

## THE FAMILY NOTERIDAE THOMSON (COLEOPTERA: ADEPHAGA) IN MIRADORES LAGOON, VERACRUZ, MEXICO, WITH A DESCRIPTION OF ITS ASSEMBLAGE

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### ABSTRACT

The family Noteridae Thomson, 1860 of the tropical region is poorly known. In the present work, the Noteridae from Miradores Lagoon in the municipality Emiliano Zapata, Veracruz, Mexico, are reported. The fauna consists of two subfamilies, four genera, and seven species. The subfamily Notomicrinae Zimmermann, 1919 with the species *Notomicrus sharpi* Balfour-Browne, 1939 and the genera and species *Hydrocanthus marmoratus* Sharp, 1882, *Mesonoterus laevicollis* Sharp, 1882, and *Suphisellus levis* Fall, 1909 are **new state records** for Veracruz. General habitat distribution showed all species were found in the swampy area, five species in edges, and only two species in holes. The only species found in all the three habitats were *Suphisellus lineatus* (Horn, 1871) and *Suphisellus nigrinus* (Aubé, 1838). An annotated list and illustrated key to the species of Noteridae present in Miradores Lagoon are provided.

Key Words: aquatic beetles, Hydradephaga, distribution, habitat, key

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Noteridae Thomson, 1860 are a small family of beetles belonging to the Hydradephaga. They have aquatic habits, and adults usually are small to moderate in size (1.0–5.8 mm). The body is oval to elongate-elliptical, often drop-shaped, with greatest width at the anterior third. The elytra and prothorax form a nearly continuous convex lateral outline (Noterinae). The venter is usually flat, whereas the dorsum is moderately convex, or semispherical in *Suphis* Aubé and some species of *Suphisellus* Crotch (Dettner 2016) (Figs. 13–19). All have a ventral platform, commonly known as the “noterid platform,” primarily comprised of the metacoxae, specifically a raised portion of the inner metacoxal lamellae (Roughley 2001; Dettner 2016) (Fig. 2), along with a long, curved spur on the inner apical margin of the front tibiae (Fig. 3) or rows of spines around the margin, as in *Notomicrus* Sharp (Fig. 4).

The specialized morphology of adults and larvae and their capacity to pupate underwater makes the Noteridae, along with the Torridincolidae Steffan (Myxophaga), the only strictly aquatic families of beetles presently known (Spangler 1982, 1996; Hilsenhoff 1992). Adults and larvae are found in shallow backwaters or low currents, commonly among the roots of aquatic plants or between emergent plants. Both larvae and adults are primarily

carnivores but also feed on decayed plants and animals (Spangler 1982; Roughley 2001). They play an important role in recycling nutrients within the ecosystem (Young 1967).

Currently, the family is made up of three subfamilies, six tribes, 17 genera, and about 270 species worldwide (Miller 2009; Nilsson 2011; García *et al.* 2012; Gómez and Miller 2013; Baca *et al.* 2014; Miller and Montano 2014; Baca and Toledo 2015; Guimarães and Ferreira-Jr 2015; Manuel 2015). Two subfamilies, six genera, and 30 species are known from Mexico, Central America, and the West Indies (Spangler 1982; Megna and Deler 2006). In Mexico, there is no previous regional work on the diversity and ecological aspects of the family, but 18 species from five genera are recorded at the national scale: *Notomicrus* (two species), *Mesonoterus* Sharp (one species), *Suphisellus* (nine species), *Suphis* (one species), and *Hydrocanthus* Say (five species) (Arce-Pérez and Roughley 1999; Arce-Pérez 2004; Arce-Pérez and Baca 2017). From the state of Veracruz, only four species are known: *Suphisellus lineatus* (Horn, 1871), *Suphisellus nigrinus* (Aubé, 1838), *Suphisellus epleri* Arce-Pérez and Baca, 2017, and *Suphis cimicooides* Aubé, 1837 (Arce-Pérez and Roughley 1999; Arce-Pérez 2004; Arce-Pérez and Baca 2017). The purpose of our present work is to

update the taxonomic knowledge of the Noteridae present in Miradores Lagoon, Veracruz, Mexico, and to provide an annotated list and an illustrated key for the species as well as some aspects of the species' ecology.

## MATERIAL AND METHODS

**Study Area.** Miradores Lagoon is located in central Veracruz in the Emiliano Zapata municipality (19° 28' 21" N and 96° 47' 12" W), at an elevation between 850 and 900 m above sea level (Fig. 1). The lagoon is maintained by the flow of small rivers and streams and by direct precipitation (Brug-Aguilar 2010). The climate is temperate humid with an average temperature of 25.2° and an average annual rainfall of 2,779.1 mm (Comisión de Estudios del Territorio Nacional-UNAM 1970). In this region, the seasons of the year are delimited as follows: rainy (warm and humid, June–October), dry (warm and dry, April–May), and cold rainy (humid temperate, November–March) (Williams-Linera 2007). The surrounding vegetation is composed of *Casuarina* L. (Casuarinaceae), lowland thorny forest, and wild grass; additionally, there is aquatic vegetation such as reeds (*Scirpus* L., Cyperaceae), water hyacinth (*Eichhornia crassipes* (Mart.) Raf.; Pontederiaceae),

duck weed (*Lemna* L., Araceae), and waterweed (*Elodea* Michx.; Hydrocharitaceae). Agricultural and recreational activities such as fishing and grazing take place in the study area.

**Sampling.** Noterids were collected monthly from March 1997 to February 1998 in three habitats: shorelines (= SM); a small swampy area (= SW) with dominant aquatic vegetation (*Scirpus* sp., *E. crassipes*, *Lemna* sp., and *Elodea* sp.); and temporal holes (= HO) dug for tree-planting along the lagoon (collected in March, April, August, and September 1997). Adult specimens were randomly captured in SM and SW using an aquatic hand net (41 × 15 cm, 0.025 mesh), while a small strainer (5 cm in diameter) was used to capture the specimens in HO. All collected specimens were preserved in 96% ethanol and sorted later in the laboratory.

**Taxonomy.** An annotated list and an illustrated key to the noterid subfamilies, genera, and species from Miradores Lagoon are provided. Data listed in Material Examined include data of collection, habitat code, and number of specimens (in parentheses). All specimens were collected by the first author except where indicated. Diagnosis of species and keys are based on Guignot (1948) Young (1978, 1979, 1985), and Arce-Pérez and Roughley (1999).

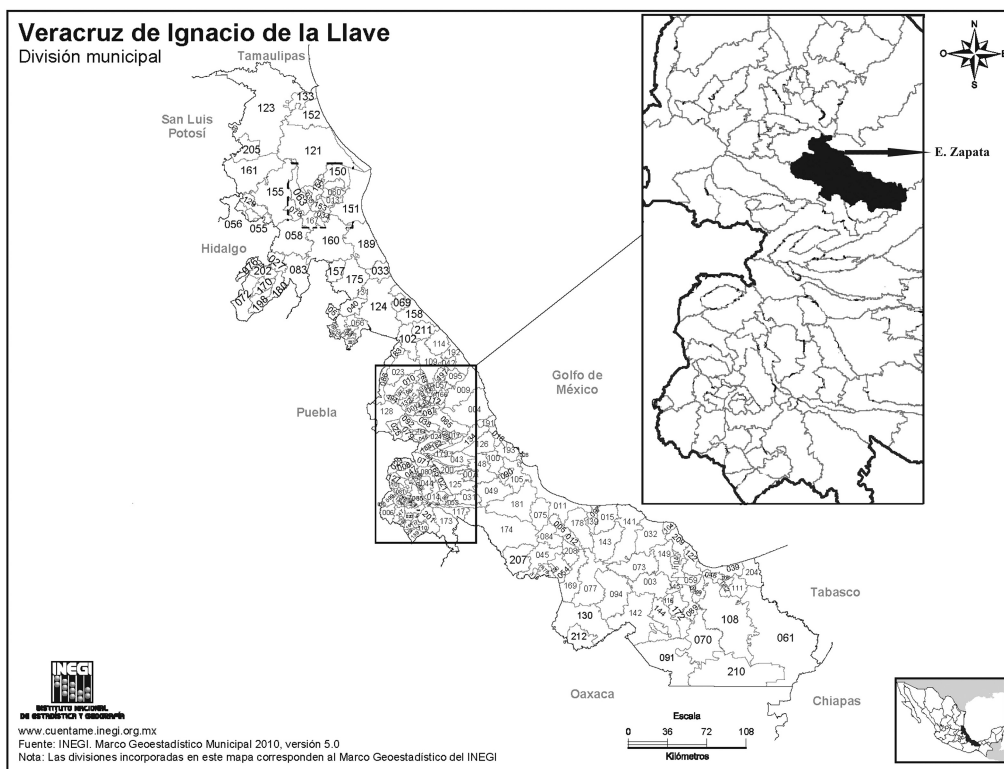


Fig. 1. Location of Miradores Lagoon, Veracruz, Mexico.

Measurements are in mm. All specimens were deposited in the Entomological Collection of the Institute of Ecology, A.C, Xalapa, Veracruz, Mexico (IEXA).

## RESULTS

**Taxonomic Composition.** A total of 4,131 specimens of Noteridae belonging to two subfamilies, four genera, and seven species were collected, representing 100%, 80%, and 41%, respectively, of those native to Mexico (Arce-Perez and Roughley 1999; Nilsson 2011; Arce-Pérez and Baca 2017). Notomicrinae is represented by one genus and one species and Noterinae by three genera and six species. *Notomicrus sharpi* Balfour-Browne, 1939, *Mesonoterus laevicollis* Sharp, 1882, *Hydrocanthus marmoratus* Sharp, 1882, and *Suphisellus levis* (Fall, 1909) are **new state records** for Veracruz. Therefore, the noterid fauna of Veracruz is comprised of two subfamilies, five genera, and eight species, representing 100% of the subfamilies and 47% of the species known to occur in Mexico.

**Seasonal and Habitat Distribution.** The most speciose genus in Miradores Lagoon was *Suphisellus* with four species; *Mesonoterus*, *Hydrocanthus*, and *Notomicrus* were represented by a single species each. All species were present throughout the year, except *N. sharpi* collected during the four months of the rainy season. General habitat distribution showed all species were found in SW, five species in SM, and only two species in HO. The only species found in all three habitats were *S. lineatus* and *S. nigrinus* (Table 1), which suggests they are opportunistic species that tend to use temporal microhabitats such as the holes for planting trees along the shoreline of the lagoon for their dispersal.

## DISCUSSION AND CONCLUSION

The noterid fauna of Miradores Lagoon is conformed by two subfamilies, four genera, and seven species. Our results increase the noterid fauna of Veracruz from one to two subfamilies, from two to five genera, and from three to eight known species.

Much additional work is required in aquatic ecosystems to ascertain the total number of Noteridae that exists in Veracruz, considering the high variety of environments derived from its diverse topography (Soto and Geissert 2011)

In general, few species of Noteridae are reported as part of aquatic coleopteran assemblages (Temunović *et al.* 2007). As noted above, adults and larvae are found in shallow backwaters or slow currents and commonly between the roots of aquatic plants or between emergent plants. These conditions occur in the swampy area of Miradores Lagoon, with a greater diversity of aquatic plants (reeds, water hyacinth, duck weed, and water weed), shallow backwaters, little movement of water, and less exposure to currents and wind. This explains why the swampy area (SW) is the habitat with the greatest species richness and abundance of specimens in Miradores Lagoon (Table 1). Water movement, scarcity or dispersion of aquatic vegetation, changes in water movement along the edge of the lagoon, and the presence of predatory fish (Centrarchidae, Gerreidae) and amphibians may be important impediments to the proper establishment of Noteridae in Miradores Lagoon. The capture of Noteridae in the holes for planting trees was very sporadic due to the rapid drying and absence of aquatic vegetation, so beetles were only collected in the rainy and cold rainy seasons (March, April, August, and September) during which there was scarce development of filamentous algae to provide some food and support.

On the other hand, it is also possible that species richness and abundance was higher in the swamp (SW) because this is the microhabitat less affected by human activities. There is greater disturbance along the periphery of the lagoon, where grazing and agricultural activities affect the shore where sampling was performed. Additionally, at some sites around the lagoon, fertilizers used on certain crops (corn and tomato) drain into the lagoon; this could cause adverse effects on the diversity and abundance of the noterid fauna.

Finally, the current value given to biodiversity studies has helped to increase the taxonomic and

**Table 1.** Distribution of Noteridae by habitat in Miradores Lagoon, Veracruz, Mexico.

Species	Shoreline	Swampy area	Temporal Holes
<i>Notomicrus sharpi</i>	X	X	
<i>Mesonoterus laevicollis</i>	X	X	
<i>Hydrocanthus marmoratus</i>	X	X	
<i>Suphisellus levis</i>		X	
<i>Suphisellus lineatus</i>	X	X	X
<i>Suphisellus nigrinus</i>	X	X	X
<i>Suphisellus epleri</i>		X	
<b>Total</b>	<b>5</b>	<b>7</b>	<b>2</b>

ecological knowledge of aquatic Coleoptera (Gómez-Anaya *et al.* 2004; Campbell *et al.* 2008; Arce-Pérez *et al.* 2002, 2010). Therefore, the annotated list and illustrated key presented herein will help with the recognition of most species and promote future systematic, biological, and distributional studies of aquatic beetles in the state of Veracruz.

#### AN ANNOTATED LIST OF THE NOTERIDAE FROM MIRADORES LAGOON, VERACRUZ, MEXICO

##### Subfamily Notomicrinae, New State Record *Notomicrus* Sharp, 1882, New State Record

##### *Notomicrus sharpi* Balfour-Browne, 1939, New State Record (Fig. 13)

This species is recorded from the Nearctic region (Florida, USA) and Neotropical region in Bahamas, Costa Rica, Cuba, Dominican Republic, Guatemala, Jamaica, Mexico, Panama, Puerto Rico, British Virgin Islands and Guadeloupe archipelago (Nilsson 2011; Manuel 2015). In Mexico, it is known from Oaxaca, San Luis Potosí, and Tamaulipas (Arce-Pérez and Roughley 1999).

**Material Examined.** 30-VII-1997, SM (1); 28-VIII-1997, SW (2); 21-IX-1997, SW (2); 7-XII-1997, SW (1). Also, Actopan, La Mancha Ecological Reserve (INECOL), 30-V-2002 in water lettuce (*Pistia stratiotes* L., Araceae), L. Cervantes col. 1♂ (IEXA).

##### Subfamily Noterinae Tribe Noterini

##### *Mesonoterus* Sharp, 1882, New State Record

##### *Mesonoterus laevicollis* Sharp, 1882, New State Record (Fig. 14)

This species is recorded from the Neotropics in Bolivia, Brazil, Cuba, Guatemala, Mexico, and Paraguay (Nilsson 2011).

**Material Examined.** 22-II-97, SW (11); 28-III-97, SM (8); 30, IV-97, SW (10); 18-V-97, SW (27); 26-VI-97, SW (31); 30-VII-97, SW (16); 28, VIII-97, SW (27); 21-IX-97, SW (6); 30-X-97, SW (10); 16-XI-97, SM (1); 7-XII-97, SW (8); 11-I-98, SM (1).

##### *Hydrocanthus* Say, 1823, New State Record

##### *Hydrocanthus marmoratus* Sharp, 1882, New State Record (Fig. 15)

This species is recorded from the Neotropical region in Guatemala, Mexico, and Panama (Nilsson 2011). Arce-Pérez and Roughley (1999) mistakenly

recorded this species from Veracruz, but now its presence in the state is verified.

**Material Examined.** 22-II-97, SW (1); 28-III-97, SW (9); 30, IV-97, SM (9); 18-V-97, SW (25); 26-VI-97, SW (127); 30-VII-97, SW (33); 28, VIII-97, SW (35); 21-IX-97, SW (27); 30-X-97, SW (28); 16-XI-97, SW (16); 7-XII-97, SW (3); 11-I-98, SW (7).

##### *Suphisellus* Crotch, 1873

##### *Suphisellus levis* Fall, 1909, New State Record (Fig. 16)

This species is recorded from the Neotropical region in Mexico (Nilsson 2011) in the states of Nayarit and Sinaloa (Arce-Pérez and Roughley 1999). According to Leech (1948), Fall described this species from Baja California Sur (San José del Cabo), but it has not been recorded from the peninsula since then and is questionable.

**Material Examined.** 22-II-97, SW (31); 28-III-97 SW (15); 30-IV-97, SW (70); 18-V-97, SW (74); 26-VI-97, SW (56); 30-VII-97, SW (52); 29-VIII-97, SW (198); 21-IX-97, SW (121); 30-X-97, SW (33); 16-XI-97, SW (8); 7-XII-97, SW (9); 11-I-98 SW (8).

##### *Suphisellus lineatus* (Horn, 1871) (Fig. 17)

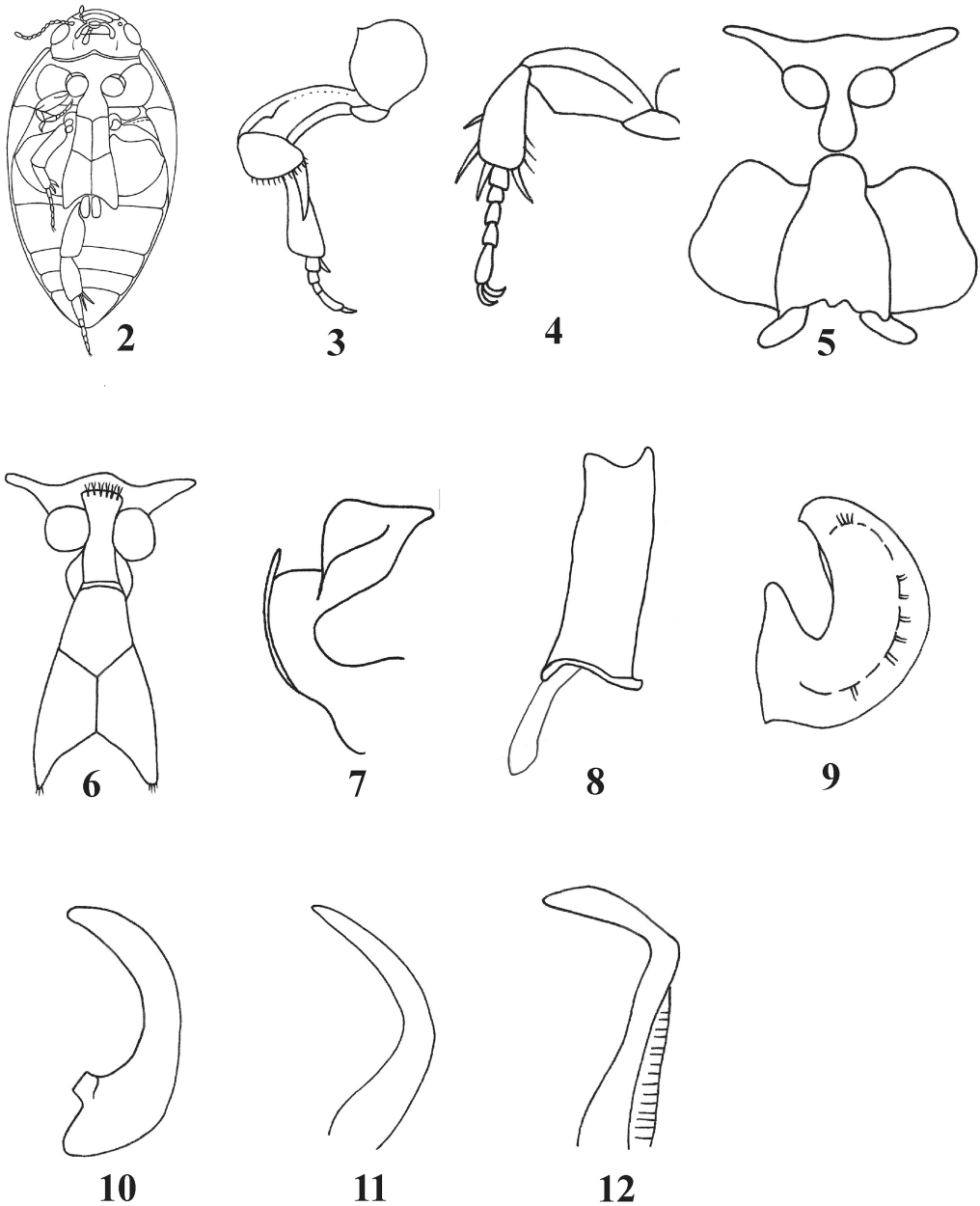
This species is recorded from the Nearctic region (Texas, USA) and in the Neotropics in Belize, Guatemala, and Mexico (Nilsson 2011). It is known from Baja California Sur, Jalisco, Michoacán, Nayarit, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Sinaloa, Sonora, Tamaulipas, and Veracruz (Córdoba and now Miradores Lagoon) (Sharp 1882).

**Material Examined.** 22-II-97, SW (53); 28-III-97, HO (15); 30-IV-97, SW (86); 18-V-97, SW (85); 26-VI-97, SW (58); 30-VII-97, SW (16); 28-VIII-97, HO (5); 21-IX-97, HO (9); 30-X-97, SW (17); 16-XI-97, SM (18); 7-XII-97, SW (46); 11-I-98, SM (13).

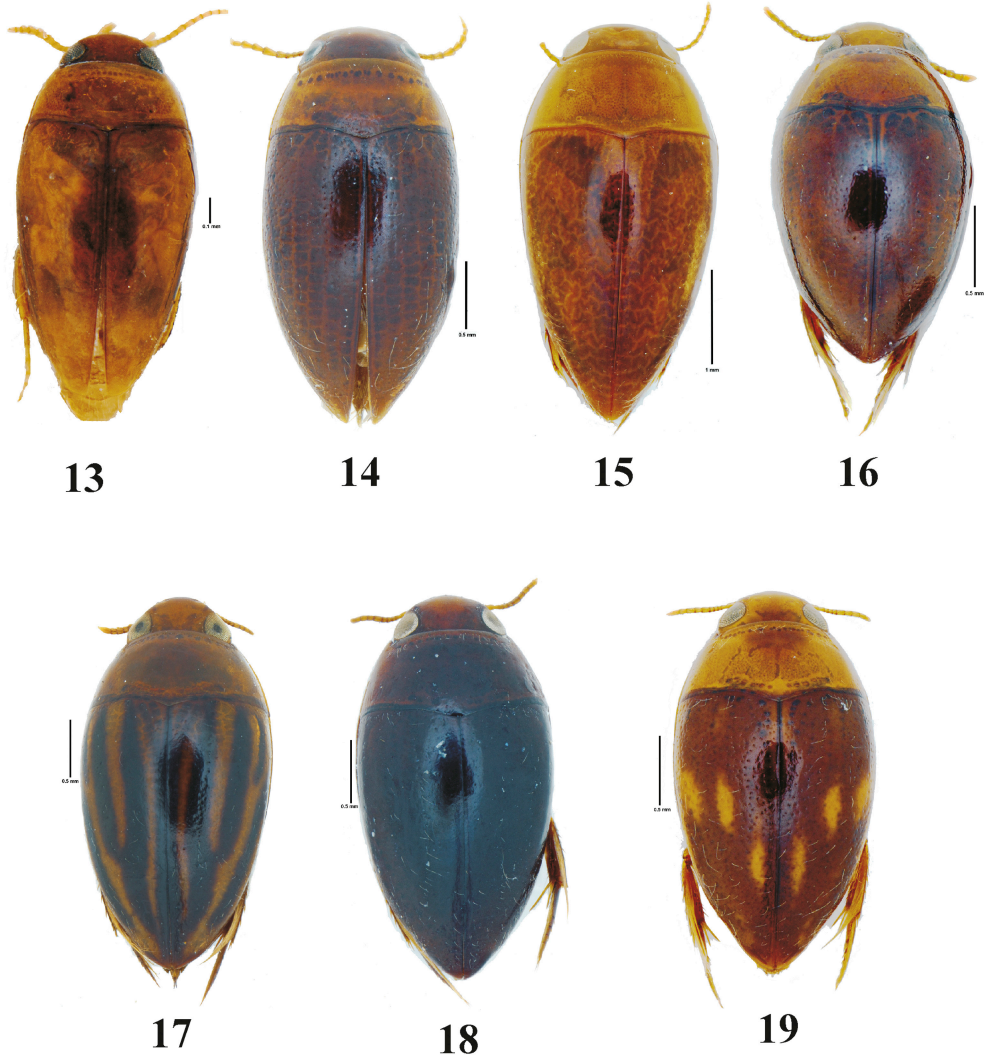
##### *Suphisellus nigrinus* (Aubé, 1838) (Fig. 18)

This species is recorded from the Neotropical region in Antigua (Lesser Antilles), Argentina, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Ecuador, Guadalupe, Guatemala, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Suriname, Trinidad, Uruguay, and Venezuela (Nilsson 2011). It is known from Campeche, Chiapas, Jalisco, Oaxaca, Quintana Roo, Tabasco, Tamaulipas, and Veracruz (no precise locality) (Arce-Pérez and Roughley 1999; Young 1979).

**Material Examined.** 22-II-97, SW (54); 28-III-97, SM (9); 30-IV-97, HO (10); 18-V-97, SW (4); 26-VI-97, SW (18); 30-VII-97, SW (30); 28-VIII-97, SM (9);



**Figs. 2–12.** Diagnostic structures of Noteridae. **2)** *Hydrocanthus* sp., ventral view **3)** *Hydrocanthus* sp., foreleg; **4)** *Notomicrus* sp., fore leg; **5)** *Mesonoterus* sp., prosternal and metacoxal processes; **6)** *Suphisellus* sp., prosternal and metacoxal processes; **7)** *Notomicrus sharpi*, median lobe; **8)** *Mesonoterus laevicollis*, median lobe; **9)** *Hydrocanthus marmoratus*, median lobe; **10)** *Suphisellus levis*, median lobe; **11)** *Suphisellus lineatus*, median lobe; **12)** *Suphisellus nigrinus*, median lobe. Fig. 2 taken from Usinger (1956); Figs. 3–4 taken from Roughley (2001); Figs. 5–6 taken from Arce-Pérez and Roughley (1999); Fig. 7 taken from Young (1978); Fig. 9 taken from Guignot (1948); Fig. 10 taken from Young (1985); Figs. 11–12 taken from Young (1979).



**Figs. 13–19.** Dorsal habitus of the Noteridae from Miradores Lagoon, Veracruz, Mexico. **13**) *Notomicrus sharpi*; **14**) *Mesonoterus laevicollis*; **15**) *Hydrocanthus marmoratus*; **16**) *Suphisellus levis*; **17**) *Suphisellus lineatus*; **18**) *Suphisellus nigrinus*; **19**) *Suphisellus epleri*.

21-IX-97, SW (12); 30-X-97, SW (35); 16-XI-97, SW (9); 7-XII-97, SW (7);, 11-I-98 SW (16).

***Suphisellus epleri* Arce-Pérez and  
Baca, 2017  
(Fig. 19)**

This species is recorded from the Neotropical region in Mexico (Arce-Pérez and Baca 2017). *Suphisellus epleri* is similar to *S. neglectus*, differing by the presence of the median lobe in lateral view less dilated towards the apex (always expanded in *S. neglectus*).

**Material Examined.** 22-II-97, SW (44); 28-III-97, SW (139); 30-IV-97, SW (81); 18-V-97, SW (110); 26-VI-97, SW (609); 30-VII-97, SW (130); 28-VIII-97, SW (357); 21-IX-97, SW (443); 30-X-97, SW (204); 16-XI-97, SW (73); 7-XII-97, SW (132); 11-I-98, SW (18).

**KEY TO THE SPECIES OF NOTERIDAE FROM  
MIRADORES LAGOON, VERACRUZ, MEXICO**  
(Adapted and modified from Guignot 1948,  
Young 1978, 1979, 1985, and Arce-Pérez and  
Roughley 1999)

1. Internal apex of front tibiae always with a large or small spur (Fig. 3); body oval and slightly convex, length exceeding 1.9 mm (Noterinae) ..... 2
- 1'. Internal apex of front tibiae without spur, with thick spines around internal margin (Fig. 4); body elongated and tapered, length not greater than 1.8 mm. Body yellow with dark brown head and fine punctation in front of eyes and clypeus; pronotum slightly reddish with slightly dark circular spots on base and center of apical region; elytra with light brown spots at base, slight rows of dots on disc (Fig. 13), length 1.4–1.5 mm; male genitalia as in Fig. 7 (Notomicrinae) .....  
..... *Notomicrus sharpi*
2. Apex of protibia with a well-developed, curved spur (Fig. 3); prosternal process apically truncate or slightly triangular (Fig. 2); metacoxal processes with a broad and deeply angular excision at apex, ending on each side with a diverging triangular process (Fig. 6); length 1.9–5.5 mm ..... 3
- 2'. Apex of protibia with a slender but conspicuous, long spur; protibia long and narrow, with outer apical angle rounded (*Mesonoterus*); prosternal process rounded (Fig. 5). Head and elytra dark yellow; pronotum pale yellow; elytra with unevenly distributed, coarse punctuation separated by twice width of punctures (Fig. 14); last abdominal ventrite strongly convex (moderately ridged in female); length 2.8–3.0 mm; male genitalia as in Fig. 8 .....  
..... *Mesonoterus laevicollis*
3. Pronotum with a line near the lateral margin, originating at base and extending entirely throughout; apex of prosternal process broad, at least 2.5–3.0 times breadth between coxae, broader than long (Fig. 2); metatibiae wide; apical maxillary palpomere truncated at apex or very slightly notched; metacoxal process with a wide, angular separation posteriorly, with short divergent, triangular processes (Fig. 2) (*Hydrocanthus*); specimens completely reddish yellow, dorsally polished and shiny; elytra darker, subcutaneously marmorated (with a diamond-shaped pattern, Fig. 15); lateral region of prosternal process and meso- and metaventrites sparsely setose; length 4.2–4.5 mm; male genitalia as in Fig. 9 .....  
..... *Hydrocanthus marmoratus*
- 3'. Pronotum with a line near lateral margin, originating from posterior angle and disappearing medially; apex of prosternal process twice width of intercoxal space, not as wide as long (Fig. 6); metatibia somewhat thin; apical maxillary palpomere broadly notched at apex; metacoxal process with a wide angular separation posteriorly, with long divergent, triangular processes (Fig. 6); length 1.9–3.5 mm (*Suphisellus*) ..... 4
4. Body short, stout, hemispherical, light yellow or reddish yellow, elytra uniformly colored or with longitudinal lighter brown spots ..... 5
- 4'. Body widest near base of elytra and tapering posteriorly; color light yellow with dark bands or completely black ..... 6
5. Venter pale yellow as appendages; head and pronotum yellow without dark areas; elytra reddish yellow (Fig. 16); length 2.1–2.3 mm; male genitalia as in Fig. 10 .....  
..... *Suphisellus levis*
- 5'. Venter reddish yellow, appendages pale yellow; head and pronotum yellow with dark shadows; elytra dark yellow elytra with 3 pale yellow, elongate-oval spots on disk; length 2.7–2.8 mm (Fig. 19) .....  
..... *Suphisellus epleri*
6. Body completely reddish yellow, elytra with 3 wide, dark, longitudinal vittae and a smaller one between the second and third (Fig. 17); length 3.2–3.5 mm; male genitalia as in Fig. 11 .....  
..... *Suphisellus lineatus*
- 6'. Body completely reddish black; head, appendages, and pronotum paler, elytra reddish black, shiny (Fig. 18); length 3.3–3.4 mm; male genitalia as in Fig. 12 .....  
..... *Suphisellus nigrinus*

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