

THE GENUS *PACHYCONDYLA* (HYMENOPTERA: FORMICIDAE) IN PARAGUAY

ALEXANDER L. WILD

Department of Entomology, University of California, Davis,

Davis, CA 95616. e-mail: alwild@ucdavis.edu

Abstract.- Eleven species of the genus *Pachycondyla* are reported from Paraguay, four of which are new records for the country. An illustrated key to the workers of the species is provided, along with diagnoses, distribution data, taxonomic notes and natural history information for each of the species.

Resumen.- Se registran once especies del género *Pachycondyla* en Paraguay, cuatro de ellas son nuevos registros para el país. Se proporciona una clave ilustrada para las obreras de las especies, junto con las diagnósis, datos de distribución, notas taxonómicas e información de historia natural para cada una de las especies.

The genus *Pachycondyla* F. Smith 1858 is a large group of ants in the subfamily Ponerinae. There are around 200 described species worldwide, mostly known from the tropics and sub-tropics (Bolton 1995.) The species of *Pachycondyla* are diverse in their morphology and their behavior, ranging from cryptobiotic leaf litter inhabitants to large, aggressive epigeic and arboreal ants. Where they are present, many species are abundant and conspicuous insects. This study presents the first catalogue of the Paraguayan *Pachycondyla*, along with a key for identification of species based on the worker caste.

The larger species of *Pachycondyla*, especially *P. striata* F. Smith 1858 and *P. villosa* (Fabricius 1804), are easily recognized by most Paraguayan farmers as the “*tahyí hû pukú*.” These ants are known for their size, the pugnacity with which they defend their nests, and their painful stings.

Most species of *Pachycondyla* appear to be generalist scavengers and predators of arthropods, which they subdue with venom (Orivel and Dejean 2001). At least one group has become specialized as termite predators (Mill 1984, Leal and Oliveira 1995). The nesting and social biology of *Pachycondyla* is variable. They live in colonies of a few dozen to a few thousand workers and nest in a variety of conditions, including soil, leaf litter, rotting

wood, dead branches, plant cavities, and epiphytes (Leal and Oliveira 1995, Longino 2002, Lucas et al 2002, Trunzer et al 1998, Wheeler 1942, Wild *pers obs.*)

The taxonomic history of the genus reflects its tremendous diversity. Until recently, these ants had been placed in several genera. Brown (in Bolton 1994, see also Brown 1973) brought them into synonymy with *Pachycondyla*. The following list provides the former classification for the species known from Paraguay, consistent with how they appear in Kempf’s (1972) “Catálogo abreviado das formigas da Região Neotropical” and the addendum by Brandão (1991):

Neoponera Emery 1901

crenata (Roger 1861)

obscuricornis (Emery 1890a)

cf. *obscuricornis*

villosa (Fabricius 1804)

Pachycondyla F. Smith 1858

crassinoda (Latreille 1802)

harpax (Fabricius 1804)

striata F. Smith 1858

Termitopone Wheeler 1936

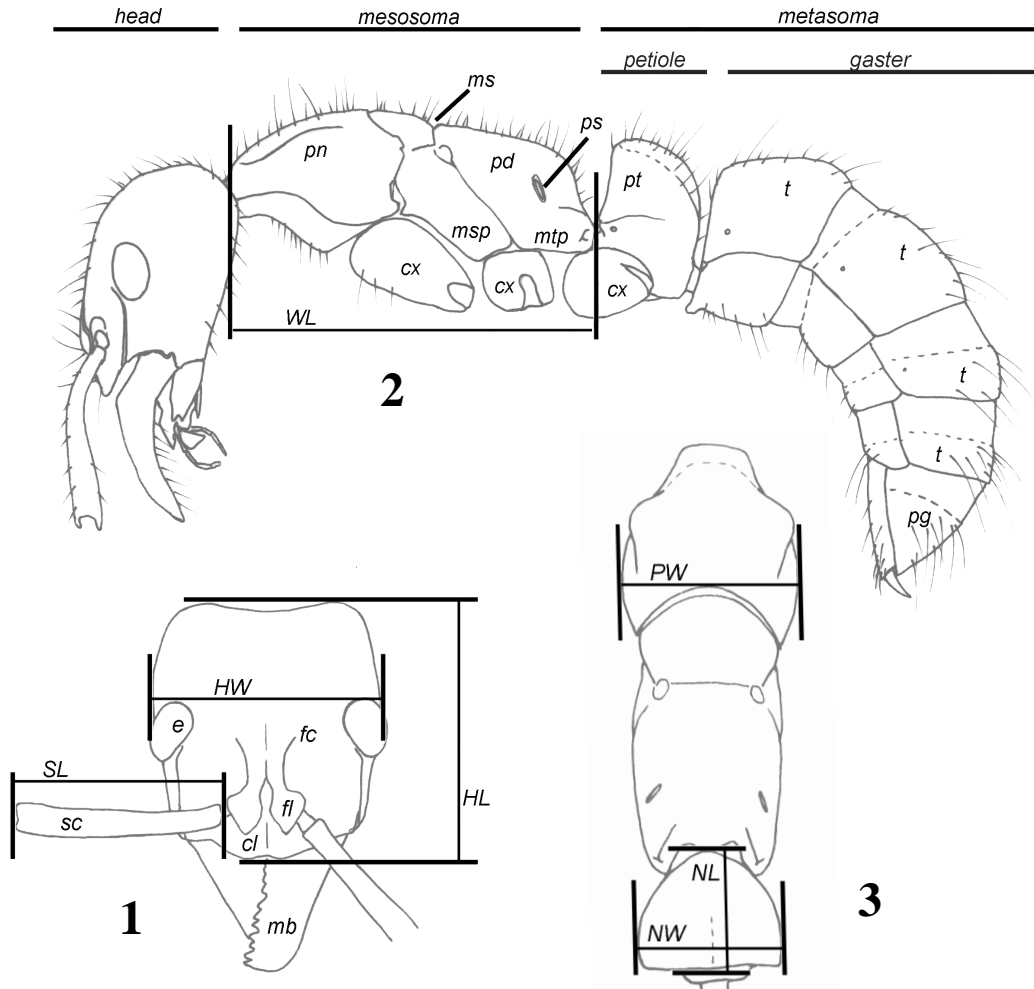
commutata (Roger 1860)

marginata (Roger 1861)

Trachymesopus Emery 1911

lunaris (Emery 1896)

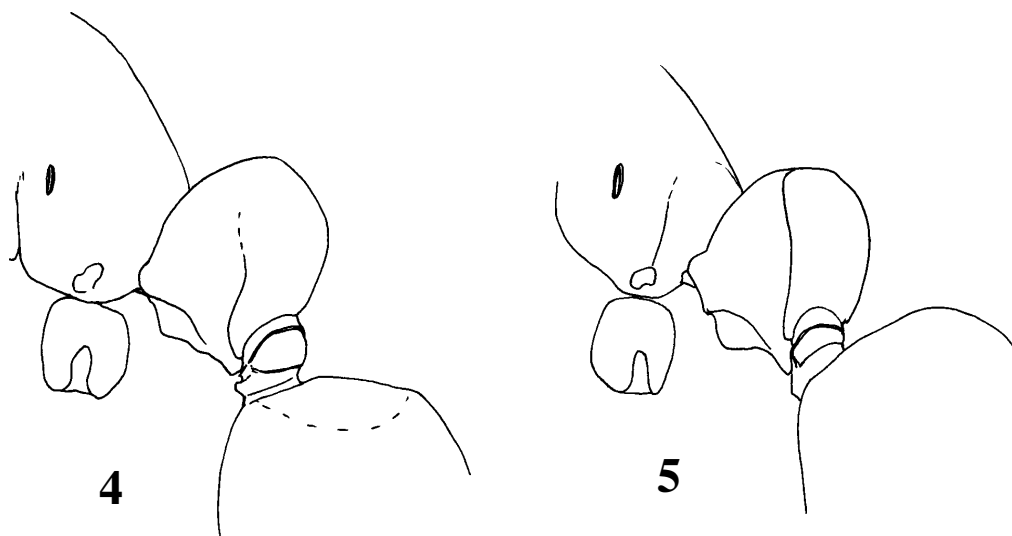
stigma (Fabricius 1804)



Figs. 1-3. Schematic figures of *Pachycondyla villosa*, showing characters and measurements referred to in the text. 1) Frontal view of head; 2) lateral view of whole body, with legs beyond coxae and antenna beyond scape removed; 3) dorsal view of mesosoma and petiole. *cl* = clypeus, *cx* = coxa, *e* = eye, *fc* = frontal carina, *fl* = frontal lobe, *HL* = head length, *HW* = head width, *mb* = mandible, *ms* = metanotal suture, *msp* = mesopleuron, *mtp* = metapleuron, *NL* = length of petiolar node, *NW* = width of petiolar node, *pd* = propodeum, *pg* = pygidium, *pn* = pronotum, *ps* = propodeal spiracle, *pt* = petiolar node, *PW* = pronotal width, *sc* = antennal scape, *SL* = scape length, *t* = tergite, *WL* = weber length.

It is not clear that *Pachycondyla* forms a monophyletic group, even following the extensive synonymy. In particular, some of the small cryptobiotic genera such as *Hypoponera* Santschi 1938 may have emerged from within *Pachycondyla*. Detailed phylogenetic work is needed to resolve this issue. It consequently bears noting that the taxonomy may change once such work is completed.

Workers and queens of *Pachycondyla* in Paraguay can be recognized on the basis of the following characters: Mandibles triangular, with at least 6 teeth (usually more) on the inner margin. When the mandibles are closed, the inner margins in frontal view reach the clypeus (Fig. 1). Frontal lobes are close together on the front of the head such that they are nearly touching (Fig. 1). The hind legs each have two



Figs. 4-5. Worker petiole, oblique rear view. 4) *P. cf. obscuricornis*; 5) *P. obscuricornis*.

apical tibial spurs, one simple and one pectinate.

Bolton (1994) and Hölldobler and Wilson (1990) provide keys that are sufficient for genus-level identification of *Pachycondyla*. There are no published keys to New World *Pachycondyla* at the species level that reflect the current taxonomy. The late W. L. Brown had been working on *Pachycondyla* and left a useful manuscript key, but it remains unpublished. Partial keys may be found in Kempf (1961) and Kempf (1964).

METHODS

Nomenclature: I use the names given in Bolton (1995), which to the best of my knowledge is the most current taxonomy for the Paraguayan species. Since taxonomic revisionary work is best carried out considering the full variation of a taxon over the whole of its geographic range, and since this is a regional work restricted to the Paraguayan fauna, I have intentionally refrained from introducing taxonomic changes, even in instances where I feel such change is probably warranted. I discuss these instances in the species synopses.

Key characters: Figures 1-3 illustrate the external anatomical features referred to in the

key and the text. The terminology is largely as used by Bolton (1994).

Distributional data: Species ranges were taken from Kempf (1972), Brandão (1991), and Brown (*unpublished manuscript*.)

Measurements: Both size and allometry are consistent and useful in separating some of the species. For each species, I took the following measurements on the maximum number of available worker specimens, up to 8 individuals. Schematics of the measurements are provided in Figures 1-3. All measurements are in millimeters.

Head width (HW)- the maximum width of the head in frontal view, posterior to and not including the eyes.

Head length (HL)- in frontal view, from the maximum posterior extension of the head to the anterior clypeal margin.

Scape length (SL)- the length of the antennal scape, not including the basal condyle.

Weber length (WL)- the distance from the anterior face of the pronotum to the maximum posterior extension of

the metapleuron, in lateral view.

Pronotal width (PW)- the maximum diameter of the pronotum, in dorsal view.

Hind tibia length (TL)- the length of the hind tibia.

Nodal width (NW)- the maximum width of the petiolar node in dorsal view.

Nodal length (NL)- the maximum length of the petiolar node in dorsal view.

For species with sufficient available specimens, I only measured ants collected in Paraguay. However, I was unable to view Paraguayan representatives of *P. commutata* and *P. crassinoda*, so measurements for those species were taken from Bolivian and Brazilian specimens.

Material examined: The specimens used in this study were drawn from the following collections:

ALWC- Alexander L. Wild personal collection, Davis, California, USA.

INBP- Museo Nacional del Historial Natural del Paraguay, San Lorenzo, Paraguay.

LACM- Los Angeles County Museum, Los Angeles, California, USA.

MCZC- Museum of Comparative Zoology, Cambridge, Massachusetts, USA.

Voucher specimens have been deposited at INBP and LACM.

KEY TO THE WORKERS OF *PACHYCONDYLA* IN PARAGUAY

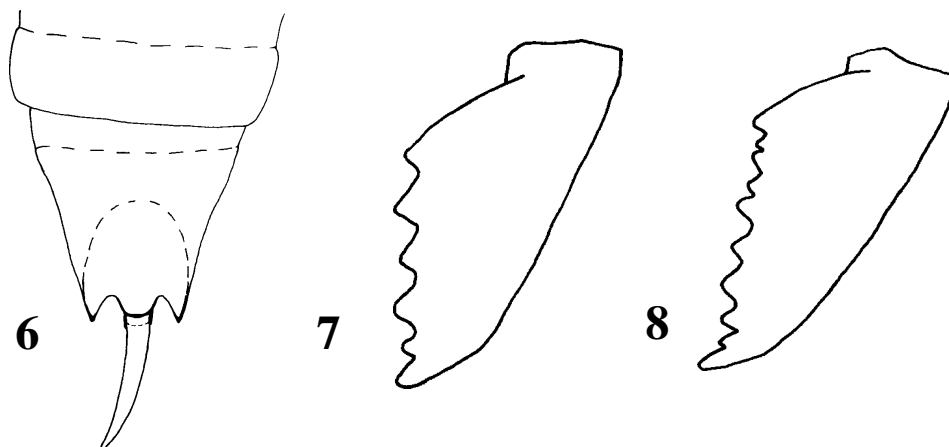
(note: I have included *Pachycondyla constricta* (Mayr 1884) in this key, indicated with an asterisk, as its known range in Argentina and Boliva indicates that it is probably found in Paraguay even though it has not yet been recorded there.)

1. Dorsal surfaces of mesosoma and metasoma glabrous, nearly entirely devoid of sculpture; pubescence on metasoma extremely sparse to absent; strongly shining black ants.....2
 - Dorsal surfaces of mesosoma and metasoma not glabrous, covered with moderate to dense pubescence, or surface sculpture, or both.....3
2. Dorsum of head deeply striate; size larger (HW > 3.0 mm).....*commutata*
 - Dorsum of head smooth, without striation; size smaller (HW < 2.0 mm).....*marginata*
3. Dorsum of mesosoma without standing pilosity.....4
 - Dorsum of mesosoma with standing pilosity.....5

CLAVE PARA LAS OBRERAS DE *PACHYCONDYLA* EN EL PARAGUAY

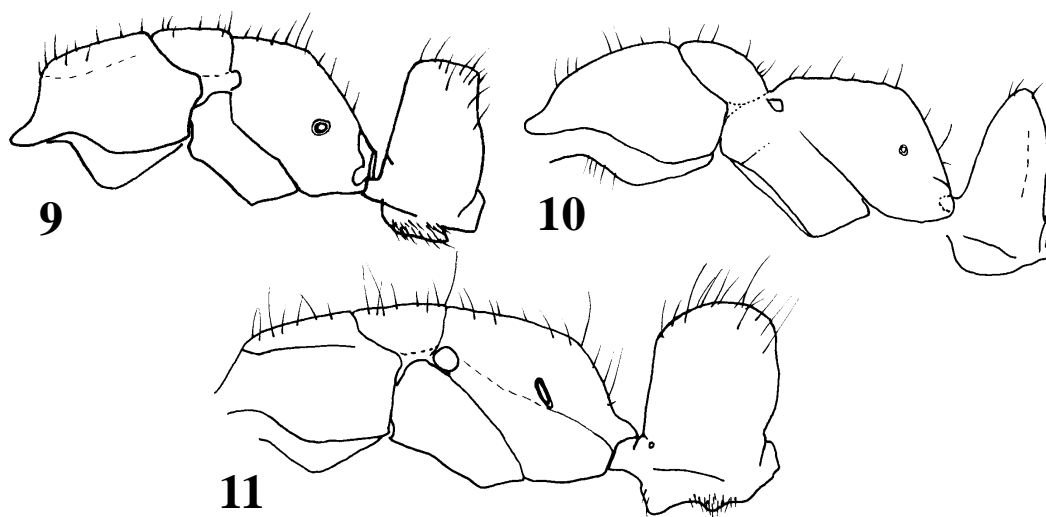
(nota: Incluyo en la clave *Pachycondyla constricta* (Mayr 1884), marcada con un asterisco, pues su distribución conocida en Argentina y Bolivia indica que posiblemente existe en Paraguay, aunque no se ha colectado todavía en el país).

1. Superficies dorsales de mesosoma y metasoma lisas y brillantes, casi enteramente desprovistas de escultura; la pubescencia del mesosoma extremadamente escasa o ausente; hormigas negras fuertemente brillantes.....2
 - Superficies dorsales de mesosoma y metasoma no lisas y brillantes, cubiertas con una pubescencia moderada a densa, o con escultura, o ambos.....3
2. Dorso de la cabeza con estriaciones profundas; tamaño mayor (HW > 3.0 mm).....*commutata*
 - Dorso de la cabeza liso, sin estriaciones; tamaño menor (HW < 2.0 mm).....*marginata*
3. Dorso del mesosoma sin pilosidad sobresaliente.....4
 - Dorso del mesosoma con pilosidad sobresaliente.....5



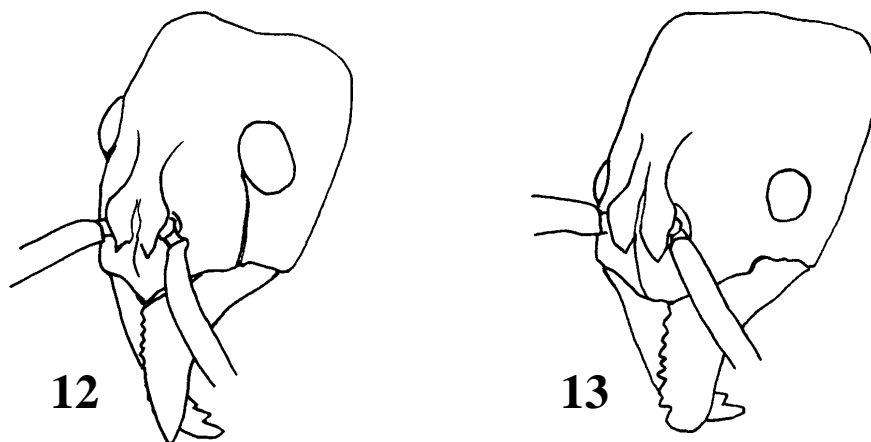
Figs. 6-8. Features of *Pachycondyla* workers. 6) Pygidium, dorsal view. 7-8) Mandible. 6) *P. crassinoda*; 7) *P. stigma*; 8) *P. lunaris*.

- | | |
|---|--|
| <p>4. Posterolateral margins of petiolar node rounded (Fig. 4); antennal scapes relatively shorter (SL/HL < 1.0).....cf. obscuricornis
 — Posterolateral margins of petiolar node angulate (Fig. 5); antennal scapes relatively longer (SL/HL > 1.0).....obscuricornis</p> <p>5. Pygidium with a triangular upturned tooth on either side of the sting (Fig. 6); large black ants with a stout, almost cuboid petiolar node.....crassinoda
 — Pygidium without teeth.....6</p> <p>6. Mandible with 6 well-pronounced teeth (Fig. 7); small species (HW < 1.5 mm), eyes reduced, with fewer than 25 ommatidia.....stigma
 — Mandible with at least 8 teeth or denticles (Fig. 8), other characters variable.....7</p> <p>7. Opening of propodeal spiracle round or elliptical in lateral view (Fig. 9, 10).....8
 — Opening of propodeal spiracle slit-like in lateral view, at least 2x as long as broad and usually much more (Fig. 11).....9</p> <p>8. Scapes long (SL/HL > 1.0), in full frontal view they surpass the posterior margin of the head by at least ¼ their length; propodeum strongly depressed beneath level of mesonotum in lateral view, mesonotal suture distinctly impressed (Fig.</p> | <p>4. Perfil posterolateral del nodo del pecíolo liso (Fig. 4); escapos antenales relativamente cortos (SL/HL < 1.0)....cf. obscuricornis
 — Perfil posterolateral del nodo del pecíolo angular (Fig. 5); escapos antenales relativamente largos (SL/HL > 1.0)..obscuricornis</p> <p>5. Pigidio a ambos lados del agujijón con un diente triangular dirigido hacia arriba (Fig. 6); hormigas negras grandes con pecíolo robusto, casi en forma de cubo...crassinoda
 — Pigidio sin dientes.....6</p> <p>6. Mandíbula con 6 dientes bien marcados (Fig. 7); especie pequeña (HW < 1.5 mm), ojos reducidos, con menos de 25 omatidios.....stigma
 — Mandíbula con por lo menos 8 dientes o denticulos (Fig. 8); otros caracteres variables.....7</p> <p>7. Abertura del espiráculo propodeal redonda o elíptica en vista lateral (Fig. 9,10).....8
 — Abertura del espiráculo propodeal como raja en vista lateral, al menos el doble más larga que ancha y normalmente mucho más (Fig. 11).....9</p> <p>8. Escapos alargados (SL/HL > 1), en vista frontal de la cabeza sobrepasan el perfil posterior con por lo menos ¼ de su largo; el propódeo en vista lateral marcadamente deprimido bajo el nivel del mesonoto, el surco mesonotal distintamente impreso (Fig.</p> |
|---|--|



Figs. 9-10. Worker mesosoma and petiole, lateral view. 9) *P. lunaris*; 10) *P. constricta*; 11) *P. crenata*.

- 10); eyes larger, greater than 100 ommatidia.....***constricta****
- Scapes short (SL/HL < .8), and in full frontal view do not surpass posterior margin of the head; propodeum in profile not strongly depressed below level of mesonotum, mesonotal suture not distinctly impressed (Fig. 9) eyes reduced, fewer than 50 ommatidia.....***lunaris***
9. Head with a distinct raised carina leading from lateral corner of the clypeus to the inner margin of the eye (Fig. 12); eyes located higher on the head, in full frontal view extending posterior to the maximum extension of the frontal carinae.....10
- Head without a distinct carina leading from the lateral corner of the clypeus to the eye (Fig. 13); eyes located lower on the head, not reaching the maximum posterior extension of the frontal carinae.....11
10. Anterior and dorsal faces of petiolar node in profile meet at a sharp angle (Fig. 14); size larger (HW > 2.0 mm); body covered in dense golden pubescence.....***villosa***
- Anterior and dorsal faces of petiolar node not clearly differentiated in profile, node more rounded (Fig. 11); size smaller
- 10), ojos mas grandes, con mas de 100 ommatidios.....***constricta****
- Escapos cortos (SL/HL < .8), en vista frontal no sobrepasan el perfil posterior de la cabeza; el propódeo en vista lateral no marcadamente deprimido bajo el nivel del mesonoto; surco mesonotal no distintamente impreso (Fig. 9); ojos mas pequeños, con menos de 50 ommatidios.....***lunaris***
9. Cabeza con una visible carena elevada que atraviesa las genas de la esquina lateral del clípeo hasta el margen interior del ojo (Fig. 12); ojos ubicados más arriba en la cabeza, en vista frontal extendiéndose más atrás de la extensión máxima de las carenas frontales.....10
- Cabeza sin una visible carena que atraviesa las genas de la esquina lateral del clípeo al ojo (Fig. 13); ojos ubicados más abajo en la cabeza, no alcanzan la extensión máxima posterior de las carenas frontales.....11
10. Los perfiles anteriores y dorsales del nodo del pecíolo en vista lateral se encuentran en ángulo agudo (Fig. 14); tamaño más grande (HW > 2.0 mm); cuerpo cubierto en una pubescencia áurea densa.....***villosa***
- Perfiles anteriores y dorsales del nodo del pecíolo no fácilmente distinguibles en vista lateral, el nodo mas redondo (Fig. 11); tamaño



Figs. 12-13. Worker head, oblique anterior view. 12) *P. villosa*; 13) *P. striata*.

- | | | | |
|--|----------------|--|----------------|
| (HW < 2.0 mm)..... | <i>crenata</i> | mas pequeño (HW < 2.0 mm)..... | <i>crenata</i> |
| 11. Size larger (HW > 2.8 mm); in dorsal view, petiolar node is nearly as long as broad (Fig. 15); gastric tergites densely punctate and opaque..... | <i>striata</i> | 11. Tamaño mayor (HW > 2.8 mm); en vista dorsal el nodo del pecíolo es casi tan largo como ancho (Fig. 15); los tergos del gáster finamente punteados y opacos..... | <i>striata</i> |
| — Size smaller (HW < 2.0 mm); in dorsal view, petiolar node is nearly twice as broad as long (Fig 16); gastric tergites moderately shining..... | <i>harpax</i> | — Tamaño menor (HW < 2.0 mm); en vista dorsal el nodo del pecíolo es casi dos veces más ancho que largo (Fig. 16); los tergos del gáster moderadamente brillantes..... | <i>harpax</i> |

SPECIES SYNOPSES

Pachycondyla commutata (Roger 1860)

(Figs. 17, 18)

Worker diagnosis: *P. commutata* is a giant black ant, strongly shining, with distinct striation on the head radiating outwards from the frontal lobes. The head in frontal view is trapezoidal, with its widest diameter anterior of the eyes. The petiole is relatively small, and is slightly longer than broad in dorsal view.

Measurements: HL 3.66-3.71, HW 3.03-3.12, SL 3.59-3.70, WL 5.39-5.58, PW 2.42-2.44, TL 3.77-3.92, NW 1.18-1.26, NL 1.25-1.32. (n = 2).

Similar species: *P. marginata* is much smaller than *P. commutata* (HW < 2.0 mm in *marginata*), has no striation on the dorsum of the head, and has a petiolar node that is considerably broader than long. *P. commutata* is superficially similar to ants of the genus

Dinoponera, but can be differentiated by its smaller size (HW < 4.0 mm) and absence of a pair of distinct clypeal teeth.

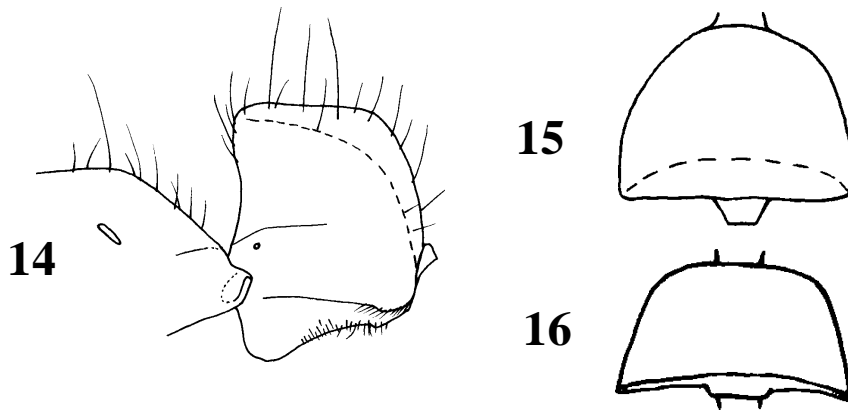
Range: Colombia to Paraguay (?).

Literature Records: *Central:* San Lorenzo (Fowler 1981).

Discussion: Fowler (1981) lists this ant as occurring in Paraguay. Since I have not seen the specimens, I cannot confirm his record. Apart from Fowler's note, *commutata* is not known from south of Mato Grosso, Brazil (Kempf 1972).

P. commutata is a specialist predator on termites of the genus *Syntermes*. Mill (1984) provides observations on the foraging, recruitment, and predatory behavior of *commutata* in Brazil.

Pachycondyla crassinoda (Latreille 1802)
(Fig. 6, 19, 20, 21)



Figs. 14-16. Worker petiole. 14) Lateral view; 15-16) dorsal view. 14) *P. villosa*; 15) *P. striata*; 16) *P. harpax*.

Worker diagnosis: A very large black ant with a pair of stout, upturned triangular teeth on the apex of the pygidium. The petiolar node is unusually large, nearly cuboid. The pronotum lacks humeral carinae, and the mesonotum and propodeum form a continuous convexity in lateral view. The eyes are relatively flat and low on the head, in frontal view not surpassing the maximum posterior extension of the frontal carinae.

Measurements: HL 3.55-3.87, HW 3.27-3.58, SL 2.99-3.37, WL 4.88-5.32, PW 2.26-2.47, TL 3.04-3.36, NW 2.08-2.27, NL 1.74-1.89. (n = 3).

Similar species: *P. crassinoda* is unlikely to be confused with any other species. *P. striata* is smaller (HW < 3.1 mm), lacks teeth on the pygidium, and has distinct longitudinal striation on the dorsum of the head.

Range: Venezuela to Paraguay.

Discussion: As this manuscript was being prepared, Bolivar Garcete collected a single specimen of *P. crassinoda* from the Parque Nacional Río Negro, Dept. Alto Paraguay. I have not seen the specimen, but based on Garcete's description of the pronotum and pygidial teeth, and the fact that Garcete's morphological measurements of the Paraguayan specimen concord with measurements of specimens from Brazil, there can be little doubt of its identity. This is the first record of *P.*

crassinoda from Paraguay.

Pachycondyla crenata (Roger 1861)

(Figs. 11, 22, 23)

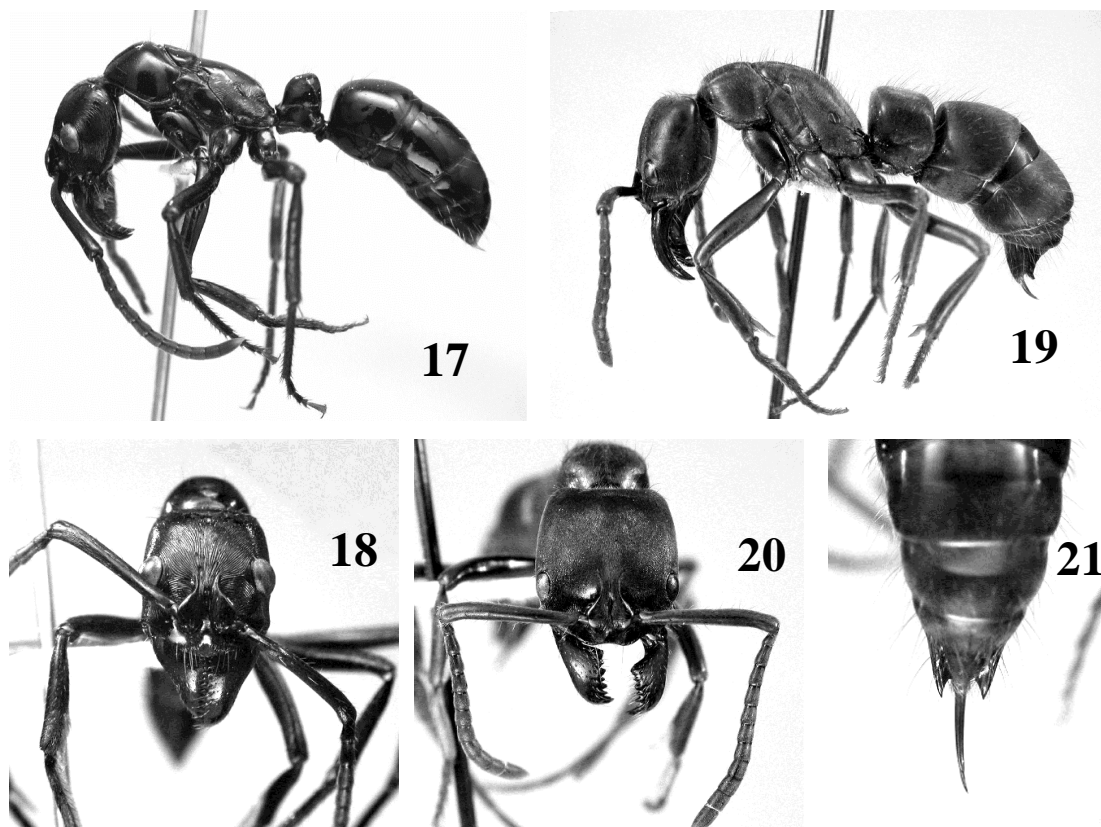
Worker diagnosis: *P. crenata* is a medium-sized brown species with a distinctive rounded petiolar node. The dorsal face of the node in lateral view is convex and reaches maximum height in its posterior third. The eyes are conspicuously protruding, and in frontal view they bulge out beyond the lateral margins. The integument of *P. crenata* often has a slight iridescence.

Measurements: HL 1.64-1.97, HW 1.50-1.75, SL 1.47-1.88, WL 2.36-2.88, PW 1.03-1.32, TL 1.43-1.80, NW 0.87-1.02, NL 0.75-0.88. (n = 7).

Similar species: *P. villosa* is larger (HW > 2.4 mm), has an angular margin separating the concave antero-lateral and flat dorsal faces of the petiole, and has a more dense golden pubescence.

Range: Southern Mexico to northern Argentina.

Paraguay material examined: *Alto Paraná:* Ciudad del Este; *Amambay:* Parque Nacional Cerro Corá; *Canindeyú:* Reserva Natural del Bosque Mbaracayú; *Guairá:* Roque Gonzalez; *Paraguarí:* Parque Nacional Ybycuí; *San Pedro:* Jaguareté Forest Rio Verde.



Figs. 17-21. *Pachycondyla* workers (all specimens from Brazil, Mato Grosso: Chapada dos Guimarães, 15°26'S 55°45'W). 17, 19) Lateral view. 18, 20) head. 17-18) *P. commutata*; 19-21) *P. crassinoda*.

Literature Records: *Cordillera*: San Bernadino (Forel 1906).

Discussion: The name *P. crenata* refers to a variable complex of ants and may contain several unnamed cryptic species over its full range (Longino 2002). The specimens from Paraguay vary slightly in size but appear to be conspecific.

Elsewhere in its range, this species is reported to nest in plant cavities, including those of the noted ant-plants *Tachigalia* and *Cordia* (Longino 2002, Wheeler 1942). Throughout the Neotropics, *crenata* is a commonly encountered arboreal and terrestrial forager. In Paraguay, I have collected it in gallery forest, riparian forest, and inundated low forest.

Pachycondyla harpax (Fabricius 1804)
(Figs. 16, 24, 25)

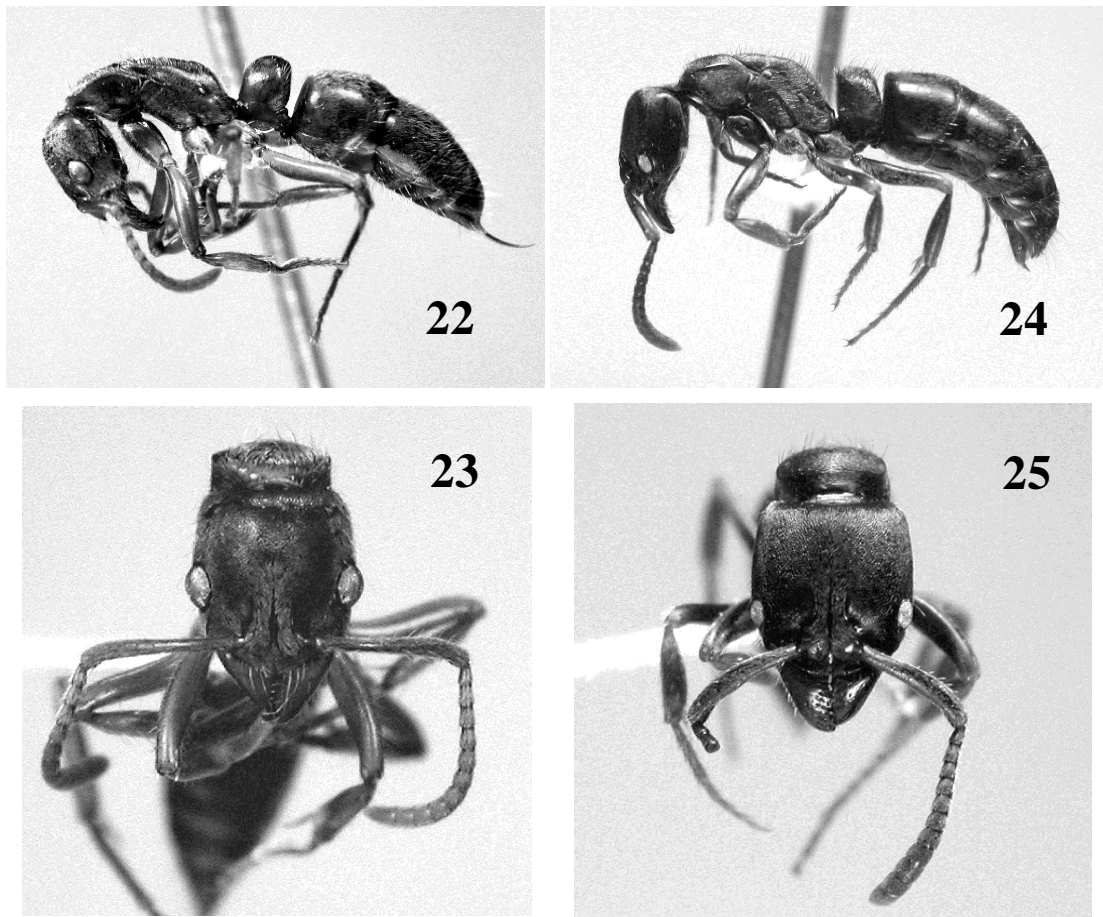
Worker diagnosis: *P. harpax* is medium-sized black species with a broad petiole and a lightly shining metasoma. The eyes are relatively flat and low on the head, in frontal view not surpassing the maximum posterior extension of the frontal carinae.

Measurements: HL 1.89-1.92, HW 1.77-1.83, SL 1.50-1.55, WL 2.70-2.74, PW 1.31-1.36, TL 1.43-1.49, NW 1.22-1.26, NL 0.63-0.68. (n = 3).

Similar species: *P. striata* is much larger (HW > 2.8 mm), and the integument of the gastric tergites in *P. striata* is opaque, not shining.

Range: Southern United States to northern Argentina.

Paraguay material examined: *Amambay*: Parque Nacional Cerro Corá; *Canindeyú*: Tendal, Ita Poty; *Cordillera*: Caacupé.



Figs. 22-25. *Pachycondyla* workers. 22, 24) Lateral view. 23, 25) head. 22-23) *P. crenata*, specimen from Paraguay, Dept. Guairá: Roque Gonzalez, 25°53'S 57°17'W; 24-25) *P. harpax*, specimen from Paraguay, Dept. Cordillera: Caacupé, 25°23'S 57°09'W.

Literature Records: “Paraguay” (s.loc.) (Emery 1890b, Forel 1895).

Discussion: *P. harpax* over the whole of its range is rather variable, and may actually contain several cryptic species, even in sympatry (Longino 2002). All of the Paraguay material appears to be conspecific.

The specimens from Paraguay were collected as ground foragers in open habitats such as roadsides and stream banks. This species probably nests in soil, although I have not seen a nest.

Pachycondyla lunaris (Emery 1896)
(Figs. 8, 9, 26, 27)

Worker diagnosis: *P. lunaris* is a compact

ferruginous ant. The propodeal spiracle is round, the scapes fall short of the occipital margin, and the eyes are reduced, with fewer than 50 ommatidia.

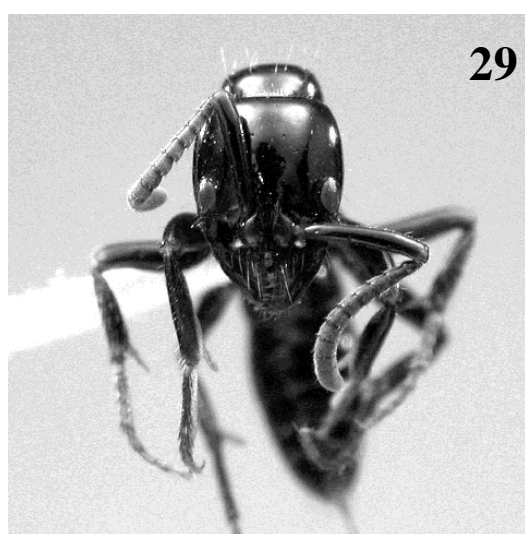
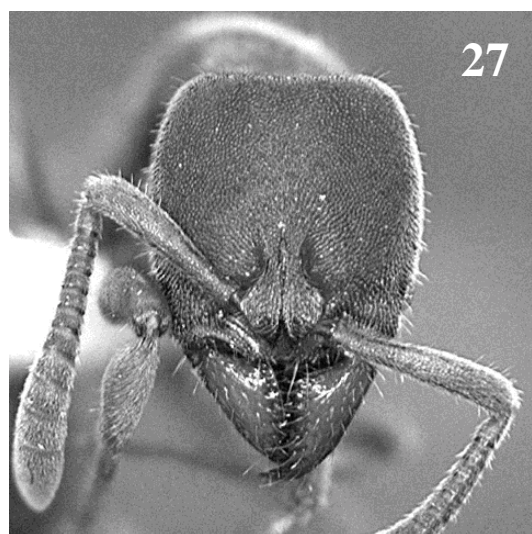
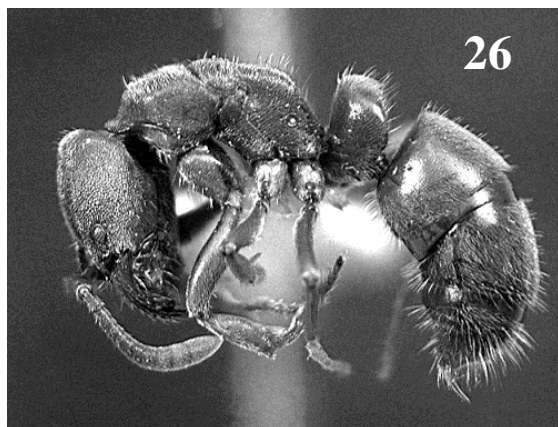
Measurements: HL 1.21, HW 1.11, SL 0.84, WL 1.57, PW 1.83, TL 0.77, NW 0.77, NL 0.49. (n = 1).

Similar species: *P. lunaris* is unlikely to be confused with any other species. *P. stigma*, a darker ant of similar size, has only six teeth on the mandible (Fig. 7) and a considerably less bulky petiolar node.

Range: Guianas to southern Brazil.

Paraguay material examined: *Canindeyú*: Reserva Natural del Bosque Mbaracayú.

Literature Records: “Paraguay” (s.loc.)



Figs. 26-29. *Pachycondyla* workers. 26, 28) Lateral view. 27, 29) head. 26-27) *P. lunaris*, specimen from Paraguay, Dept. Canindeyú: Reserva Natural del Bosque Mbaracayú, 24°06'S 55°28'W; 28-29) *P. marginata*, specimen from Paraguay, Dept. Cordillera: Caacupé, 25°23'S 57°09'W.

(Emery 1896).

Discussion: *P. lunaris* was originally described by Emery (1896) from Paraguay. Brown apparently planned to synonymize *lunaris* with the Central American species *ferruginea* F. Smith 1858, as he did not include *lunaris* in his unpublished key and listed the range of *ferruginea* as “s Mexico to se Brazil.” The Paraguayan form falls within the range of variation I have observed in Central American specimens, so it is very probable that *lunaris* is a junior synonym of *ferruginea*. However, since taxonomic revisionary work is beyond the scope of this regional key, I leave

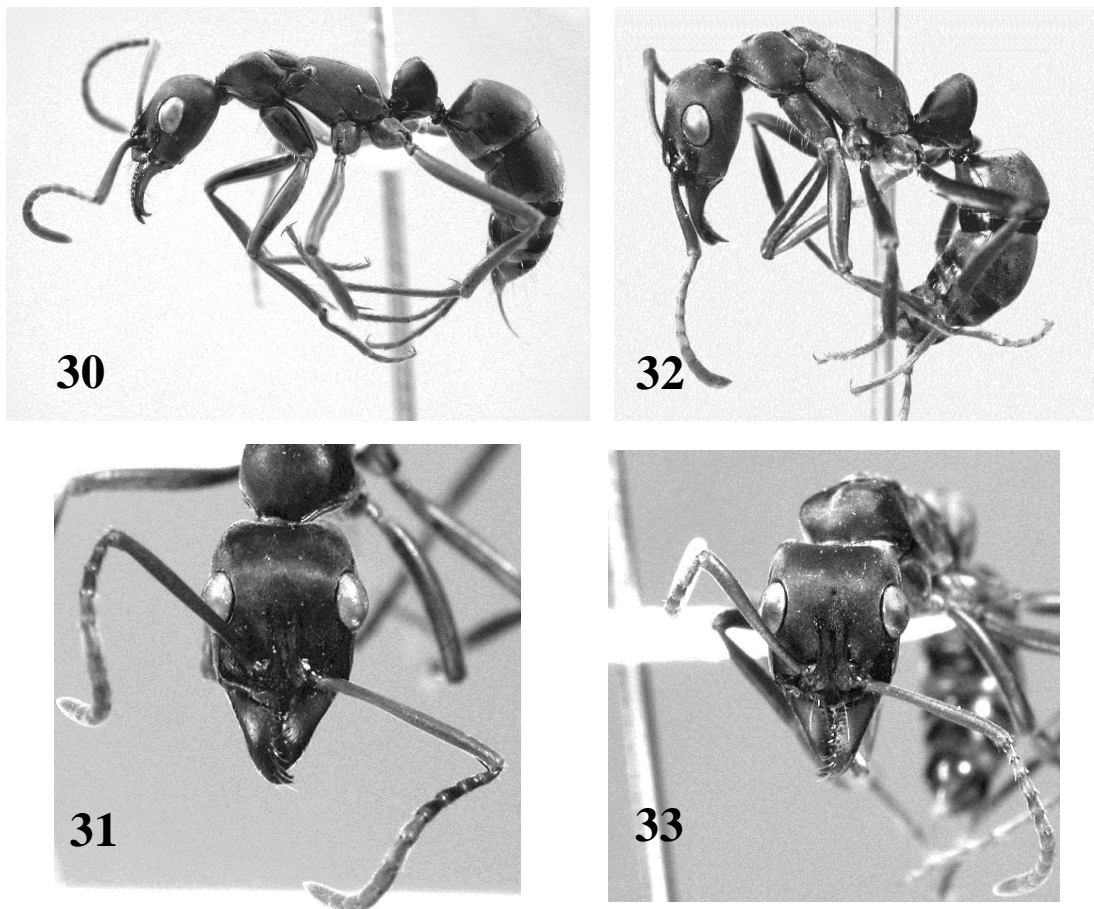
the taxonomy as it currently stands.

Little is known about the biology of this species. The single specimen from Mbaracayú was taken in a Berlese funnel sample from leaf litter in the *tierra firme* tall forest.

***Pachycondyla marginata* (Roger 1861)**

(Figs. 28, 29)

Worker diagnosis: A medium sized black species, with a smooth and strongly shining integument on the head, mesosomal dorsum, petiolar node, and metasoma. The meso- and metapleura are longitudinally striate. The eyes are located low on the head and are relatively



Figs. 30-33. *Pachycondyla* workers. 30, 32) Lateral view. 31, 33) head. 30-31) *P. obscuricornis*, specimen from Paraguay, Dept. Canindeyú: Col. '11 de Setiembre,' 25°02'S 55°34'W; 32-33) *P. cf. obscuricornis*, specimen from Paraguay, Dept. Canindeyú: Reserva Natural del Bosque Mbaracayú, 24°06'S 55°30'W.

flat. In full frontal view, the eyes do not exceed the lateral margins of the head.

Measurements: HL 2.27-2.31, HW 1.88-1.94, SL 1.63-1.64, WL 3.10-3.14, PW 1.43-1.44, TL 1.73-1.77, NW 0.91-0.96, NL 0.64-0.69. (n = 3).

Similar species: *P. marginata* is unlikely to be confused with any other species. *P. commutata* is much larger (HW > 3.0 mm), with a striate head, and all other Paraguayan species have the body covered in sculpture and/or pubescence.

Range: Southern Brazil and Bolivia to northern Argentina.

Paraguay material examined: *Cordillera:* Caacupé Campamento Jack Norment;

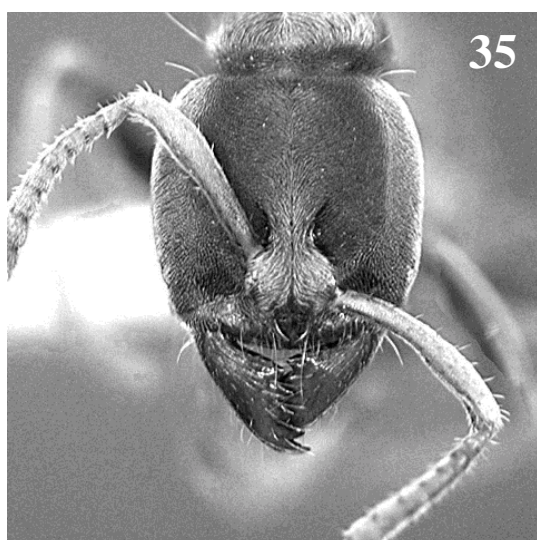
Misiones: Est. Ñu Porá; *Paraguari:* Parque Nacional Ybycuí.

Literature Records: "Paraguay" (s.loc.) (Borgmeier 1959, Emery 1890b, Forel 1895).

Discussion: *P. marginata* is a specialist predator of termites. In Brazil, the species preys exclusively on *Neocapritermes opacus* and exhibits frequent migratory behavior (Leal and Oliveira 1995).

Pachycondyla obscuricornis Emery 1890a (Figs. 5, 30, 31)

Worker diagnosis: *P. obscuricornis* is an elongate, dark-colored species lacking standing hairs on the mesosomal dorsum, petiole, and much of the metasoma. The integument of



Figs. 34-37. *Pachycondyla* workers. Figure 34. 34, 36) Lateral view. 35, 37) head. 34-35) *P. stigma*, specimen from Paraguay, Dept. San Pedro: Tapiracuai Loma, 24°53'S 56°10'W; 36-37) *P. striata* worker, specimen from Paraguay, Dept. Canindeyú: Reserva Natural del Bosque Mbaracayú, 24°06'S 55°30'W.

P. obscuricornis appears satiny and opaque, owing to a finely punctate sculpture and a very fine, dense pubescence. The eyes are large and bulge out over the lateral margins of the head, and there is a distinct carina running from the inner margin of the eye to the lateral margin of the clypeus. The postero-lateral margins of the petiolar node and of the propodeum are angulate.

Measurements: HL 2.28-2.34, HW 1.77-1.86, SL 2.37-2.42, WL 3.52-3.70, PW 1.40-1.47, TL 2.64-2.83, NW 0.84-0.88, NL 0.93-0.98. (n = 5).

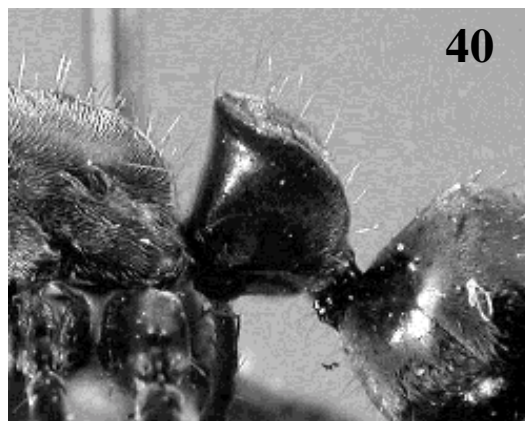
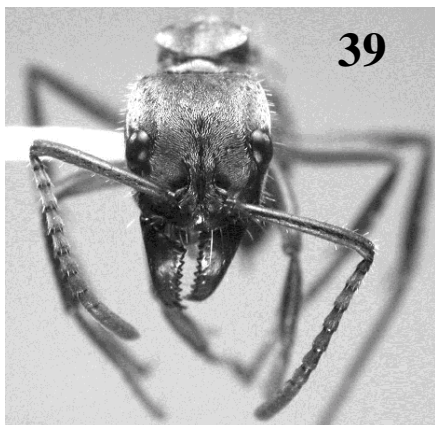
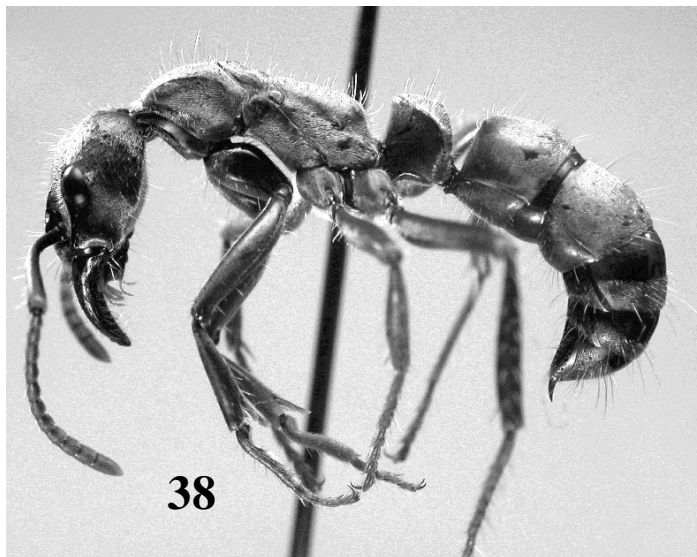
Similar species: *P. obscuricornis* is easily confused with *P. cf. obscuricornis*, but the lat-

ter species has rounded postero-lateral margins on the petiole. *P. cf. obscuricornis* also has a broader head, slightly smaller eyes, relatively shorter antennal scapes (SL/HL ratio < 1.0 in *P. cf. obscuricornis*, >1.0 in *P. obscuricornis*), and a more convex propodeal dorsum in lateral view.

Range: Southern Mexico to southern Brazil.

Paraguay material examined: *Amambay:* Parque Nacional Cerro Corá; *Canindeyú:* Reserva Natural del Bosque Mbaracayú, Tendal; *Misiones:* Ayolas; *Paraguarí:* Parque Nacional Ybycuí.

Discussion: This is the first record of *P.*



Figs. 38-40. *Pachycondyla villosa*, worker. 38) Lateral view. 39) head. 40) lateral view of the petiole; 38-39) form with more quadrate petiole (*P. villosa villosa* sensu Lucas et al 2002), specimen from Paraguay, Dept. Canindeyú: Reserva Natural del Bosque Mbaracayú, 24°06'S 55°30'W; 40) form with narrower petiole (*P. villosa inversa* sensu Lucas et al 2002), lateral view. Specimen from Paraguay, Dept. Central: Areguá, 24°06'S 55°30'W. 25°18'S 57°23'W.

obscuricornis from Paraguay. This ant is a distinctive ground-foraging inhabitant of open low forests, cerrados, and riparian forests. The movements of *P. obscuricornis* are quick, erratic and notably wasp-like. I have seen one nest, in a rotting log in a riparian forest.

Pachycondyla* cf. *obscuricornis

(Figs. 4, 32, 33)

Worker diagnosis: *P.* cf. *obscuricornis* is an elongate, dark-colored species lacking standing hairs on the mesosomal dorsum. The in-

tegument of *P.* cf. *obscuricornis* appears satiny and opaque, owing to a finely punctate sculpture and a very fine, dense pubescence. The eyes are large and bulge out over the lateral margins of the head, and there is a distinct carina running from the inner margin of the eye to the lateral margin of the clypeus. The postero-lateral margins of the petiolar node and of the propodeum are rounded.

Measurements: HL 2.43, HW 1.96, SL 2.27, WL 3.67, PW 1.61, TL 2.66, NW .99, NL 1.05. (n = 1).

Similar species: *P. cf. obscuricornis* is easily confused with *P. obscuricornis*, but the latter species has the postero-lateral margins on the petiolar node more angular. *P. obscuricornis* also has a relatively narrower head, larger eyes, longer antennal scapes (SL/HL ratio >1.0 in *P. obscuricornis*, <1.0 in *P. cf. obscuricornis*), and in lateral view a less convex propodeal dorsum.

Range: Peru to Paraguay.

Paraguay material examined: *Canindeyú:* Reserva Natural del Bosque Mbaracayú.

Discussion: *P. cf. obscuricornis* matches the short description of *Pachycondyla obscuricornis* r. *latocciptus* Forel 1921 from Ecuador, but without seeing the types I cannot confirm this identification. *P. cf. obscuricornis* is clearly distinct from the locally sympatric *obscuricornis*, and I have seen rather similar *cf. obscuricornis* specimens from Bolivia and Peru. In Peru, *cf. obscuricornis* is sympatric with a similar third species in the complex, *P. apicalis* (Latreille 1802), so it is clear that this Paraguayan form is not merely an allopatric variant of *apicalis*. Until the identity of *latocciptus* is clarified, this species will likely remain without a name.

The two specimens recorded from Paraguay were foraging individually on the forest floor of the *tierra firme* tall forests of Mbaracayú.

Pachycondyla stigma (Fabricius 1804)

(Figs. 7, 34, 35)

Worker diagnosis: *P. stigma* is a small, dark brown species with only six teeth on the mandible, reduced eyes of fewer than 25 ommatidia, and a narrow petiolar node whose anterior and posterior faces in profile converge on a blunt apex without a distinct dorsal face.

Measurements: HL 1.17-1.31, HW 1.10-1.29, SL 0.84-0.98, WL 1.57-1.82, PW 0.78-0.91, TL 0.84-0.94, NW 0.56-0.68, NL 0.32-0.39. (n = 8).

Similar species: *P. stigma* is unlikely to be confused with any other species. *P. lunaris* is a ferruginous ant of similar size, but it has more

than 6 teeth on the mandible and a much bulkier petiolar node with a distinct dorsal face.

Range: Southern United States to northern Argentina, also Southeast Asia and the Pacific.

Paraguay material examined: *Asunción:* Jardín Botánico; *Boquerón:* Parque Nacional Tte. Enciso; *Canindeyú:* Reserva Natural del Bosque Mbaracayú; *Concepción:* Entre Flores 13k N Concepción; *San Pedro:* Tapiracuai Loma.

Discussion: *P. stigma* is a tramp species in tropical and subtropical areas worldwide (Wilson and Hunt 1967, Shattuck 1998), but is probably native to the Neotropics. This is the first record of *P. stigma* from Paraguay. In Paraguay, *stigma* is often found in leaf litter in forested areas. I have seen two nests, both in rotting wood.

Pachycondyla striata F. Smith 1858

(Figs. 15, 36, 37)

Worker diagnosis: A large, bulky black ant. The dorsal surfaces of the head and mesosoma have a fine longitudinal striation. The eyes are relatively flat and low on the head, in frontal view not surpassing the maximum posterior extension of the frontal carinae. The standing pilosity has a reddish tinge.

Measurements: HL 3.12-3.33, HW 2.83-3.10, SL 2.67-2.86, WL 4.40-4.75, PW 1.98-2.25, TL 2.55-2.77, NW 1.58-1.85, NL 1.04-1.26. (n = 8).

Similar species: *P. harpax* is much smaller (HW < 2.0 mm), with a relatively broader petiole and noticeably shinier gastric tergites. *P. crassinoda* lacks striation on the head and has two stout triangular teeth at the apex of the pygidium.

Range: Southern Brazil south to Uruguay and west to Northwest Argentina.

Paraguay material examined: *Amambay:* Parque Nacional Cerro Corá; *Canindeyú:* Reserva Natural del Bosque Mbaracayú; *Cordillera:* Caacupé; *Guairá:* Roque Gonzalez; *Itapúa:* El Tirol; *Misiones:* Est. Ñu Porá; *Paraguarí:* Parque Nacional Ybycuí; *San*

Pedro: Gral. Resquín.

Literature records: *Cordillera*: San Bernadino (Forel 1906); "Paraguay" (s. loc) (Forel 1895).

Discussion: *P. striata* is a common ground-foraging ant of forested habitats throughout eastern Paraguay. I have two records of *striata* nests from the *tierra firme* tall forests, both in soil under bark and rotting wood.

Pachycondyla villosa (Fabricius 1804)
(Figs. 12, 14, 38, 39)

Worker diagnosis: *P. villosa* is a large black ant covered in a dense golden pubescence. There is a longitudinal carina running from the lateral margin of the clypeus to the inner margin of the eye. The petiolar node in profile has a concave anterior face and a sharply differentiated dorsal face.

Measurements: HL 2.71-3.08, HW 2.40-2.90, SL 2.61-2.84, WL 4.19-4.68, PW 1.77-2.04, TL 2.91-3.16, NW 1.26-1.53, NL 1.14-1.34. (n = 8).

Similar species: *P. villosa* is unlikely to be confused with any other species. *P. crenata* is smaller (HW < 2.0 mm), with a rounded petiolar node and a more moderate pubescence.

Range: Southern Texas to northern Argentina.

Paraguay material examined: *Alto Paraguay*: Parque Nacional Defensores del Chaco; *Amambay*: Parque Nacional Cerro Corá; *Caaguazú*: Aleman Kué; *Canindeyú*: Reserva Natural del Bosque Mbaracayú; *Central*: Areguá, Luque; *Concepción*: Entre Flores 13k N Concepción, Horqueta; *Cordillera*: Caacupé Campamento Jack Norment; *Paraguarí*: Parque Nacional Ybycuí; *San Pedro*: Jaguareté Forest Rio Verde.

Literature records: *Alto Paraná*: Tacurú Pucú (Emery 1906); *Asunción*: Asunción (Forel 1907); "Paraguay" (s.loc.) (Forel 1895).

Discussion: *P. villosa* may be a complex of several closely-related species. Lucas et al (2002) provide strong congruent morphological and chemical evidence in support of three

distinct sympatric species in northeastern Brazil. Although they did not introduce taxonomic changes, they tentatively refer two variants with narrower petioles to the subspecies *P. villosa inversa* (F. Smith 1858), and the third variant with a more quadrate petiole to *P. villosa* s.str. On the basis of morphology, at least two of the forms are broadly sympatric throughout the Neotropics (Lucas et al, 2000, Wild *pers obs.*). Given the consistency of the differences and the sympatric distribution, it is likely that these forms are reproductively isolated.

In Paraguay I have seen two variants that correspond to the morphological forms of Lucas et al (2002). The more commonly collected of the two variants (*P. villosa* s. str.) in lateral view has a more quadrate petiolar node, with distinguishable dorsal and posterior faces (Fig. 12, 38). This form tends to have reddish coloration of the petiole, the coxae, and the femora. Most of the material examined corresponds to *P. villosa* s. str.

The second form (*P. villosa inversa*) has a sharper petiolar node, in lateral view with a strongly concave anterior face and a single convex declining dorso-posterior face (Fig. 40). This form lacks the reddish coloration. I have seen specimens from Areguá (Dept. Central) and Caacupé (Dept. Cordillera).

P. villosa is a very common arboreal forager in a wide range of habitats. In Paraguay, I have seen foragers in undisturbed primary tall forest, gallery forest, scrub forest, campo cerrado, pastures, lawns, and orchards. I observed one nest in a 15-cm diameter dead branch in gallery forest. Elsewhere in its range, *P. villosa* nests opportunistically in a variety of arboreal sites, including bromeliads, orchids, branches, and natural plant cavities (Longino 2002, Trunzer et al 1998, Wheeler 1942).

ACKNOWLEDGEMENTS

I would like to thank Bolivar Garcete for collecting many of the specimens used in this study, and for taking measurements of *P. crassinoda*. John Kochalka, Carlos Aguilar,

and Bolívar Garcete at the Museo Nacional del Historia Natural del Paraguay provided laboratory space and generously allowed me access to their collections. Antonio Claudio Ferreira da Costa and the Fundación Moisés Bertoni made possible extensive collections at the Reserva Natural del Bosque Mbaracayú. Phil Ward and Shelah Morita reviewed the manuscript and provided many invaluable comments. The U.S. Peace Corps and a U.S. National Science Foundation Graduate Research Fellowship supported me while I was living in Paraguay and the United States, respectively.

LITERATURE CITED

- Bolton, B. 1994. Identification guide to the ant genera of the world. Cambridge, Mass.: Harvard University Press, 222 pp.
- Bolton, B. 1995. A new general catalogue of the ants of the world. Cambridge, Mass.: Harvard University Press, 504 pp.
- Borgmeier, T. 1959. Myrmecologische Studien. II. An. Acad. Bras. Cienc. 31:309-319.
- Brandão, C. R. F. 1991. Adendos ao catálogo abreviado das formigas da região Neotropical (Hymenoptera: Formicidae). Rev. Bras. Entomol. 35:319-412.
- Brown, W. L., Jr. 1973. A comparison of the Hylean and Congo-West African rain forest ant faunas. Pp. 161-185 in: Meggers, B. J., Ayensu, E. S., Duckworth, W. D. (eds.) Tropical forest ecosystems in Africa and South America: a comparative review. Washington, D.C.: Smithsonian Institution Press, viii + 350 pp.
- Emery, C. 1906. Studi sulle formiche della fauna neotropica. XXVI. Bull. Soc. Entomol. Ital. 37:107-194.
- Emery, C. 1890a. Voyage de M. E. Simon au Venezuela (Décembre 1887 - Avril 1888). Formicides. Ann. Soc. Entomol. Fr. (6)10:55-76.
- Emery, C. 1890b. Studii sulle formiche della fauna neotropica. Bull. Soc. Entomol. Ital. 22:38-80.
- Emery, C. 1896. Studi sulle formiche della fauna neotropica. XVII-XXV. Bull. Soc. Entomol. Ital. 28:33-107.
- Emery, C. 1901. Notes sur les sous-familles des Dorylines et Ponérines (Famille des Formicides). Ann. Soc. Entomol. Belg. 45:32-54.
- Emery, C. 1911. Hymenoptera. Fam. Formicidae. Subfam. Ponerinae. Genera Insectorum 118:1-125.
- Fabricius, J. C. 1804. Systema Piezatorum secundum ordines, genera, species, adjectis synonymis, locis, observationibus, descriptionibus. Brunswick: C. Reichard, xiv + 15-439 + 30 pp.
- Forel, A. 1895. A fauna das formigas do Brazil. Bol. Mus. Para. Hist. Nat. Ethnogr. 1:89-139.
- Forel, A. 1906. Fourmis néotropiques nouvelles ou peu connues. Ann. Soc. Entomol. Belg. 50:225-249.
- Forel, A. 1907. Formicides du Musée National Hongrois. Ann. Hist.-Nat. Mus. Natl. Hung. 5:1-42.
- Fowler, H. G. 1981. Nuevos registros de hormigas para el Paraguay (Hymenoptera Formicidae). Neotropica (La Plata) 26:183-186.
- Hölldobler, B., and E. O. Wilson. 1990. The ants. Cambridge, Mass.: Harvard University Press, xii + 732 pp.
- Kempf, W. W. 1961. As formigas do gênero *Pachycondyla* Fr. Smith no Brasil (Hymenoptera: Formicidae). Rev. Bras. Entomol. 10:189-204.
- Kempf, W. W. 1964. Miscellaneous studies on Neotropical ants. III. (Hymenoptera: Formicidae). Stud. Entomol. 7:45-71.
- Kempf, W. W. 1972. Catálogo abreviado das formigas da região Neotropical. Stud. Entomol. 15:3-344.
- Latreille, P. A. 1802. Description d'une nouvelle espèce de fourmi. Bull. Sci. Soc. Philomath. Paris 3:65-66.
- Leal, I. R. and P. S. Oliveira. 1995. Behav-

- ioral ecology of the neotropical termite-hunting ant *Pachycondyla* (= *Termitopone*) *marginata*: colony founding, group-raiding and migratory patterns. *Behav. Ecol. Sociobiol.* 37: 373-383.
- Longino, J. 2002. The Ants of Costa Rica. Online publication: <http://www.evergreen.edu/ants/AntsofCostaRica.html>.
- Lucas, C., D. Fresneau, K. Kolmer, J. Heinze, J. H. C. Delabie, D. B. Pho. 2002. A multidisciplinary approach to discriminating different taxa in the species complex *Pachycondyla villosa* (Formicidae). *Biol. J. Linn. Soc.* 75: 249-259.
- Mayr, G. 1884. [Untitled. Descriptions of eight new species.] Pp. 31-38 in: Radoszkowsky, O. Fourmis de Cayenne Française. *Tr. Rus. Entomol. Obshch.* 18:30-39.
- Mill, A E. 1984. Predation by the ponerine ant *Pachycondyla commutata* on termites of the genus *Syntermes* in Amazonian rain forest [Brazil]. *J. Nat. Hist.* 18:405-410.
- Orivel, J. and A. Dejean. 2001. Comparative effect of the venoms of ants of the genus *Pachycondyla* (Hymenoptera: Ponerinae). *Toxicon* 39: 195-201.
- Roger, J. 1860. Die *Ponera*-artigen Ameisen. *Berl. Entomol. Z.* 4:278-312.
- Roger, J. 1861. Die *Ponera*-artigen Ameisen (Schluss). *Berl. Entomol. Z.* 5:1-54.
- Santschi, F. 1938. Notes sur quelques *Ponera* Latr. *Bull. Soc. Entomol. Fr.* 43:78-80
- Smith, F. 1858. Catalogue of hymenopterous insects in the collection of the British Museum. Part VI. Formicidae. London: British Museum, 216 pp.
- Trunzer, B.; J. Heinze, and B. Hölldobler. 1998. Cooperative colony founding and experimental primary polygyny in the ponerine ant *Pachycondyla villosa*. *Insectes Sociaux* 45: 267-276.
- Wheeler, W. M. 1936. Ecological relations of ponerine and other ants to termites. *Proc. Am. Acad. Arts Sci.* 71:159-243.
- Wheeler, W. M. 1942. Studies of Neotropical ant-plants and their ants. *Bull. Mus. Comp. Zool.* 90:1-262.