A giant new arboreal species of the ant genus *Anochetus* from Brazil (Formicidae: Ponerinae)

Rodrigo M. Feitosa [1], Sebastien Lacau [2], Wesley D. Da Rocha [3,4], Anibal R. Oliveira [5] & Jacques H. C. Delabie [3,6]*

[1] Museu de Zoologia da Universidade de São Paulo, Av. Nazaré 481, 04263-000 Ipiranga, São Paulo, SP, Brazil

[2] Laboratório de Biossistemática Animal, Universidade Estadual do Sudoeste da Bahia, Campus Juvino Oliveira, BR 415, Km 03, s/nº, 45700-000 Itapetinga, Bahia, Brazil

[3] Laboratório de Mirmecologia, Convênio UESC/CEPEC, Centro de Pesquisas do Cacau, C.P. 7, 45600-000 Itabuna, BA, Brazil

[4] Programa de Pós-Graduação em Zoologia, Universidade Estadual de Santa Cruz, 45662-000 Ilhéus, BA, Brazil

[5] Departamento de Ciências Biológicas, Universidade Estadual de Santa Cruz, 45662-000 Ilhéus, BA, Brazil

[6] Departamento de Ciências Agrárias e Ambientais, Universidade Estadual de Santa Cruz, 45662-000 Ilhéus, BA, Brazil

* Corresponding author

Abstract. A new species of the trap-jaw ant genus *Anochetus* Mayr 1861, *A. hohenbergiae* Feitosa & Delabie **n. sp.**, is described from Northeastern Brazil. Gynes and workers were collected in association with epiphytic bromeliads living in the canopy of trees used as shading in cocoa plantations. *Anochetus hohenbergiae* is the largest species known for the genus and shares a number of morphological characters with the species in the *emarginatus* group of *Anochetus*. Besides its remarkable size, this species can be distinguished from others in the genus by a strong concavity of the posterior margin of head, absence of propodeal spines, and conical shape of petiolar node. A detailed description of this new form and a discussion of its position within the genus are provided.

Résumé. Une nouvelle espèce de fourmi arboricole géante du genre *Anochetus* (Formicidae : Ponerinae) du Brésil. Une nouvelle espèce de fourmi du genre *Anochetus* Mayr 1861, *A. hohenbergiae* Feitosa & Delabie **n. sp.**, est décrite du Nordeste du Brésil. Des gynes et des ouvrières ont été récoltées en association avec des broméliacées épiphytes de la canopée d'arbres utilisés pour l'ombrage des cacaoyères. *Anochetus hohenbergiae* est la plus grande espèce connue dans le genre et possède un certain nombre de caractères morphologiques en commun avec les espèces du groupe *emarginatus*. En plus de sa taille remarquable, elle peut être distinguée des autres espèces du genre par la concavité marquée qu'elle présente sur la marge postérieure de la capsule céphalique, l'absence d'épines propodéales et le noeud pétiolaire conique. Une description détaillée de cette nouvelle espèce et une discussion sur sa position dans le genre est présentée.

Keywords: Trap-jaw ants, *emarginatus* group, *Hohenbergia*, Neotropical, Taxonomy.

Species of the ponerine ant genus *Anochetus* Mayr 1861 are widely distributed in the world's tropics and subtropics and are among the most distinctive and easily recognizable lineages of ants. *Anochetus* shares with their close relative *Odontomachus* Latreille 1804 the long and straight mandibles inserted just on each side of the cephalic midline. The mandibles of these ants are entirely adapted for their predaceous habits, lying nearly parallel at full closure and opening to about 180º when the ants are searching for prey or are threatened by enemies (Brown 1978; Fisher & Smith 2008).

E-mail: acques.delabie@gmail.com, rfeitosa@usp.br, slacau@uesb.br, wd.darocha@gmail.com, aroliveir@gmail.com

Accepté le 23 mars 2012

Anochetus was treated globally by Brown (1978). In the Neotropical Region, it is represented by 24 extant species with ranges from tropical Mexico, east into some Caribbean Islands, to northern Argentina (Fernández & Sendoya 2004; Bolton *et al.* 2006). Ants of this genus may nest and forage in different habitats. Most species nest in the ground or in rotten wood and often can be found foraging well above ground level on forest or savanna tree trunks, generally after dark. Other species nest in the soil of arid areas, and forage over the ground surface near midday in only scanty shade (Brown 1978; Lattke 2003; Fernández 2007). Furthermore, some species appear to be exclusively arboreal nesters and foragers, although direct observations are very rare in this habitat (Brown 1978; Delabie *et al.* 2003; Longino 2007).

Since Brown's revision (1978), eleven additional

species were described for the Neotropical Region: eight fossils species from Dominican Amber (*A. ambiguus* De Andrade 1994, *A. brevidentatus* Mackay 1991, *A. conisquamis* De Andrade 1994, *A. corayi* Baroni-Urbani 1980, *A. dubius* De Andrade 1994, *A. exstinctus* De Andrade 1994, *A. intermedius* De Andrade 1994, *A. lucidus* De Andrade 1994); two species from the mountains west of Cali, Colombia (*A. elegans* Lattke 1986 and *A. vallensis* Lattke 1986); and a species associated with leaf-cutter ants in Paraguay and Argentina (*A. miserabilis* González-Campero & Elizalde 2008).

Comparatively, species of *Anochetus* are usually smaller than those of the close relative *Odontomachus*. However, the description of *A. elegans* by Lattke (1986) modified the concept of the genus and blurred the size limits between *Anochetus* and *Odontomachus*. In fact, until this moment, *A. elegans* was the largest species known for the genus (worker total length 12.24–12.51 mm).

A recent increase in sampling effort of canopy ants in Northeastern Brazilian wet forests and associated agroecosystems revealed a new species totally unlike any previously described in the genus. This is the largest species known for *Anochetus* (worker total length > 12.70 mm). In this study we describe the gynes and workers of this giant new arboreal species and discuss its affinities with other species in the genus.

Material and Methods

Observations were made at 40x magnification with a Leica MZ9.5 stereomicroscope. High resolution digital images are here presented thanks to the kind permission of Dr Brian L. Fisher. These images are available on the Antweb webpage (www.antweb.org). Images taken under the scanning electron microscope (SEM) were used to record morphological details. Scanning electron microphotographs were made with the JEOL JSM-840* microscope of the Common Service of Electronic Microscopy of the Muséum National d´Histoire Naturelle, Paris, France.

Measurements were made with a micrometer and recorded to the nearest 0.001mm. All measurements are given in millimeters, and the abbreviations used are:

HW: Head Width; the maximum width of the head capsule, measured in full face view, at a median transverse line that touches the posterior margins of the compound eyes.

HL: Head Length; the maximum length of head capsule excluding the mandible, measured in full face view, in a straight line from the midpoint of the anterior clypeal margin to the midpoint of the median transverse line that touches the superior margins of the occipital corners.

ML: Mandible Length; in full face view taken with the mandibles in place, the distance from the anteriormost portion of head to apex of closed mandibles.

SL: Scape Length; the chord length of the antennal scape, excluding the basal condyle and its peduncle.

EL: Eye Length; maximum diameter of compound eye in lateral view.

WL: Weber´s Length; the diagonal length of mesosoma in profile, from the midpoint of the anterior pronotal declivity to the posterior basal angle of the metapleuron.

PL: Petiole Length; the longitudinal axis of petiole in lateral view, from the visible insertion point of the petiole in the mesosoma to the dorsal corner of the posterior peduncle.

GL: Gaster Length; the maximum length of gaster in lateral view.

TL: Total Length; the summed length of HL, ML, WL, PL, and GL.

CI: Cephalic Index; 100*HW/HL.

OI: Ocular Index; 100*EL /HW.

SI: Scape Index; 100*SL/HW.

Terms for external morphology and surface sculpturing follow, respectively, Bolton (1994) and Harris (1979). Reproductive females are here called "gynes" (see Feitosa & Brandão 2008). Generic characters are not mentioned in the species description (for a complete generic diagnosis see Brown 1978). Depository collections are referred to by the following acronyms: **CASC**, California Academy of Sciences, San Francisco, CA, USA; **CPDC,** Laboratório de Mirmecologia, Centro de Pesquisas do Cacau, Itabuna, Bahia, Brazil; **MNHN,** Muséum National d'Histoire Naturelle, Unité d'Entomologie, Paris, France; **MZSP,** Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil.

Results

Anochetus hohenbergiae Feitosa & Delabie, n. sp.

Holotype worker. Brasil: Bahia, Ilhéus, Áreas Exp. CEPEC, 14º46'30"S 39º03'03"W, X.1996, Carmo, J.C.S., #5119 [CPDC].

Paratypes. Same locality as holotype, #4586, 18.XI.1992, E. Silveira col. (1 gyne) [CPDC]; #4586C, 28.I.1993, P.A.O. Soares col. (1 gyne) [CPDC]; #5537, III.2007, Wesley D. da Rocha col., PD0700104/ PD700209 (2 gynes) [CPDC]; same information, PD700318/PD700319 (2 gynes) [MZSP]; same information, PD700195 (1 gyne) [CASC]; no further data (1 worker) [MNHN]; Una, Fazenda Ararauna, "cabruca" cacao plantation, 15°18'S 39°09'W, 22.II.2009, Wesley D. da Rocha col., C1E6FA (1 gyne) [CPDC]; same information, 05.III.2009 Wesley D. da Rocha col., C5E2FA (2 workers) [CPDC, MZSP]; #5680, Una, REBIO, XI.2011-II.2012, col. Daniela Uzel Sena (3 workers) [CPDC].

Diagnosis. Size very large in comparison to the Neotropical species known in the genus (TL > 12.70); HL + ML > 4.30; posterior margin of head strongly concave; mandibles with a row of 13–16 teeth in the masticatory margin; propodeum unarmed; petiolar node with a single, reduced apical tooth.

Worker. Holotype: HL 2.39; HW 2.10; ML 1.95; SL 2.83; EL 0.49; WL 4.05; PL 0.93; GL 3.46; TL 12.78; CI 87.76; SI 134.88; OI 23.26. Color dark brown with head and gaster slightly darker than mesosoma and petiole; legs yellowish in the coxae and grading to dark brown towards tarsi. Pilosity whitish and relatively dense; body covered by long, flexuous, suberect hairs, except for the mesopleura which is entirely glabrous;

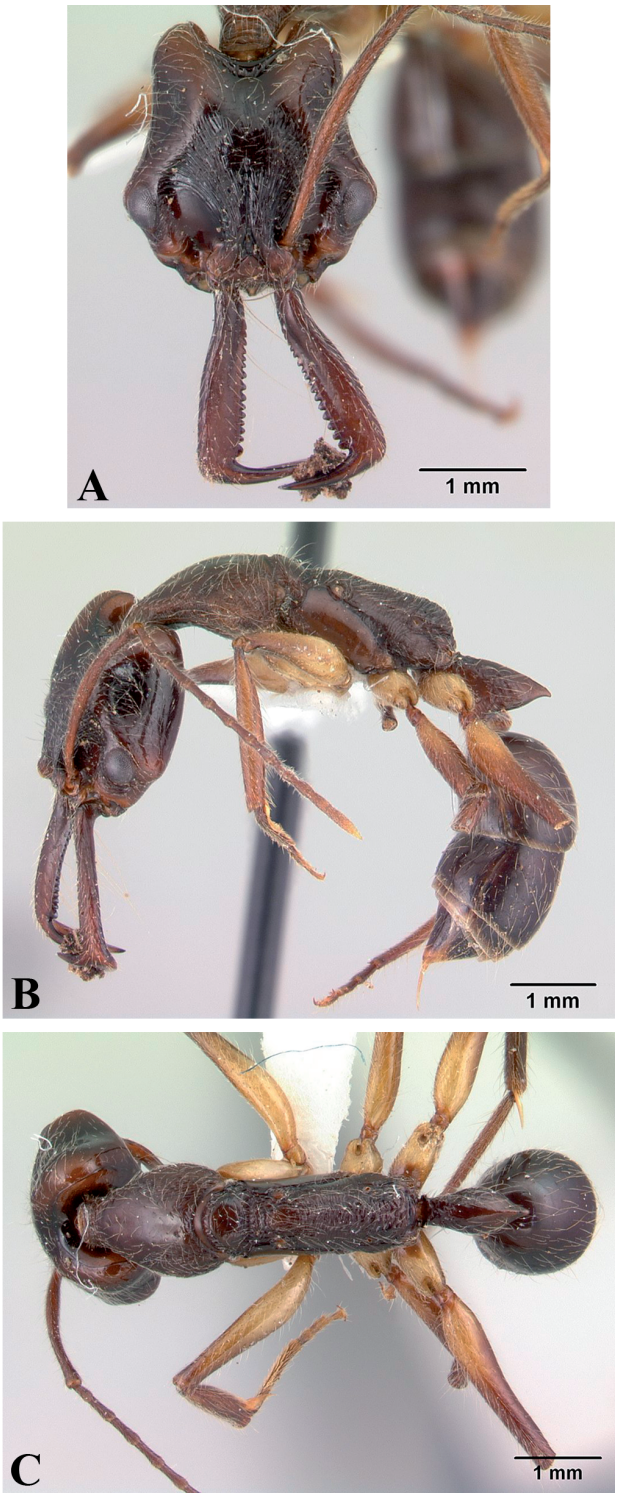

Figure 1
Holotype worker of *Anochetus hohenbergiae* (specimen CASENT0178921). **A,** head in full face view; **B,** lateral view; **C,** dorsal view.

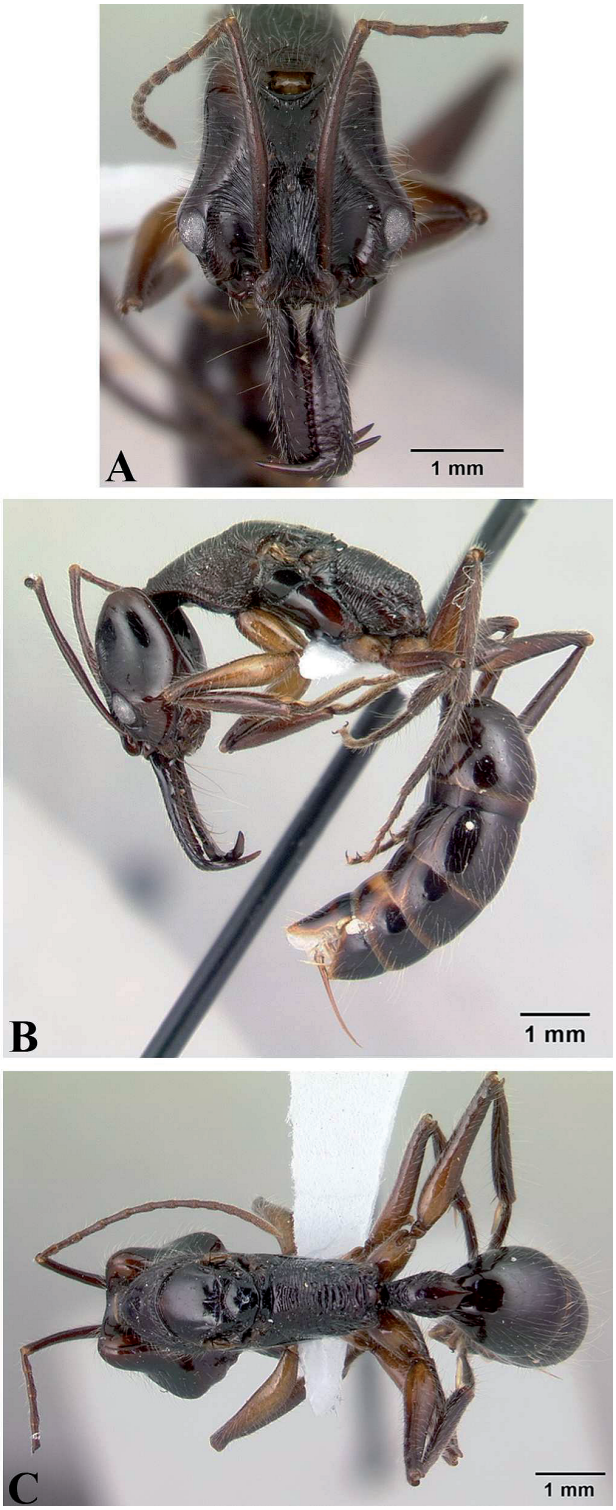

Figure 2
Paratype gyne of *Anochetus hohenbergiae* (specimen CASENT0179445). **A,** head in full face view; **B,** lateral view; **C,** dorsal view.

antennae and legs with short, suberect hairs along a fine appressed pubescence in antennal funiculi and tarsi. Mandibles shiny, finely and densely covered by minute punctuation; cephalic capsule mostly smooth and shining, with oblique striae fanning out from frontal carinae to about two-thirds of head length, cleft medially by the posteromedian longitudinal impression; antennal scapes with the same pattern of sculpture that mandibles. Pronotum with anterior and lateral portions

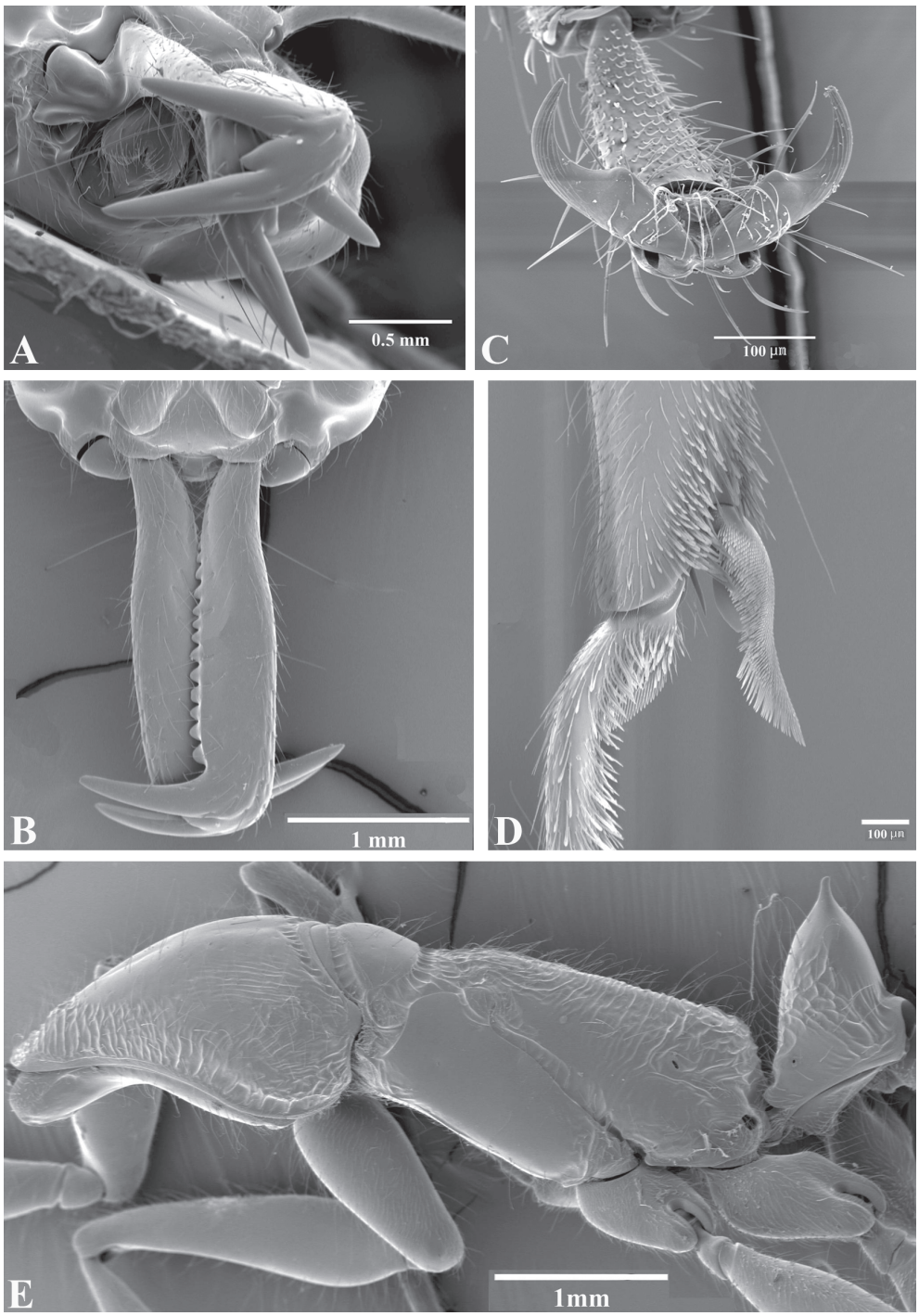

Figure 3
SEM images of *Anochetus hohenbergiae* worker. **A,** detail of mandibles apical portion and mouthparts in frontal view; **B,** clypeal area and mandibles in full face view; **C,** pretarsal claws of right front leg; **D,** detail of the right front leg tibial spur; **E,** mesosoma and petiole in profile.

irregularly costulate, central disc smooth and shiny; central disc of mesonotum and mesopleura entirely smooth and shiny; metapleura with a smooth central area and coarse rugulation along the margins; propodeal dorsum transversely costulate, except by its anterior area which presents short, irregular, longitudinal costulae; legs smooth and shiny; petiolar node sparsely rugose, with anterior and posterior faces predominantly smooth; gaster shiny and devoid of any conspicuous sculpture (figs. 1, 3).

Head subquadrate, with vertexal margin strongly concave, virtually U-shaped; posteromedian incision shallow, but conspicuous. Masticatory margins of mandibles with a row of 13–16 teeth (fig. 3B); intercalary tooth one fifth of the ventral apical tooth (fig. 3A). Antennal scapes thickened in midlength and fairly surpassing the posterolateral margins of vertex; funicular segments gradually thickened distally. Compound eyes well developed.

Mesosoma noticeably elongate. Pronotum evenly convex in lateral view, without projections; promesonotal suture relatively narrow and well impressed. Mesonotum elliptical in dorsal view; mesopleura forming a unique plate, without a transverse incision separating anepisternum and katepisternum; mesopleural tooth absent. Metanotal groove broad and well marked; metanotal spiracle distinct; metapleura ending in a rounded lobe, not projecting over petiolar peduncle; metapleural tooth vestigial. Propodeum unarmed; dorsal face meeting the declivous face in a slight curve; in lateral view, dorsal profile only minimally convex; propodeal spiracle minute, elliptical, and directed posterad. Legs long and slender; pretarsal claws with a short basal lobe (fig. 3C).

Petiole subtriangular and thick, slightly inclined posteriorly; in lateral view, anterior and posterior faces gently convex medially; node with a single, reduced apical tooth, faintly curved posterad, but not overhanging posterior face of petiole in dorsal view; anterior ventral process rounded and weakly developed.

Gaster elongate. First gastral segment (abdominal III) evenly convex dorsally and laterally, with sternite nearly straight; constriction between segments I and II of gaster (abdominal III and IV) only feebly impressed.

Gyne. Paratypes (n=5): HL 2.49–2.63; HW 2.15–2.24; ML 1.95–2.05; SL 2.83–2.93; EL 0.49–0.59; WL 4.20–4.39; PL 1.02–1.12; GL 4.29–4.93; TL 14.05–15.02; CI 83.33–88.46; SI 128.89–131.82; OI 22.22–26.09. Similar to conspecific worker, but not ergatoid. Body size larger and color slightly darker than in worker. Dorsal surface of head with three distinct ocelli; eyes moderately larger than in worker. Pronotum relatively narrow; scutum large and rounded; notauli indistinct; parapsidial lines feebly visible and subparallel; tegulae reduced and lighter than adjacent integument; scutoscutellar sulcus broad and weakly impressed; scutellum rounded and placed at the same level as the scutum; axillae subtriangular; anepisternum clearly separated of katepisternum by a S-shaped suture; propodeum only moderately convex (fig. 2).

Male. Unknown.

Etymology. The specific epithet is a reference to the observed association of this species with epiphytes of the genus *Hohenbergia* Schult.f. (Bromeliaceae: Bromelioideae).

Figure 4
Distribution map for *Anochetus hohenbergiae*. The black square shows the region where the specimens were found (in three distinct localities very close).

Comments. *Anochetus hohenbergiae* shares its large size, elongate body and serially dentate mandibles with members of the *emarginatus* group, a Neotropical species-complex proposed by Brown (1978). This species can be guided to the couplet 3 of Brown's key (1978: 572) where it is stranded due the petiolar characteristics which do not fit any of the alternatives. In fact, *A. hohenbergiae* is unlikely to be confounded with any other *Anochetus* species. This is the largest species in the genus, and the combination of abundant pilosity, posterior margin of head strongly concave, mandibles with a row of 13–16 teeth in the masticatory margin, propodeum unarmed, and petiolar node with a single, reduced apical tooth is unique in the genus. This species shares the exceptionally large body size with *A. elegans* Lattke 1987 (TL 12.24–12.51 mm); however *A. hohenbergiae* is even larger (TL > 12.70) and lacks the pair of blunt petiolar spines of *A. elegans*.

The holotype worker of *A. hohenbergiae* lacks the tibia and tarsus of the left mid- and hind legs, and of the right mid leg.

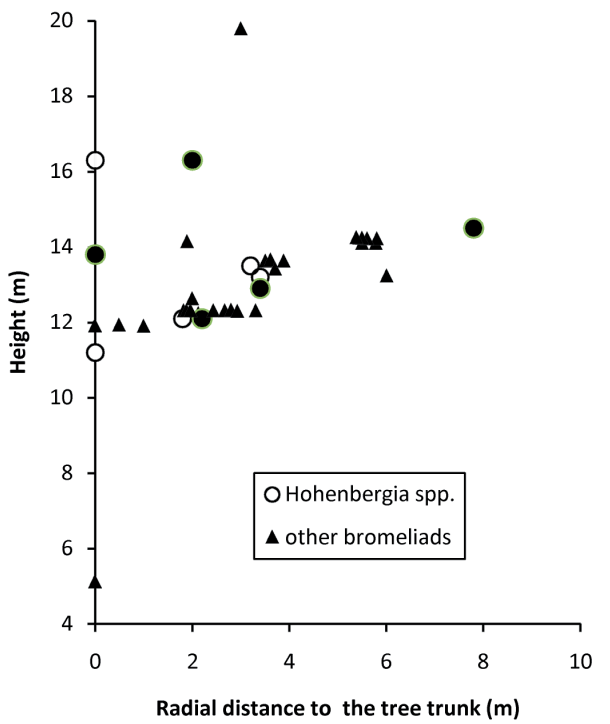

Figure 5
Distribution of *Anochetus hohenbergiae* among the bromeliads in the canopy of an *Erythrina* legume used to shade cocoa plantations at Ilhéus, Bahia, Brazil. Full circles: *Hohenbergia* spp. sheltering *A. hohenbergiae*; empty circles: plants of the same genus without *A. hohenbergiae*; triangles: specimens of other bromeliad genera.

Distribution. *Anochetus hohenbergiae* is known only from three localities in southern state of Bahia, Northeastern Brazil. An increase in sampling effort of canopy ants in Brazilian rain forests may result in more distribution records of this remarkable species.

Natural history. Several years ago (1992), three dealate gynes of *Anochetus hohenbergiae* were collected together at the base of an unidentified epiphyte on a 23 m high tree in the CEPLAC experimental areas at Ilhéus, suggesting that pleometrotic colony founding may occur (Delabie, *pers. obs.*). During the following years a single gyne and two workers were collected in the same locality, but no information was obtained on their habits, except that at least one of the workers was collected foraging on the ground in a cocoa plantation.

Recently, a survey of canopy ants in native and introduced trees used to shade cocoa plantations at the same locality and in Una county (67 km S of Ilhéus), revealed new specimens, all of them associated with epiphytic bromeliads. Six dealate gynes and two workers were found associated with several individuals belonging to two Bromeliaceae species: *Hohenbergia blanchetii* (Baker) E. Morren ex Mez, and *Hohenbergia* sp. At Ilhéus, the bromeliads were fixed at 12–16 meters high to a single tree (24 meters high), *Erythrina fusca* Loureiro (Leguminosae, Fabaceae), an introduced species commonly used to shade cocoa plantations (Delabie *et al.* 2007) (fig. 4). At Una, the ants were found at the base of *Hohenbergia* spp. on two different native trees, *Enterolobium contortisiliquum* (Vell.) Morong (Leguminosae, Mimosoideae) and *Rollinia laurifolia* Schlecht. (Annonaceae), at 14 and 19 meters high (the trees were 21 and 28 meters high, respectively). Each gyne was associated with a single bromeliad, which suggests that they were probably founding colonies.

An astigmatine mite (Acari: Sarcoptiformes: Astigmatina) was found attached to the body of one of the workers. The mite was in the hypopus stage, an heteromorphic deutonymph which is a resistant form that lacks mouthparts, has a closed gut, is highly resistant to environmental stress, and commonly has ventral suckers with which it secures attachment to insects and other animals when searching for suitable sites to achieve its full development. The relationship generally is restricted to phoretic dispersal in that these nymphs lack functional mouthparts (Walter & Krantz 2009).

The scarcity of *A. hohenbergiae* in collections is in part because colonies are restricted to the canopy of scattered trees in the forest. Given the large size of the individuals and restricted nesting habitat, colonies of

this species are probably small (<100 individuals), as common for most *Anochetus* species.

According to Brown (1978: 560), members of the *emarginatus* group of *Anochetus* are arboreal or semi-arboreal foragers that often nest in hollow branches or in epiphytes or between palm leaf bases well above ground level. This is also the case with *A. hohenbergiae*, which probably nest between the lateral leaves of bromeliads or in galleries along the *Hohenbergia* roots. Nevertheless, there are two species recently described for the group that are known to nest in the ground: *A. elegans* and *A. miserabilis*. In spite of shared morphological features, the *emarginatus* group is quite heterogeneous biologically.

Brown (1978: 553) mentions that ergatoid gynes are fairly common in *Anochetus* and are probably the only functional queens in some groups, including the *emarginatus* group. However, current studies report the occurrence of gamergates (reproductive workers) in *Anochetus emarginatus* (Fabricius 1804) (Chris Starr, in prep.). Longino (2007) suggests that another species in the group, *A. striatulus* Emery 1890, may also have gamergates, González-Campero & Elizalde (2008) described winged gynes of *A. miserabilis*, a species also placed in the *emarginatus* group.

Despite the morphological affinities between *A. hohenbergiae* and the members of the *emarginatus* group of *Anochetus*, we refrain from placing this aberrant ant in this group until a proper phylogenetic analysis of the Neotropical species of *Anochetus* can be performed.

Acknowledgments. Thanks to Claire Villemant, Pierre Rasmont, John Longino, and Brian Fisher for the critical reading of the manuscript. We are indebted to Brian Fisher, Michele Esposito, and April Nobile (CASC) for the preparation and for permitting the use of the Auto-Montage figures. The authors acknowledge support of the FAPESB/SECTI-CNPq PRONEX program PNX0011/2009, "Rede Multidisciplinar de Estudos sobre Formigas Poneromorfas do Brasil". RMF acknowledges his research grant received from Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), no. 07/01310–2. ARO and JHCD are research fellows of CNPq.

References

Baroni Urbani C. 1980. *Anochetus corayi* n. sp., the First Fossil Odontomachiti Ant (Amber Collection Stuttgart: Hymenoptera, Formicidae. II: Odontomachiti). *Stuttgarter Beiträge zur Naturkunde, Serie B (Geologie und Paläontologie)* **55**: 1-6.

Bolton B. 1994. *Identification guide to the ant genera of the world*. Harvard University Press. Cambridge, Massachusetts, USA, 222 p.

Bolton B., Alpert G., Ward P. S., Naskrecki P. 2006. *Bolton's Catalogue of Ants of the World: 1758–2005*. Harvard University Press, Cambridge, Massachusetts, USA, CD-ROM.

Brown W. L. Jr. 1978. Contributions toward a Reclassification of the Formicidae. Part VI. Ponerinae, Tribe Ponerini, Subtribe Odontomachiti. Section B. Genus *Anochetus* and Bibliography. *Studia Entomologica* **20**: 549-638.

De Andrade M. L. 1994. Fossil Odontomachiti ants from the Dominican Republic (Amber Collection Stuttgart: Hymenoptera, Formicidae. VII: Odontomachiti). *Stuttgarter Beiträge zur Naturkunde Serie B (Geologie und Paläontologie)* **199**: 1-28.

Delabie J. H. C., Jahyny B., Nascimento I. C., Mariano C. S. F., Lacau S., Campiolo S., Philpott S.M., Leponce M. 2007. Contribution of cocoa plantations to the conservation of native ants (Insecta: Hymenoptera: Formicidae) with a special emphasis on the Atlantic Forest fauna of southern Bahia, Brazil. *Biodiversity and Conservation* **16**: 2359-2384.

Delabie J. H. C., Ospina M., Zabala G. 2003. Relaciones entre hormigas y plantas: Una introducción, p. 167–181. *in*: **Fernández, F. (ed)**, *Introducción a las hormigas de la región Neotropical*. Instituto de Investigación de Recursos Biológicos Alexander von Humbolt. Bogotá, Colombia.

Feitosa R. M., Brandão C. R. F. 2008. A taxonomic revision of the Neotropical myrmicine ant genus *Lachnomyrmex* Wheeler (Hymenoptera: Formicidae). *Zootaxa* **1890**: 1-49.

Fernández F. 2007. Subfamília Ponerinae *s.str.,* p. 123–219. *in*: **Jiménez E., Fernández F., Arias T. M., Lozano-Zambrano F. H. (eds.)**, *Sistemática, biogeografía y conservación de las hormigas cazadoras de Colombia*. Instituto de Investigación de Recursos Biológicos Alexander von Humbolt. Bogotá, Colombia.

Fernández F., Sendoya S. 2004. List of Neotropical ants. *Biota Colombiana* **5**: 3-109.

Fisher B. L., Smith M. A. 2008. A Revision of Malagasy Species of *Anochetus* Mayr and *Odontomachus* Latreille (Hymenoptera: Formicidae). *PLoS ONE* (e1787) **3(5)**: 1-23.

González-Campero M. C., Elizalde L. 2008. A new species of *Anochetus* (Hymenoptera: Formicidae: Ponerini) from Argentina and Paraguay, associated with a leaf cutter ants. *Entomotropica* **23**: 97-102.

Harris R. A. 1979. A glossary of surface sculpture. *Occasional Papers of the Bureau of Entomology of the California Department of Agriculture* **28**: 1-32.

Lattke J. E. 1986. Two new species of Neotropical *Anochetus* May (Hymenoptera: Formicidae). *Insectes Sociaux* **33**: 352-358.

Lattke J. E. 2003. Subfamilia Ponerinae, p. 307–330. *in*: **Fernández F. (ed)**, *Introducción a las Hormigas de la Región Neotropical*. Instituto de Investigación de Recursos Biológicos Alexander von Humbolt. Bogotá, Colombia.

Longino J. T. 2007. *Ants of Costa Rica*. Available from: http://www.evergreen.edu/ants/AntsofCostaRica.html (accessed: October 2010).

Mackay W. P. 1991. *Anochetus brevidentatus*, new species, a second fossil Odontomachiti ant (Hymenoptera: Formicidae). *Journal of the New York entomological Society* **99**: 138-140.

Walter D. E., Krantz G. W. 2009. Oviposition and life stages, p. 57–61. *in*: **Krantz G. W., Walter D.E. (eds)**, *A manual of acarology*. 3rd Edition. Texas Tech University Press, Lubbock.