino) found in Costa Rica between altitudes of 500-1500 m (Longino, 2006). A brief overview of the ten species making up the *crassicornis* complex (Bolton, 2000) shows most of them to inhabit low to medium altitudes except for *S. pasisops* (Bolton), found in cloud forests of 1500 m, so it seems that the cold weather (>2000 m) specialists are, for the while being, restricted to the *gundlachi* complex, implying some close relationship.

A phylogenetic analysis is in order to get a better grip on the issue but it should include not only the species as they are presently known but also representative populations from different sites for each species, especially the more widespread ones with broad geographical and altitudinal coverage such as *S. gundlachi* or *S. denticulata*. Upon discussing morphological variability within *S. gundlachi*, Bolton (2000) points out the distinctness of some high altitude specimens from Colombia, which could represent a different species. A similar situation repeats itself when Bolton discusses variability within *S. denticulata* and some high altitude specimens from SW Colombia. Longino (2006) found and described three species apparently closely related to *S. subedentata* Mayr that form an elevational succession along the slopes of his sampling sites in Costa Rica with each occupying a determined altitudinal range. A similar situation is then conceivable for *S. gundlachi* and *S. denticulata*, or perhaps other species. More sampling and alpha taxonomy is needed, especially in the mountains of Colombia, Ecuador, Peru, and Bolivia, before we may have a better picture of the distribution and relations of the *gundlachi* complex cold weather specialists. Climate change and the ever increasing destruction and fragmentation of the Andean cloud forests actively work against such a research agenda.

***Strumigenys madrigalae* n. sp.**

Figs 4 – 5. *Strumigenys madrigalae* n. sp. Worker. Scale bar = 0.25mm. Pilosity omited.

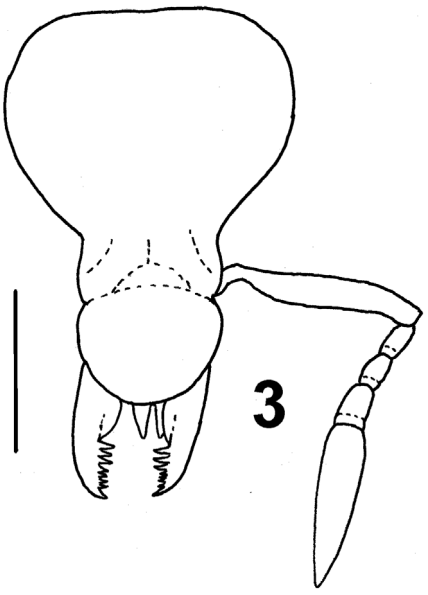

Fig 4. *Strumigenys madrigalae* n. sp., head dorsal view.

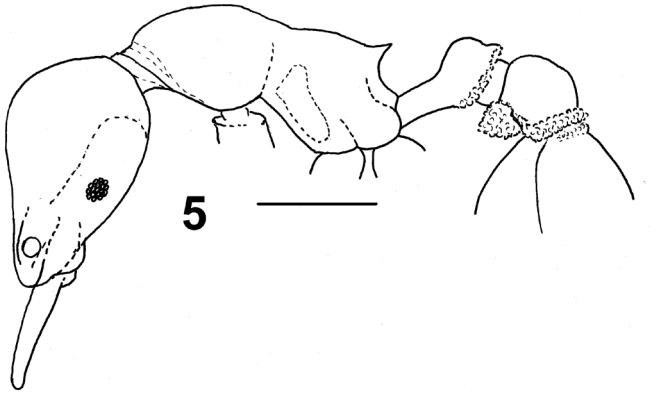

Fig 5. *Strumigenys madrigalae* n. sp., body lateral view. Elongated shape on mesopleuron outlined by broken line defines area of smooth and shining sculpturing.

Diagnosis. Mandibular dentition with 5 acute teeth apicad of basal lamella, the basal 3 largest; teeth followed by 4 minute preapical denticles, and apical tooth; no diastemma between teeth and lamella, lamella higher than longest teeth. Postpetiolar dorsum smooth.

Type Material. Holotype: Ecuador, Loja, Reserva El Madrigal, 4.04655°S 79.17583°W, 6.3 km SSE of Loja, 2350m, 28 August 2014, J. Lattke 3590-17. Holotype (worker) deposited in QCAZ. Paratype: One dealate queen with the same locality data and date as the holotype but from sample Lattke 3590-14 is also deposited in QCAZ.

Worker description. Holotype: HL 0.61, HW 0.45, ML 0.13, SL 0.31, PW 0.29, AL 0.61mm; CI 74, MI 21, SI 69. Posterior cephalic margin has shallow median concavity

with head in dorsal view, occipital lobe weakly expanded laterally; posterolateral cephalic margin convex, with curved decumbent spatulate hairs, apical scrobal hair absent. Four standing hairs present between highest point of vertex and occipital margin. Eye oval-elongate with 5 ommatida in the longest axis. Scape external margin with appressed spatulate hair close to base; also with three erect spatulate hairs, one basad of basal angle; three spatulate hairs that curve apicad present close to scape apex. Anterolateral clypeal margins convex throughout, clypeal dorsum with appressed squamate hairs. Mandibular dentition with 5 acute teeth apicad of basal lamella, the basal 3 are largest; followed by 4 minute preapical denticles, and apical tooth; no diastemma between teeth and lamella, lamella higher than longest teeth.

Promesonotal dorsal margin broadly convex in lateral view, metanotal groove broad and shallow, propodeal dorsal margin straight, slightly elevated above metanotal groove and forming obtuse angle with declivitous margin. Pronotal humeral hair absent, mesonotum with two hairs, erect and slightly arched medially. Anterior pronotal margin with transverse crest bearing row of short spatulate hairs. Propodeal tooth short, sharply pointed with lamella extending posterad towards low metapleural lobes; propodeal spiracle directed posterolateally, separated from posterior margin of lamella by not more than one diameter.

Petiolar node forms convex dome with two erect hairs close to posterior margin, hairs slightly inclined posterad, anterolaterally with two pairs of curved decumbent hairs; postpetiole with three pairs of standing hairs; anterad, posterad, and laterad. Petiole with narrow fringe of spongiform tissue along posterior margin, laterally and dorsally, none ventrally; postpetiole with well-developed ventral and lateral spongiform tissue which continues onto dorsoposterior margin, narrow fringe present on anterior margin of abdominal tergite IV; none present on abdominal sternite IV. Abdominal tergite IV with sparse erect hairs, each slightly inclined posterad; mostly smooth and shining with short, basal longitudinal costulae, not longer than the maximum metatibial width. Profemur dorsum with elongate bullae, rice grain shaped. Outer surface of meso- and metatibia with decumbent arched hairs, each hair about as long as respective maximum tibial width or slightly shorter. Head, mesosoma, and petiole densely and finely reticulate-punctae; mesopleuron mostly smooth medially; postpetiolar dorsum smooth. Coxae, femora and tibiae densely reticulate-punctate. Body mostly ferruginous brown, dorsum of head and thorax dark brown, gaster black.

Gyne. HL 0.71, HW 0.51, ML 0.15, SL 0.34, PW 0.41, AL 0.82mm; CI 72, MI 21, SI 67. Gyne comparable with the worker and differing in expected traits such as the greater development of the mesosoma and presence of ocelli.

Etymology. The specific epithet "madrigalae" is derived from the name of the nature reserve in which the specimens were found, Madrigal.

Discussion. This species fits within the *schulzi* group as defined by Bolton (2000:214) but the dental arrangement in *S. madrigalae* is unlike any of the other species in the group as it lacks a couple of teeth after the first five that follow the basal lamella, for a total of 10 teeth compared with the 12 teeth of other species. Using the key for Neotropical *Pyramica* in Bolton (2000:137), this species will key smoothly to couplet 65, where it coincides with the characteristics of *S. microthrix*, a species known from Costa Rica and Colombia. Using the original description of *S. microthrix* by Kempf (1975:422) as well as that of Bolton (2000: 185), and images of a specimen (INBIOCRI001283688) available from Antweb, it was possible to identify several discrete differences between the two species. The occipital lobes in *S. microthrix* are more strongly expanded and its mandible has only 5 acute teeth between the minute preapical denticles and the basal lamella. The hairs laterally bordering the clypeus are more slender in *S. madrigalae*. *S. microthrix* lacks standing hairs on the mesosomal and petiolar dorsum, and the anterior margin of its petiolar node forms an abrupt angle with peduncle. The postpetiole has a negligible amount of ventral spongiform tissue. The postpetiolar node has one pair of erect hairs and very sparse erect hairs on the gastral dorsum. The postpetiolar dorsum is densely sculpted in *S. microthrix*. Please see the discussion for *S. lojanensis* for information on the type locality of *S. madrigalae*.

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