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## A new species of *Neoscelis* from Jalisco, Mexico (Coleoptera: Scarabaeidae: Cetoniinae)

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**Abstract.** *Neoscelis coracina* Mudge et Ratcliffe sp. n., from Jalisco, Mexico, is described and illustrated. Intraspecific variation is discussed, and diagnostic characters separating *N. coracina* sp. n. from *N. dohrni* (Westwood, 1855) are given. The key to males of New World Goliathini is revised. Notes on habitat, behavior, and collecting *N. coracina* sp. n. are included. A new state record is provided for *N. dohrni*.

**Taxonomy, Scarabaeidae, Cetoniinae, Goliathini, *Neoscelis*, new species, Mexico**

Krikken (1984) indicated there are 79 genera and approximately 387 species of Goliathini from the Old World. These include some of the largest and most impressive scarab beetles in the world. The New World Goliathini includes only two genera, *Neoscelis* Schoch, 1897 and *Ischnoscelis* Burmeister, 1842, and four species: *I. hoepfneri* (Gory et Percheron, 1833), *N. coracina* sp. n., *N. dohrni* (Westwood, 1855) and *N. longiclava* Morón et Ratcliffe, 1989. All are known only from south central Mexico and are considered to be remnants of past Miocene dispersal of ancestral Asian goliathines via the Bering land bridge to North America (Morón & Ratcliffe 1989). Members of the New World Goliathini are impressive beetles as well. Males of *N. coracina* sp. n. and *N. dohrni* possess bifurcated clypeal horns and elongated forelegs with densely orange-setose, elongated tarsi.

In 1999 five specimens of *Neoscelis*, all male, were collected by the first author in Jalisco, Mexico. All were similar in appearance to *N. dohrni* but distinctive in the shape of the preocular carina, clypeal tubercles, clypeal horn, and color. A visit to the same site in late November 2001 failed to produce additional specimens. A third visit to the same locality in late September – early October 2002 produced an additional 64 males and 7 females. All males were similar to the original series but with more variation in size, color, and development of the clypeal tubercles and clypeal horn. This further convinced us that it is an undescribed species distinct from *N. dohrni*.

While the new species is known from only a single locality in Jalisco, the distribution of *N. dohrni* is disparate, being recorded from Aguascalientes, Guerrero, Jalisco, Nayarit and Jalisco (Morón et al. 1997). The following specimens represent a new state record for Colima: 1 male, 1 female, Campo Cuatro, 19°21'13"N, 103°51'41"W, ±18 km (air) NW Colima, 1300-1375 m, 7.x.1999; 1 male, km.43, Carr. Minatitlán-Colima, 1130 m, 19°25'04"N, 104°00'41"W, oak forest, 6.x.1999, all RLWE.

Measurements were made using an ocular micrometer looking straight down on the specimen. Colors described are those seen under a bright, fiber optic light source. Collection/institutional codens for type repositories follow the Bishop Museum's "Insect and Spider Collections of the World" web site at <http://hbs.bishopmuseum.org/codens/codens-inst.html>:

- BMNH The Natural History Museum, London, United Kingdom;  
 CEAM Centro de Entomologica y Acarologia, Montecillo, Mexico;  
 EBCC Universidad Nacional Autónoma de Mexico, Estación de Biología "Chamela", San Patricio, Jalisco, Mexico;  
 EMEC University of California, Essig Museum of Entomology, Berkeley, California, USA;  
 MNHN Muséum National d'Histoire Naturelle, Paris, France;  
 RLWE Richard L. Westcott;  
 UNAM Universidad Nacional Autónoma de Mexico, Mexico D.F., Mexico;  
 UNSM University of Nebraska State Museum, Lincoln, Nebraska, USA;  
 USNM National Museum of Natural History, Washington D.C., USA;  
 ZMHB Museum für Naturkunde der Humboldt-Universität, Berlin, Germany.

## Key to the males of the New World Goliathini

(after Morón & Ratcliffe 1989)

Females remain unknown for two species.

- 1 Clypeal horn bifurcate from base. Protibia without teeth laterally at apex. Elytra and femora bicolored. Thoracic sternites densely setose ..... *Ischnoscelis hoepfneri* (Gory et Percheron)
- 1' Clypeal horn bifurcate past middle (Figs 7-8). Protibia with two teeth laterally at apex. Elytra and femora unicolorous. Thoracic sternites weakly or moderately setose ..... 2
- 2 Club of antennae distinctly longer than stem. Protarsi nearly glabrous beneath. Shining black ..... *Neoscelis longiclava* Morón et Ratcliffe
- 2' Club of antennae slightly shorter than stem. Protarsi densely orange-setose ventrally. Color dark metallic green, sometimes with copper reflections (Fig. 3); or shining black, occasionally with blue-green reflections (Fig. 1) ..... 3
- 3 Preocular carina angularly declivous anteriorly, not extending mesad (Fig. 8). Clypeus with elongated, acute tubercle projecting distinctly forward and upward either side of horn (Fig. 6). Horn deeply bifurcate, rami long, acute; large males with each ramus bearing a large tubercle on posterior face at about middle (Fig. 8); color dark metallic green, sometimes with copper reflection (Fig. 3) ..... *N. dohrni* (Westwood)
- 3' Preocular carina extending anteromesally, forming well-developed, elevated, anteriorly declivous, acute tubercle between each eye and central longitudinal ridge (Fig. 7). Clypeus typically with weakly elevated tubercle projecting anterolaterally either side of horn (Fig. 5). Horn more shallowly bifurcate, rami broadly subtriangular, each without tubercle on posterior face (Fig. 7); color shining black, occasionally with blue-green reflection (Fig. 1) ..... *N. coracina* Mudge et Ratcliffe sp. n.

***Neoscelis coracina* Mudge et Ratcliffe sp. n.**

(Figs 1-2, 5, 7, 9, 11-12)

Type locality (Fig. 13). Mexico, Jalisco, 2 km SW Puerta el Zapatero, 19°50'07"N, 103°05'49"W, 1615 m.

Type material. Holotype (UNAM) labeled: "MEXICO: Jalisco, 2 km SW Puerta el Zapatero, 19°50'07" 103°05'49", 1615 m, 30 Sept. - 4 Oct. 2002 / Banana/beer bait trap, coll. A. D. Mudge / HOLOTYPE *Neoscelis coracina* Mudge and Ratcliffe" (printed red label). Allotype (UNAM) with same locality data, 30.ix.2002. A. D. Mudge, F. A. Noguera, R. L. Westcott. Paratypes all with same locality data: 5 males, 8.x.1999, A. D. Mudge leg.; 11 males, 2 females, 30.ix.2002, A. D. Mudge, F. A. Noguera & R. L. Westcott leg.; 33 males, 1 female, 30.ix.-4.x.2002 / Banana/beer bait trap, A. D. Mudge leg.; 15 males, 1 female, 4.x.2002, F. A. Noguera leg.; 4 males, 2 females, 4.x.2002, R. L. Westcott leg. Paratypes are deposited in the following collections: BMNH, CEAM, EBCC, EMEC, MNHN, UNSM, USNM (currently at UNSM), ZMHB, Miguel A. Morón (Xalapa, Veracruz, México), Andreas Reichenbach (Leipzig, Germany), Coke Smith (Port Angeles, WA) and the authors.

**Description.** Holotype male (Fig. 1). Length from anterior margin of pronotum to apex of elytra 21.8 mm, width across humeri 12.2 mm, length from occiput to fork of clypeal horn 4.9 mm. Dorsum shining black, with faint dark blue-green reflections at higher magnifications.

Head (Figs 5, 7). Frons slightly concave, densely rugopunctate, shagreened between punctures; punctures moderately large, setigerous; setae usually long, erect, pale. Surface of clypeus moderately, irregularly rugopunctate. Clypeus in dorsal view expanded apically from base into slightly elevated, laterally compressed, acute tubercle, becoming angularly constricted subapically into broad clypeal horn; horn recurved strongly upward and backward from plane of clypeal disc, with shaft of horn expanded and bisected apically into 2 acute rami; clypeus in dorso-lateral view concave on either side of central longitudinal ridge, surface rugopunctate, setigerous; setae mostly long, erect, pale; preocular carina above antennal insertion extending anteromesally, forming well-developed, elevated, anteriorly declivous, acute tubercle between eye and central longitudinal ridge. Interocular width (dorsal view) 6.4 transverse eye diameters. Antennae 10-segmented, club slightly shorter than stem; club (lateral view) about 3 times wider than stem; first segment of club with narrow, longitudinal patch of dense setae; setae moderately short, stout, erect, tawny.

Pronotum. Form broadly convex transversely, strongly convex longitudinally, with 2 small, irregular, shallow depressions slightly above lateral margin at widest point. Surface shagreened, moderately densely punctate; punctures small, round, shallow, becoming slightly denser and larger anterolaterally, setigerous; setae erect, pale, minute. Lateral margin with strong marginal bead, shallowly emarginate in basal half. Posterior angles slightly obtuse with basal margin shallowly emarginate on either side of scutellum. Scutellum with few small, setigerous punctures; setae moderately long, erect, pale. Lateral margins grooved for about 1/2 of length.

Mesepimeron. Surface densely punctate; punctures small, setigerous; setae mostly long, erect, pale.

Elytra. Surface shagreened, tricostate. Sutural costa extending from apex of scutellum to apex of elytra; discal and subhumeral costae slightly bowed mesad and with apices joined at apical umbone; surface on either side of costae moderately densely punctate (slightly more so than pronotum), punctures small, denser and larger along lateral margins, setigerous; setae, erect, minute, pale. Lateral margins with strong marginal bead. Sides above lateral margins from approximately subhumeral arch to apex strigulate, with strigulae becoming finer and denser posteriorly.

Pygidium. In lateral view, surface evenly convex, transversely and concentrically strigulate, with strigulae emanating in a ring pattern from central point slightly above apex, setigerous; setae minute, erect, pale.

Venter. Thoracic sternites shining black with faint, dark blue-green reflections, reflections on disc of metasternum brighter, more cupreous. Surface shagreened, disc of metasternum impunctate, otherwise moderately densely punctate, becoming strigulopunctate at margins; punctures small, setigerous; setae long, erect, pale. Mesosternum more rugopunctate. Meso-metasternal process (lateral view) subtriangular, margins evenly rounded; anterior face nearly vertical from plane of sternum, densely punctate, setigerous; setae long, erect, pale; ventral surface at approximately 40° angle from plane of sternum; lateral margins (ventral view) roundly dilated, apex slightly lobed. Abdominal sternites dark reddish-brown (darker towards lateral margins) with faint, dark blue-green reflections; posterior margins of sternites 1-5 with narrow, brighter, reddish-brown transverse band; surface shagreened, moderately densely punctate; anterior and lateral portions of first abdominal sternite and lateral portions of sternites 2-5 strigulopunctate; punctures round, shallow, setigerous; setae minute, pale on disc, becoming long, erect, pale at margins.

Legs. Color black with dark blue-green reflections. Protibia about 1/3 longer than profemur, median edge strongly bowed mesad. Protarsus about 1/4 longer than protibia, densely setose ventrally (more so distally), setae long, ferruginous.

Parameres. Figures 11-12.

Allotype female (Fig. 2). Length 17.6 mm, width across humeri 10.3 mm. Head, pronotum and scutellum shining, vaguely brown-black, with faint, dark blue-green reflections at higher magnifications. Elytra similar with second, fourth and sixth intervals more reddish-brown. Venter similar with stronger greenish reflections, especially on metasternum.

Head. Clypeus and frons feebly, longitudinally tumescent in center; entire surface densely, coarsely rugopunctate, setigerous; setae long, erect, tawny. Clypeus in dorsal view subhexagonal, apical margin strongly reflexed, weakly bilobed; in lateral view with cariniform ridge beginning above antennal insertion, becoming gradually declivous anteriorly and ending abruptly before joining lateral margin. Interocular width (dorsal view) 5.0 transverse eye diameters. Antennae similar to that of male.

Pronotum. Form broadly convex, surface shagreened, completely densely punctate except for narrow, impunctate, longitudinal median line, becoming more rugopunctate at lateral margins; punctures moderate in size, deep, setigerous; setae dense, moderately long, erect, tawny. Lateral margin with strong marginal bead. Posterior angles obtuse with basal margin emarginate for width of scutellum. Scutellum less densely punctate, especially posteriorly; punctures slightly smaller, setigerous as on pronotum. Lateral margins grooved for about 3/5 of length.

Mesepimeron. Surface densely rugopunctate, punctures small, setigerous; setae moderately long, erect, slightly paler than on pronotum.

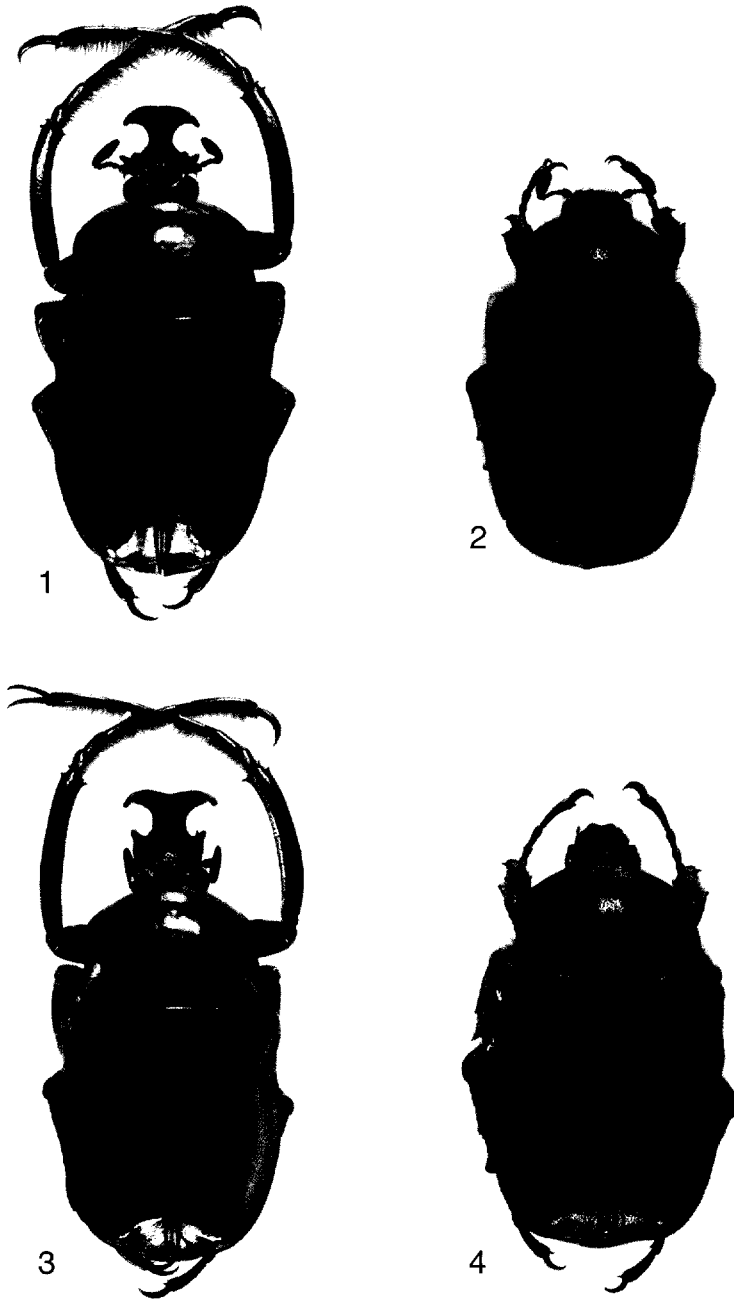
Elytra. Surface tricostate as in male, completely densely punctate, slightly less so on costae; punctures small, setigerous; setae dense, moderately long, erect, tawny. Lateral margins with strong marginal bead.

Pygidium. In lateral view surface weakly convex. Surface strigulate, similar to male, setigerous; setae dense, moderately long, erect, tawny.

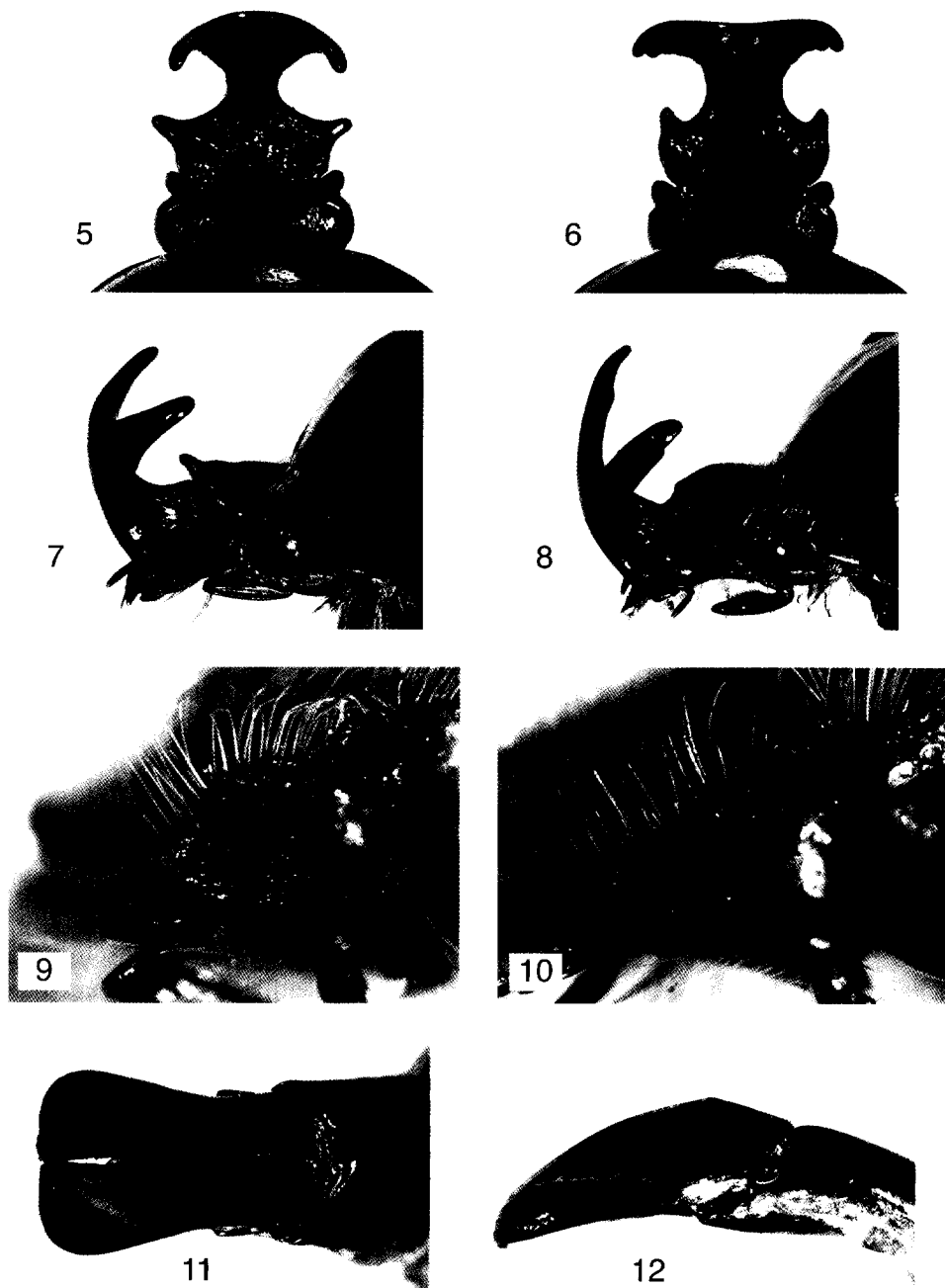
Venter. Thoracic sternites similar to male except setae denser, tawny. Anterior face and margins of meso-metasternal process (lateral view) similar to male; ventral surface in same plane as ventral sternites; shape (ventral view) similar to male except anterior margin more truncate. Abdominal sternites moderately densely punctate in middle, punctures small, setigerous; setae minute, pale, becoming more densely rugopunctate with setae long, pale at margins.

Legs. Lateral margin of protibia acute, sharp, tridentate (2 apical, 1 middle teeth); inner margin nearly straight. Protarsus similar in length to protibia, each tarsomere with 5 setae near apex ventrolaterally.

Variation. Males (n = 68). Length 18.0-24.5 mm (average 22.0 mm), width across humeri 9.8-13.2 mm (average 11.9 mm). Color varies from shining black with faint dark blue-green reflections (appearing black to the naked eye) to stronger, dark blue-green reflections on pronotum and scutellum, to a distinct dark blue-green reflection throughout. Smallest individuals with lateral margins of clypeus nearly parallel or slightly divergent, clypeal tubercles weakly developed and clypeal surface less concave on either side of central, longitudinal ridge. Majority of individuals with lateral clypeal margins more divergent, clypeal tubercles more pronounced, slightly elevated, and projecting anterolaterally. Central longitudinal ridge well-developed and clypeal surface on either side of horn more concave. In largest individuals, lateral clypeal margins strongly divergent forming a well-developed, laterally compressed, more elevated, anterolaterally projecting, acute tubercle; surface of clypeus deeply concave. In several specimens, differences in clypeal shape and tubercle development as described above were noted between left and right sides of same individual. Clypeal horn varies in degree of bifurcation, with majority of individuals possessing divergent, acute rami and some larger individuals with broader, less acute rami. Horn wear was particularly evident in 1 specimen with rami that were abraded and rounded. Proleg of one teratological specimen with only 4 short tarsomeres (lengths beginning with basal segment 1.2, 1.0, 1.0, 2.3 mm, total = 5.5 mm)



Figs 1-4. 1-2: *Neoscelis coracina* Mudge et Ratcliffe sp. n. 1 – holotype, male, length 21.8 mm; 2 – allotype, length 17.6 mm. 3-4: *N. dohrni* (Westwood). 3 – male, length 21.7 mm; 4 – female, length 19.1 mm.



Figs 5-12. 5, 7, 9, 11-12: *Neoscelis coracina* Mudge et Ratcliffe sp. n. 5 – head, male, dorsal view; 7 – head, male, oblique view; 9 – clypeus, female, lateral margin. 11-12: parameres. 11 – caudal view; 12 – lateral view. 6, 8, 10: *N. dohrni* (Westwood). 6 – head, male, dorsal view; 8 – head, male, oblique view; 10 – female, lateral margin.



compared to 5 normal tarsomeres (1.8, 2.1, 2.2, 2.5, 4.5 mm, total = 13.1 mm) on the other.

Variation. Females ( $n = 7$ ). Length 17.5-19.3 mm (average 18.2 mm), width across humeri 10.3-11.4 mm (average 10.9 mm). Color variable with 2 specimens having stronger greenish reflections on head, pronotum, scutellum, elytral costae and venter. Dorsum of 1 specimen dull orange with vague green reflections. Pronotum with narrow, impunctate, longitudinal median line varying from an uninterrupted, slightly raised line extending length of pronotum (gradually widening posteriorly) to a similar line beginning more or less on disc. Dorsal setae vary from pale (most specimens) to a deep tawny color (1 specimen).

Differential diagnosis. Male *Neoscelis coracina* sp. n. can be separated from *N. dohrni* based on color, the form of the preocular carina, clypeal tubercles and clypeal horn. *N. coracina* sp. n. (Figs 1, 5, 7), is shining black, occasionally with dark blue-green reflections. The preocular carina extends anteromesally, forming a well-developed, elevated, anteriorly declivous, acute tubercle between each eye and the central longitudinal ridge. The clypeal tubercles are weakly elevated and project anterolaterally on either side of the clypeal horn. *N. dohrni* (Figs 3, 6, 8), is dark metallic green, occasionally with copper reflections. The preocular carina is angularly declivous anteriorly, where it joins the lateral clypeal margin, hence the frontal tubercles between each eye and the central longitudinal ridge are completely lacking. The clypeal tubercles are sharper, more elongated and project distinctly forward and upward on either side of the clypeal horn. The size and shape of the clypeal horn is also distinctive (Figs 5-8). *N. dohrni* possesses longer, more acute rami which in large males bear a distinct tubercle on the posterior face at about the middle. However, because this secondary sexual character appears subject to greater variation, we do not consider it to be as important. The genitalia are essentially identical to those of *N. dohrni*, but this is not surprising considering that these are putative sister species and the genitalia of American Goliathini are similar. Using the key in Morón & Ratcliffe (1989), *N. coracina* sp. n. runs to *N. dohrni* in couplet 2, which includes the statement "Metallic bluish green, rarely black". However, black color forms are not mentioned in their description of *N. dohrni*, and we have never seen one among numerous specimens examined. Morón & Ratcliffe (1989) may have considered *N. coracina* sp. n. to be a black form of *N. dohrni*.

Female *N. coracina* sp. n. are blackish, sometimes with faint green reflection, while *N. dohrni* are typically metallic green, occasionally with copper reflections (Figs 2, 4); however, both species have dull orange forms. In the seven females we examined it is possible to separate *N. coracina* sp. n. from *N. dohrni* based on differences in the lateral clypeal margin. In *N. coracina* sp. n. a declivous, cariniform ridge extending anteriorly from the antennal insertion is interrupted abruptly about half-way by the somewhat concave lateral clypeal margin (Fig. 9). In *N. dohrni* this ridge is more or less continuous and evenly declivous along the entire lateral margin (Fig. 10).

**Etymology.** From the Latin "*coracinus*", meaning raven-like or black as a crow, referring to the generally shining black color of this species. The specific epithet, *coracina*, agrees with the female gender of *Neoscelis*. Though Schoch did not provide a derivation when he formed the generic name, our research strongly suggests that the suffix comes from the Greek *skelis* (meaning rib or leg), which is feminine.

**Habitat, behavior, and collecting notes.** Originally we labeled the collecting site "Puerta del Zapatero", which the Global Gazetteer (<http://www.calle.com/world/index.html>) locates at 19°53'N, 103°03'W, elevation 1971 meters. However, the Gazetteer also lists "Puerta el Zapatero", 19°50'N, 103°05'W, 1632 meters. Based on the data we recorded and the habitat (pine-oak forest being typical at the higher elevation), clearly it is the latter location that applies to the site where we collected *N. coracina* sp. n. Our GPS reading was taken along the highway, but most of the specimens are from areas up to about 100 meters higher along a gated dirt track leading into the hills. A few males were observed flying at the lowest elevations.

The original vegetation at this site was probably mixed oak woodland and tropical deciduous forest with some pine at the higher elevations. Although significant numbers of oak and a few pines remain, much of the habitat has been cutover and shows regrowth (some fairly old) of various hardwood trees, shrubs and forbs (Fig. 13). There are dense areas of *Acacia* spp. and various other trees and shrubs, including what appears to be a species of arborescent *Mimosa* sp. When we first visited this site in 1999, and again in 2001, it was already disturbed but less so than we found it in 2002. Now, it exhibits much more evidence of woodcutting, grazing, and conversion to agriculture. What a difference a year can make!

The five specimens collected in October 1999, all males, were found feeding on the mostly younger stems (about 2.5 cm diameter) of a semiligneous upright shrub, probably in the family Asteraceae. It has multiple branches stemming from the base, broadly lanceolate leaves, and grows up to about four meters tall (Fig. 15). No beetles were seen on 29 November 2001, but feeding scars (Fig. 16) were evident on the same plant they were collected on in 1999. In 2002, *N. coracina* sp. n. was collected on this same host but on different plants, some growing very close to the original collection site (which is now a fenced cornfield). Eight individuals were encountered on a single plant, including a male-female pair. Most of the males were on different branches at a height of more than two meters. Only one branch had more than one male, that being two that were separated by more than a meter. After landing, males would move rapidly towards the terminal portion. They could be seeking a better position on the branch (perhaps determined by the nutritional quality, i.e., newer growth), and females may favor males with a better position. Though no physical contact was observed, such behavior would likely lead to aggressive encounters between males competing for similar sites. The larger proportion of males to females collected overall could indicate that the spatial arrangement of males on this bush is a lek type of reproductive strategy.

Aggregations of males, particularly ones where males are forced to demonstrate qualities relevant to female choice, offer females the opportunity to quickly choose the best among them in a “best-of- $n$ -males” strategy (Thornhill & Alcock 1983). Those males that can obtain and defend a better position from rivals may gain exclusive access to or be preferentially selected by females in a game of “Winner takes all”. Similar behavior has been documented for *N. dohrni*. The male “owner” defends its territory from intruders by using its clypeal horn and long forelegs to spar with and push down other males (Morón & Ratcliffe 1989; Nogueira et al. *in press*; Mudge & Westcott, personal observation). The observed gathering of male *N. coracina* sp. n. may indicate an aggregation pheromone. The widely spaced males and their calm behavior does not indicate a female sex pheromone. The gathering may also indicate host plant allelochemical or visual cues; however, that there were other plants of the same species in the immediate vicinity, but only on this one were so many individuals encountered, appears to support the presence of a pheromone.

It was not confirmed that the pair encountered in the foregoing observation was in copula. However, the long forelegs of the male were wrapped around the female from above, firmly grasping both her and the branch below. Similar “guarding” behavior by males during mating has been observed in *N. dohrni* (Mudge & Westcott, personal observation). In male insects, leg modifications that promote better grasping of females during copulation and help prevent another male from pulling or wedging him off are common (Thornhill & Alcock 1983).

Based mostly on our observations in 2002, it appears that the beetles spend the night elsewhere than on the host plants (where they feed and mate) because we did not observe them flying until after noon, nor were they noticed on the plants before then. Most were collected from the shrubs well after that time. We rarely encountered females on the plants (or elsewhere), but in most cases they were part of a pair. One female was collected on the leaf of a small oak sapling higher up the hillside. Males were not encountered on any other plant, but a few were netted as they were flying about the area, so distinctive with their elongated, outstretched forelegs.

All species of New World Goliathini, including *N. coracina* sp. n., have been collected using fruit-baited traps (Morón & Ratcliffe 1989; Ramírez & Mudge, personal collection). Bait traps were constructed from 32 oz. clear plastic Solo<sup>®</sup> cups with four 6 mm drain holes in the bottom. Each trap was filled to a height of about 5 cm with fermenting bananas and beer mixed together in a small plastic bucket right before trap placement. Three traps were placed on 30 September 2002 in the immediate vicinity of the original 1999 collection site. Ten additional traps were placed ca. 50-75 meters apart along the track as it continued uphill. Traps were hung ca. 5-7 meters high in trees, using a modified tropics net handle, in open sunny areas within the canopy or from a lower branch. Of the original 13 traps, ten were still intact when they were checked and removed four days later. Of the ten, seven caught at least one *N. coracina* sp. n. A total of 34 males and 2 females, all



Figs 13-16. 13 – type locality; 14 – banana/beer bait trap; 15 – F. A. Noguera with host plant; 16 – feeding scar on host plant.

alive, were collected from bait traps (average = 3.6/trap, range = 1-9/trap, n = 10 traps, Fig. 14). Additional species of Cetoniinae and numbers collected include: *Cotinis laticornis* Bates, 1889 (1); *C. mutabilis* (Gory et Percheron, 1833) (59); *C. pueblensis* Bates, 1889 (6); *Euphoria* probably *inda* (Linnaeus, 1760) (1); *Gymnetis difficilis* Burmeister, 1842 (1); *Gymnetosoma stellata* (Latreille, 1833) (1); *Hologymnetis cinerea* (Gory et Percheron, 1833) (17); *H. moroni* Ratcliffe et Deloya, 1992 (5); and *Ischnoscelis hoepfneri* (Gory et Percheron, 1833) (1).

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