

Description of *Mooreonuphis bidentata* a new species of Onuphidae (Annelida: Polychaeta) from the Mexican Caribbean with remarks on the distribution of the genus

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Mooreonuphis bidentata, a new species of onuphid polychaete, is newly described from the Mexican Caribbean. It was found in dead coral rocks at depths of 2.2 m and can be distinguished from its congeners by having simple filaments branchiae from chaetigers 19–24, as well as bi- and tridentate pseudocompound falcigers and large median simple tridentate hooded hooks in the first four chaetigers. Including *M. bidentata* sp. nov., the genus *Mooreonuphis* includes 19 species, which have been exclusively collected on the American coasts, mainly in tropical and temperate waters. From the Caribbean Sea, six species have been recorded. Of these, *M. bidentata* sp. nov., *M. cirrata*, *M. dangrigae* and *M. intermedia* are the only species having their locus typicus in this tropical region. A taxonomic key is presented for all the species of *Mooreonuphis* recorded from both sides of the American seas.

Keywords: Polychaeta, Onuphidae, *Mooreonuphis*, Caribbean Sea

Submitted 21 August 2012; accepted 19 September 2012; first published online 29 October 2012

INTRODUCTION

The family Onuphidae was erected by Kinberg (1865) as ‘Onuphiæa’, based on the genus *Onuphis*. The first species included in the family belonged to the genus *Nereis* (*N. tubicola* Müller, 1776, presently valid as *Hyalinoecia tubicola*). Paxton (1986) made an excellent historical revision of this family, accepting 23 valid genera with about 300 described species (Paxton, 1986; Budaeva & Fauchald, 2011). The onuphids have been reported worldwide, from all oceans and at all depths (Glémarec, 1991); their members are mostly tubicolous, ranging from a few centimetres to 3 m in length (Paxton, 1986). Since their tubes can occur in dense aggregations, these worms can be quite important in the stabilization of marine sediments (Carrera-Parra, 2009).

The genus *Mooreonuphis* was established by Fauchald (1982a) and 11 species were referred to the newly erected genus. Since then, eight new species have been added, including *M. bidentata* herein described. *Mooreonuphis* was first thought to be restricted to American waters. However, Paxton (2000) reported two yet undescribed species from Sydney, Australia, in shallow waters, although only the mention of their presence is briefly made. Seven species have been recorded from Caribbean waters: *M. bidentata* sp.

nov.; *M. cirrata* (Hartman); *M. dangrigae* (Fauchald); *M. intermedia* (Kinberg); *M. jonesi* Fauchald; *M. nebulosa* (Moore); and *M. pallidula* (Hartman). Of these, the type locality of the first four is the Caribbean.

In general, onuphids are poorly represented in the shallow waters of the Gulf of Mexico and the Caribbean, especially when compared to other areas at the same latitude but located in the Eastern Tropical Pacific (Fauchald, 1980; González-Ortiz *et al.*, 1997). Therefore, when the study of samples from the Puerto Morelos area showed that there were specimens of *Mooreonuphis* which did not correspond to any of the species so far recorded for the Caribbean, it seemed particularly interesting to analyse them and describe this new species from the Mexican Caribbean.

MATERIALS AND METHODS

The present study was based on new material collected from the Puerto Morelos fringing reef, Mexican Caribbean (20°51.319′N 86°51.798′W) in March 2010. Additional material was taken from collections made in April 2008 in Chinchorro Bank (18°34′21.4N 87°20′20.9W) Quintana Roo, Mexico. In both cases, the dead coral rocks were taken by SCUBA diving, and then fixed with a 4% formaldehyde–seawater solution. Subsequently, the rocks were fragmented to separate the organisms, which were sorted under a stereomicroscope and then preserved in 70% ethanol. The positions

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of the stations were determined by Global Positioning System (GPS).

In her detailed revision of the Onuphidae, Paxton (1986) analysed the relationships among genera but she also attempted to standardize the nomenclature of the morphological characters used under different names in this family. Her terminology modifications (Paxton, 1998), as well as those introduced by Budaeva & Fauchald (2011), are used here in the description of the new species.

The holotype and paratypes are deposited in the Colección Nacional de Poliquetos located in the Instituto de Ciencias del Mar y Limnología (ICMyL), Universidad Nacional Autónoma de México (UNAM) (CNP-ICML, UNAM; DFE.IN.061.0598).

Scanning electron microscope (SEM) photographs were taken with a JEOL JSM6360LV microscope, following standard methodology. The measurements were made for the holotype with ranges indicated in parentheses for the paratypes when appropriate. Length of body is measured without antennae or palps; body width is measured at chaetiger 10, without parapodia.

RESULTS

SYSTEMATICS

Phylum ANNELIDA Lamarck, 1809
 Family ONUPHIDAE Kinberg, 1865
 Subfamily ONUPHINAE Kinberg, 1865
 Genus *Mooreonuphis* Fauchald, 1982a
Mooreonuphis bidentata sp. nov.
 (Figures 1A–I, 2A–L)

TYPE MATERIAL

Holotype: Colección Nacional de Poliquetos, ICMyL, UNAM (CNP-ICML POH-52-001), Puerto Morelos, Quintana Roo, Mexican Caribbean, Station 6 (20°51.319'N 86°51.798'W); 3 March 2010; 2.20 m; coll. V. Solís-Weiss.

Paratypes: 4 specimens: Colección Nacional de Poliquetos, ICMyL, UNAM (CNP-ICML POP-52-001): three specimens, one of them coated with gold for SEM studies: Station 6 (20°51.319'N 86°51.798'W), Puerto Morelos, Quintana Roo, Mexican Caribbean; 3 March 2010; 2.20 m; coll. V. Solís-Weiss; and one specimen: Station 6 (18°33.23'N 87°17.95'W), San Andrés, Chinchorro Bank, Quintana Roo, Mexican Caribbean; 13 April 2008; 9 m; coll. V. Solís-Weiss.

DIAGNOSIS

Body slender, cylindrical, yellowish in preserved specimens. Prostomium short, rounded, frontal lips long and stout; two small eyes. Palpophore and ceratophores of antennae smooth, styles gradually tapering. Branchiae simple filaments from chaetigers 18–24. First 4–5 chaetigers with bi- and tridentate pseudocompound hooded falcigers, and subulate ventral cirri. Chaetigers 1–4 with large median simple tridentate hooded hooks; all falcigers and hooks with short blunt hoods. Compound spinigers from chaetigers 5–6 to 12–14. Bidentate subacicular hooded hooks from chaetigers 13–15.

DESCRIPTION

The description is based on the holotype, with variations of paratypes included. Holotype complete with 90 chaetigers,

26 mm long and 1 mm wide not including chaetae. All paratypes incomplete with 47–96 chaetigers: 22–28.8 mm long and 0.9–1.3 mm wide. Body slender, cylindrical, yellowish, with no colour pattern in organisms preserved in 70% ethanol. Prostomium short, with two long and stout frontal lips. Paired palps 0.8 mm long (1 mm in paratypes), reaching to chaetiger 1 (chaetiger 2 in a paratype). Three antennae about equal in length, with smooth ceratophores and gradually tapering styles, ending in fine tips (Figure 1A, C): median antenna 1.5 mm long (2–3 mm in paratypes) and reaching to chaetiger 4 (chaetiger 6 in a paratype), lateral antennae 1.5 mm long (2–3 mm in paratypes) reaching to chaetiger 4 (chaetiger 6 in a paratype). A small pair of eyes is located between the lateral antennae and the palps. Peristomial cirri short, inserted in the anterior margin of the peristomium, more or less between the palps and the lateral antennae (Figure 1A).

Modified parapodia (chaetigers 1 to 4–5) longer than posterior parapodia, anteroventrally directed (Figure 1A). First four chaetigers with low prechaetal lobes, and subulate postchaetal lobes (Figure 1G), later reduced, by chaetiger 12. Subulate ventral cirrus on first four chaetigers (chaetigers 1 to 4–5 in paratypes) (Figure 1F, G), replaced by glandular pad from chaetiger 5 (chaetigers 5–6 in paratypes). Branchiae as single filaments, from chaetiger 24 (chaetigers 18–24 in paratypes) (Figure 1I); at maximum development, length more than double the length of dorsal cirrus

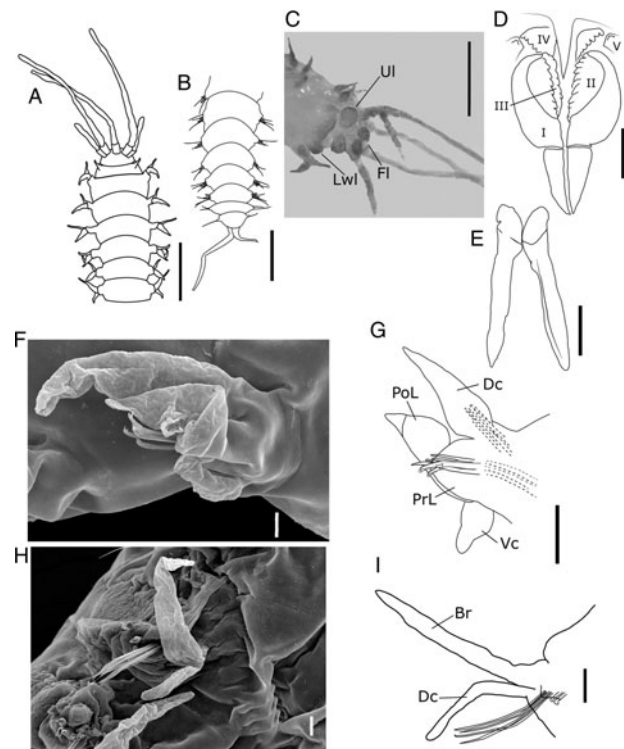


Fig. 1. *Mooreonuphis bidentata* sp. nov. (holotype): (A) anterior end, dorsal view; (B) pygidium, paratype, dorsal view; (C) anterior end, ventral view, frontal lip (Fl), upper lip (Ul), lower lip (Lwl); (D) maxillae, roman numerals = number of maxilla; (E) mandibles; (F) parapodium 3, paratype, anterior view; (G) parapodium 1, anterior view, dorsal cirrus (Dc), postchaetal lobe (PoL), prechaetal lobe (PrL), ventral cirrus (Vc); (H) parapodium 40, paratype; (I) parapodium 24, anterior view, branchia (Br), dorsal cirrus (Dc). Scale bars: A 2 mm; B 0.5 mm; C 1 mm; D, E 100 μ m; F, H, I 50 μ m; G 200 μ m.

(Figure 1H). Anterior parapodia with five very slender notoacicularae and three neuroacicularae (Figure 1G); in posterior chaetigers, acicularae reduced to two in notopodium and one in neuropodium. First four chaetigers with a large median simple tridentate hooded hook, larger and stouter than the pseudocompound hooded falcigers (Figure 2D). Chaetigers 1 to 4–5 with simple limbate chaetae, and bi- and tridentate pseudocompound hooded falcigers (Figure 2A); all falcigers and hooks with short blunt hoods: chaetiger 1 with a pseudocompound bidentate hooded falciger (1 bidentate falciger in paratypes too) (Figure 2B) and two pseudocompound tridentate hooded falcigers (2–3 tridentate falcigers in paratypes) (Figure 2C); chaetiger 2 with two pseudocompound bidentate hooded falcigers (1–2 bidentate falcigers in paratypes) and two pseudocompound tridentate hooded falcigers (2–4 tridentate falcigers in paratypes); chaetigers 3 and 4 with two pseudocompound bidentate hooded falcigers (0–2 bidentate falcigers in paratypes) and pseudocompound tridentate hooded falcigers (1–3 tridentate falcigers in paratypes); chaetiger 5 with only one pseudocompound bidentate hooded falciger (0–6 bidentate falcigers in paratypes). From chaetigers 5–6, simple limbate chaetae (Figure 2F), pectinate chaetae and compound spinigers replacing pseudocompound falcigers and simple hooks. Limbate chaetae in two fascicles (Figure 2E), inferior bundle with short chaetae, superior bundle longer and more slender (Figure 2F). Pectinate chaetae flat with about ten teeth of similar size (Figure 2K). Compound spinigers from chaetigers 5 to 12 (chaetigers 5–6

to 12–14 in paratypes) (Figures 2H, L), making holotype only specimen of the type material with compound spinigers and pseudocompound hooded falcigers in same parapodium (chaetiger 5). Pair of bidentate subacicular hooded hooks from chaetiger 13 (chaetigers 13 or 15 in paratypes), to the end of body (Figure 2I, J). Pygidium with two pairs of anal cirri (Figure 1B). Tubes not found associated with the organisms, therefore unknown.

Mandibles white, large, calcified with distally smooth cutting plates (Figure 1E). Maxillae robust and sclerotized. Maxillary formula: Mx I = 1 + 1, Mx II = 8 + 9, Mx III = 7 + 0, Mx IV = 5 + 7 and Mx V = 1 + 1 (Figure 1D).

REMARKS

The morphological characteristics and distribution of the 19 species so far recognized in the genus *Mooreonuphis* (including *M. bidentata* sp. nov.) are summarized in Tables 1 and 2. *Mooreonuphis bidentata* sp. nov., belongs to a group of 10 species with branchiae as a single filament appearing posterior to chaetiger 10. Of these, *M. exigua* from Southern California, *M. cirrata* from the Gulf of California and Ecuador, *M. guadalupensis* from north-western Mexico, *M. intermedia* from the western Atlantic, *M. jonesi* from Bermuda, and *M. dangrigae* from Belize, do not have large median simple tridentate hooded hooks. On the other hand, *M. bajacalifornica* from north-western Mexico, *M. stigmatis* from Washington, *M. veleronis* from California, and *M. bidentata* from the Mexican Caribbean, have large median simple tridentate hooded hooks at least in chaetigers 4 and 5. Therefore, *M. bidentata* sp. nov. is the first species described from the Atlantic Ocean with single filament branchiae starting posterior to chaetiger 10 and large median simple tridentate hooded hooks.

In addition, the possession of bi- and tridentate pseudocompound hooded falcigers in the first 4–5 chaetigers clearly separates *M. bidentata* sp. nov. from the other three species with large median simple tridentate hooded hooks, since in all of them only tridentate pseudocompound hooded falcigers are present. In this, *M. bidentata* sp. nov. is only similar to *M. bajacalifornica*, in having large median simple tridentate hooded hooks, pseudocompound hooded falcigers in the first 5 chaetigers and single filament branchiae around chaetiger 19; however, as mentioned above, in *M. bajacalifornica*, all the pseudocompound hooded falcigers are tridentate. Also, there are marked differences between these two species in distribution and habitat: *M. bajacalifornica* was recorded at Puerto Escondido, north-eastern Mexican Pacific, on *Spondylus princeps unicolor* (an oyster) at 30 m depth, whereas *M. bidentata* sp. nov. was found in the Mexican Caribbean Sea, in dead coral rocks at 2.2 m depth.

ETYMOLOGY

The name of this new species is due to its characteristic pseudocompound bidentate hooded falcigers, which mainly distinguishes it from other related species of *Mooreonuphis*.

TYPE LOCALITY

Puerto Morelos, Quintana Roo, Mexican Caribbean Sea.

HABITAT

The specimens of *Mooreonuphis bidentata* sp. nov. were found at 2.20 to 9 m depth on dead coral rocks.

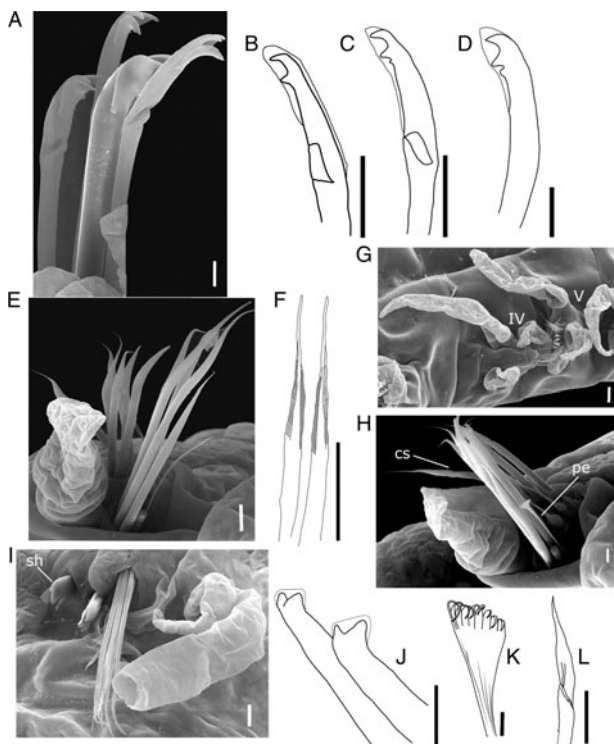


Fig. 2. *Mooreonuphis bidentata* sp. nov.: (A) pseudocompound hooded falcigers, parapodium 3, paratype; (B) pseudocompound bidentate hooded falciger; (C) pseudocompound tridentate hooded falciger; (D) large median simple tridentate hooded hook; (E) fascicles of simple limbate chaetae, parapodium 9, paratype; (F) limbate chaetae; (G) parapodia 4–5, paratype, roman numerals = number of chaetiger; (H) parapodium 8, paratype, compound spiniger (cs), pectinate chaetae (pe); (I) median parapodium, paratype, bidentate subacicular hooded hooks (sh); (J) bidentate subacicular hooded hooks; (K) pectinate chaetae; (L) compound spiniger. Scale bars: A, B, C, D, J, L 20 μm ; E, I 25 μm ; F 50 μm ; G 100 μm ; H 10 μm , K 5 μm .

Table 1. List of species in the genus *Mooreonuphis* with some comparative morphological characteristics.

Diagnostic characters	<i>M. bajacalifornica</i> De León-González, 1988	<i>M. cirrata</i> (Hartman, 1944)	<i>M. colosensis</i> Carrasco & Palma, 2003	<i>M. dangrigae</i> (Fauchald, 1980)	<i>M. elsiae</i> De León-González, 1994	<i>M. exigua</i> (Shisko, 1981)
Branchiae from chaetiger	19	17	6–7	18–21	6	14–16 (11–20)
Branchiae type	Simple filament	Simple filament	4–6 filaments	Simple filament	3 filaments	Simple filament
Pseudocompound hooded falcigers	Tridentate	Tridentate	Tridentate	Bi- and tridentate	Tridentate	Tridentate
Chaetigers with pseudocompound hooded falcigers	1–5	1–5	1–5	1–5	1–4	1–4
Chaetigers with compound spinigers	6–19	6–16	7 (6 in paratypes) to ?	6–16	6–16	4–5 to 11–15
Chaetigers with large median simple hooks	1–5	Absent	Absent	Absent	5–6	Absent
Chaetigers with cirriform ventral cirri	1–6	1–6	1–5?	4–5	4–5	3 or 4
Bidentate subacicular hooks from chaetiger	20	17	66	15–17	17	11–16
Type of aciculae	Taper to the tip	Taper to the tip	Taper to the tip	Taper to the tip	Taper to the tip	Taper to the tip
Maxillary formula	MxI = 1 + 1 MxII = 7 + 8 MxIII = 0 + 7 MxIV = 6 + 8	MxI = 1 + 1 MxII = 6 + 7 MxIII = 7 + 0 MxIV = 6 + 8 MxV = 1 + 1	MxI = 1 + 1 MxII = 8 + 8 MxIII = 8 + 0 MxIV = 6 + 8 MxV = 1 + 1	MxI = 1 + 1 MxII = 8 + 7 MxIII = 7 + 0 MxIV = 7 + 8 MxV = 1 + 1	MxI = 1 + 1 MxII = 7 + 6 MxIII = 7 + 0 MxIV = 6 + 9	MxI = 1 + 1 MxII = 6 + 6 MxIII = 7 + 8 MxIV = 7 + 8 MxV = 1 + 1
Pectinate chaetae and number of teeth	Median and posterior chaetigers; 13 teeth	7 to 10 teeth	From chaetiger 66	From chaetiger 6; 12 teeth	10–11 teeth	On most chaetigers; few teeth
Rings in ceratophores	4	5	4–5	4–5	4	3–4
Diagnostic characters	<i>M. guadalupensis</i> (Fauchald, 1968)	<i>M. intermedia</i> (Kinberg, 1865)	<i>M. jonesi</i> Fauchald, 1982b	<i>M. lineata</i> Lana, 1991	<i>M. littoralis</i> (Monro, 1933)	<i>M. microbranchiata</i> (Fauchald, 1968)
Branchiae from chaetiger	22–24	25	29	6	16–19	13
Branchiae type	Simple filament	Simple filament	Simple filament	1–6 filaments	2 filaments	2–3 filaments
Pseudocompound hooded falcigers	Bi- and tridentate	Tridentate	Tridentate	Tridentate	Tridentate	Tridentate
Chaetigers with pseudocompound hooded falcigers	1–4	1–3	1–4	1–11	1–4	1–7
Chaetigers with compound spinigers	4 to 11–13	4–13	5–13	12–22	5 to 13–14	4–11
Chaetigers with large median simple hooks	Absent	Absent	Absent	6–22	3–5	4–11
Chaetigers with cirriform ventral cirri	1–3	1–5	1–4	1 to 12–13	1–4	1–7
Bidentate subacicular hooks from chaetiger	12–13	13	14	23	13	21

Type of aciculae	Taper to the tip	Taper to the tip	Expanded tip	Taper to the tip	Taper to the tip	Taper to the tip	Taper to the tip
Maxillary formula	MxI = 1 + 1 MxII = 8 + 7 MxIII = 6 + 0 MxIV = 5 + 8 MxV = 1 + 1	?	MxI = 1 + 1 MxII = 9 + 10 MxIII = 6 + 0 MxIV = 10 + 9 MxV = 1 + 1	MxI = 1 + 1 MxII = 10 + 10 MxIII = 9 + 0 MxIV = 4 + 7 MxV = 1 + 1	MxI = 1 + 1 MxII = 7 + 7 MxIII = 7 + 0 MxIV = 6 + 10 MxV = 1 + 1	MxI = 1 + 1 MxII = 7 + 10 MxIII = 8 + 6 MxIV = 6 + 5 MxV = 1	
Pectinate chaetae and number of teeth	From chaetiger 4; few teeth	?	From chaetiger 6; 11 teeth	12–15 teeth	10 teeth	?	
Rings in ceratophores	Smooth	4–5	5	2–3	5	3	
Diagnostic characters	<i>M. nebulosa</i> (Moore, 1911)	<i>M. pallidula</i> (Hartman, 1965)	<i>M. peruana</i> (Hartman, 1944)	<i>M. segmentispadix</i> (Shisko, 1981)	<i>M. stigmatis</i> (Treadwell, 1922)	<i>M. veleronis</i> (Fauchald, 1980)	<i>M. bidentata</i> sp. nov.
Branchiae from chaetiger	6–7	6	6	7–15	19	29–30	18–24
Branchiae type	4 filaments	Simple filament	3–8 filaments	More than 4 filaments	Simple filament	Simple filament	Simple filament
Pseudocompound hooded falcigers	Tridentate	Tridentate	Tridentate	Tridentate	Tridentate	Tridentate	Bi- and tridentate
Chaetigers with pseudocompound hooded falcigers	1 to 7–8	1–5	1–5	1–4	1–3	1–3	1 to 4–5
Chaetigers with compound spinigers	7–19	6 to 17–28	6 to 19–20	4–5 to 11–16	4–16	4–13	6–6 to 12–14
Chaetigers with large median simple hooks	4–15	Absent	Absent	Absent	4–5	4 to 6–8	1 to 4
Chaetigers with cirriform ventral cirri	1 to 9–10	4–6	1–5	1–4	1–4	1–3	1 to 4–5
Bidentate subacicular hooks from chaetiger	18–20	18–29	19–20	16	16	10–14	13–15
Type of aciculae	Taper to the tip	Taper to the tip	Taper to the tip	Taper to the tip	Taper to the tip	Expanded tip	Taper to the tip
Maxillary formula	MxI = 1 + 1 MxII = 10 + 10 MxIII = 10 + 0 MxIV = 6 + 8 MxV = 1 + 1	MxI = 1 + 1 MxII = 7 + 7 MxIII = 9 + 0 MxIV = 6 + 8 MxV = 1 + 1	MxI = 1 + 1 MxII = 9 + 9 MxIII = 9 + 0 MxIV = 7 + 11 MxV = 1 + 1	MxI = falcada MxII = 8 + 8 MxIII = 8 + 10 MxIV = 7 + 10 MxV = 1 + 1	MxI = 1 + 1 MxII = 6 + 6 MxIII = 8 + 0 MxIV = 6 + 10 MxV = 1 + 1	MxII = 7 + 9 MxIII = 9 + 7 MxIV = 7 + 7 MxV = 1 + 1	MxI = 1 + 1 MxII = 8 + 9 MxIII = 7 + 0 MxIV = 5 + 7 MxV = 1 + 1
Pectinate chaetae and number of teeth	About 10 teeth	10 teeth	3–5 teeth	10 teeth	15 teeth	12 teeth	From chaetigers 5–6; about 10 teeth
Rings in ceratophores	4	4	Smooth	4	5	Smooth	Smooth

Table 2. World distribution, depth and substrate of species in the genus *Mooreonuphis* (*, type locality).

Species	Distribution	Depth	Habitat	Reference
1 <i>M. bajacalifornica</i>	*Puerto Escondido, Gulf of California, Mexican Pacific	30	On <i>Spondylus princeps unicolor</i> (oyster)	De León-González, 1988
2 <i>M. cirrata</i>	*Ángel de la Guarda Island, Gulf of California, Mexican Pacific; Gorgona Island, Colombia Florida, Gulf of Mexico; Caribbean Sea Colombian Pacific Rasa Island, Gulf of California, Mexican Pacific	20 to 40 m Intertidal	Rock and shell	Hartman, 1944 Perkins & Savage, 1975 Laverde-Castillo, 1986 Salazar-Vallejo, 1990
3 <i>M. colosensis</i>	*Punta Coloso, Antofagasta, Chile	60 m	Fine to medium sand	Carrasco & Palma, 2003
4 <i>M. dangrigae</i>	*Carrie Bow Cay and Twin Cayes, Belize Gulf of Mexico, off Tabasco and Campeche, Mexico	1.5 m 16 to 31 m	Sand, behind inner reef crest Sand; 27°C; 35.8 psu; 0.22 ml/l dissolved oxygen	Fauchald, 1980, 1982a Granados-Barba & Solís-Weiss, 1994
5 <i>M. elisiae</i>	*West of Southern Baja California, Mexican Pacific Gulf of California, Gulf of Tehuantepec, Mexican Pacific	46 to 107 m	Silty sand; 17°C;	De León-González, 1994 González-Ortiz <i>et al.</i> , 1997
6 <i>M. exigua</i>	*Southern California, USA Santa Maria Basin, off Purisima Point, California, USA Off Baja California, Mexican Pacific	41 to 319 m 65 to 139 m	Fine to coarse sand; silt and clay Sand; silt and clay	Shisko, 1981 Hilbig, 1995 Rodríguez-Villanueva <i>et al.</i> , 2003
7 <i>M. guadalupensis</i>	*Isla Guadalupe, Isla Cedros, Gulf of California, Mexican Pacific West of Southern Baja California, Mexican Pacific	Intertidal to 82 m Intertidal to 82 m	Rocks, sand	Fauchald, 1968 De León-González, 1994
8 <i>M. intermedia</i>	*Rio de Janeiro, Brazil, off the entrance to the harbour	55 to 73 m		Kinberg, 1865
9 <i>M. jonesi</i>	*Bermuda Islands	Intertidal to 1.5 m	Sand, mud-sand, <i>Thalassia</i> roots	Fauchald, 1982b
10 <i>M. lineata</i>	*Paranaguá Bay, Brazil	6 to 18 m		Lana, 1991
11 <i>M. litoralis</i>	*Conway Bay, Indefatigable Island, Galapagos Islands San Nicolas Island, California, USA	 Intertidal and 113.4 to 149.4 m	Shore pools Grey sand, mud, dead shell	Monro, 1933 Hartman, 1944
12 <i>M. microbranchiata</i>	Off Baja California, Guadalupe Island, Mexican Pacific	9 to 27 m	Rocks, sand	Fauchald, 1968, 1982a
13 <i>M. nebulosa</i>	*Monterey Bay, California, USA Off California, USA; south-western Mexico; Guatemala La Paz Bay and Asunción Island, Gulf of California, Mexican Pacific Central California to Panama; south of Los Angeles Bay, Gulf of California, Mexican Pacific South-western Gulf of California, Mexican Pacific Las Animas Island, Mexican Pacific West of Southern Baja California, Mexican Pacific Santa Maria Basin, California, USA Central and western Gulf of California, Mexican Pacific Maria Madre Island, Mexican Pacific Florida, Gulf of Mexico, Caribbean Sea	 29 to 310 m Intertidal 29 to 113 m 1228 m 27 to 129 m 19 to 142 m 22 to 92 m	Green mud, sand and gravel Mud, grey sand, corals Coarse sediment Sand, mud, orange peel grab Clayey silt to sand and gravel; 70–80% sand, 3–5% clay	Moore, 1911 Hartman, 1944, 1968 Rioja, 1962 Reish, 1968 Fauchald, 1968 Fauchald, 1972 De León-González, 1994 Hilbig, 1995 Hernández-Alcántara, 2002 Hernández-Alcántara <i>et al.</i> , 2003 Perkins & Savage, 1975

Continued

Table 2. Continued

Species	Distribution	Depth	Habitat	Reference
	California; Perlas Island, Panamá; Gulf of California, Mexican Pacific			Hartman, 1944
14 <i>M. pallidula</i>	*Off New England, USA; north-eastern South America Northern Gulf of Mexico	200 to 805 m 19 to 106 m	Coarse to fine sand, silty clay	Hartman, 1965 Gathof, 1984
15 <i>M. peruana</i>	*Independencia Bay, Perú; Secas Island, Panamá	25 to 32 m	Sand, rocks, shell	Hartman, 1944
16 <i>M. segmentispadix</i>	*Southern California, USA Santa Maria Basin, California, USA Off Baja California, Mexican Pacific	55 to 434 m 63 to 670 m	Fine to coarse sand, gravel, pebbles Silt to sand and gravel	Shisko, 1981 Hilbig, 1995 Rodríguez-Villanueva <i>et al.</i> , 2003
17 <i>M. stigmatis</i>	*Off Washington, False Bay, San Juan Island, USA Punta Pillar, San Mateo County, California, USA El Descanso, Baja California, Mexican Pacific San Juan Island, Washington, to Thurloe Bay, Baja California, Mexican Pacific	Intertidal 54 m	Sand On shells Corals	Treadwell, 1922 Hartman, 1944 Fauchald, 1968 Budaeva & Fauchald, 2010
18 <i>M. veleronis</i>	*San Clemente Island, California, USA	36 m		Fauchald, 1980, 1982a
19 <i>M. bidentata</i>	*Puerto Morelos; Chinchorro Bank, Caribbean Sea	2.2 to 9 m	On dead coral	This study, sp. nov.

DISTRIBUTION

Puerto Morelos and San Andrés, Chinchorro Bank, Quintana Roo, Mexican Caribbean Sea.

DISCUSSION

Onuphids are distributed from the littoral to deep-sea zones (Paxton, 1986), in different habitats and occasionally reach very high densities (Hsieh & Simon, 1987). In fact, it is the fourth most diverse polychaete family in the deep-sea (Paterson *et al.*, 2009). However, the genus *Mooreonuphis* seems to have a limited distribution: although Paxton (2000) reported that *Mooreonuphis* is represented in Sydney, Australia, by two yet unnamed species from shallow depths, until now, all described species of the genus have been recorded only from the American coasts (Table 2). Besides, as another indication of its restricted distribution, more than half of its species (9) have been recorded so far only from their type locality. A survey of their geographical distribution reveals that the species of *Mooreonuphis* are preferably distributed on the Pacific coasts (13 species; 68%) rather than in the Atlantic Ocean (8 species; 42%); and only the species *M. cirrata* and *M. nebulosa* have been recorded from both coasts of America (Figure 3).

Latitudinally, the genus *Mooreonuphis* is best represented in the warm-temperate regions (14 species); ten species have been recorded in tropical zones, and only *M. stigmatis* is present in cold waters from the Northern Pacific (Table 2). In the Pacific, the warm-temperate Californian Province has the higher number of species, i.e. California (5 species) and north-western Mexico (9 species) (Figure 3). Except for the Gulf of California (4 species), reports of most *Mooreonuphis* species in the Eastern Tropical Pacific come from disjunct geographical regions. On the contrary, in the Atlantic Ocean, the majority of species have been collected from

tropical areas, since the Caribbean together with the Brazilian Provinces are home to seven species of *Mooreonuphis*, while only *M. lineata* and *M. pallidula* have been reported from warm-temperate environments.

On the other hand, practically all species of *Mooreonuphis* have been recorded from shelf depths or intertidal zones: four species were found at less than 2.5 m, while the distribution range of 14 species is found between 3 and 200 m (Table 2). Despite the high diversity in the family Onuphidae in the deep-sea, only four species of *Mooreonuphis* have been recorded at depths greater than 200 m. Of those, only *M. pallidula* is also recorded on the continental slope. The species found at depths below 200 m, are characterized by large bathymetric ranges (>278 m), *M. nebulosa* being the species

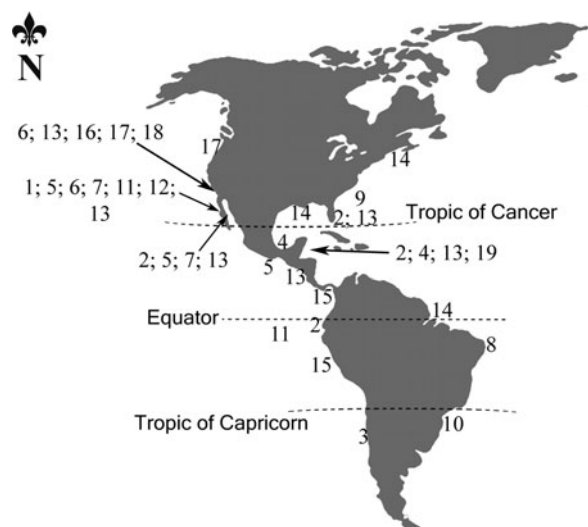


Fig. 3. World distribution of all described species of *Mooreonuphis* (numbers matching those on the list of species from Table 2).

with the largest distribution range, and the one collected at the greatest depth (1228 m), in the central region of the Gulf of California (Fauchald, 1972) (Table 2).

In summary, the distribution of the *Mooreonuphis* species shows that most of the species so far described are found in the Pacific Ocean, on the continental shelf and in warm-temperate areas. On the other hand, in vast areas of the Gulf of Mexico and South America they are not as well represented. An increased effort in sampling those areas is necessary to confirm the distribution patterns so far recognized in this genus.

KEY FOR THE SPECIES OF *MOOREONUPHIS* (AMENDED FROM FAUCHALD, 1982A)

- 1 Branchiae start on chaetigers 6 or 7 2
 - Branchiae start posterior to chaetiger 10 8
- 2 (1). All branchiae simple
 - *M. pallidula* (Hartman, 1965)
 - At least some branchiae pectinate 3
- 3 (2). Large median simple tridentate hooded hooks present 4
 - Large median simple tridentate hooded hooks absent 6
- 4 (3). Pseudocompound tridentate hooded falcigers in 4 or 8 chaetigers 5
 - Pseudocompound tridentate hooded falcigers in 11 chaetigers; large median simple tridentate hooded hooks present from chaetigers 6 to 22
 - *M. lineata* Lana, 1991
- 5 (4). Large median simple tridentate hooded hooks present on chaetigers 5 and 6 *M. elsiae* De León-González, 1994
 - Large median simple tridentate hooded hooks present from chaetigers 4 to 12–15 *M. nebulosa* (Moore, 1911)
- 6 (3). Bidentate subacicular hooded hooks present from chaetigers 16 or 19 7
 - Bidentate subacicular hooded hooks present from chaetiger 66
 - *M. colosensis* Carrasco & Palma, 2003
- 7 (6). Tridentate pseudocompound hooded falcigers in the first 5 chaetigers; bidentate subacicular hooded hooks from chaetigers 19–20 *M. peruana* (Hartman, 1944)
 - Tridentate pseudocompound hooded hooks in the first 4 chaetigers; bidentate subacicular hooded hooks from chaetiger 16
 - *M. segmentispadix* (Shisko, 1981)
- 8 (1). Branchiae with 2 or 3 filaments 9
 - All branchiae simple filaments 10
- 9 (8). Bidentate subacicular hooded hooks present from chaetiger 13 *M. littoralis* (Monro, 1933)
 - Bidentate subacicular hooded hooks present from chaetiger 21 *M. microbranchiata* (Fauchald, 1968)
- 10 (8) Expanded acicula in some anterior chaetigers 11
 - Acicula taper evenly to the tip in all chaetigers 12
- 11 (10) Expanded acicula present in chaetigers 4–8; large median simple tridentate hooded hooks present in chaetigers 4 to 6–8 *M. veleronis* (Fauchald, 1980)
 - Expanded acicula present in chaetigers 8–15; large median simple tridentate hooded hooks absent
 - *M. jonesi* Fauchald, 1982b
- 12 (10). Large median simple tridentate hooded hooks in some anterior chaetigers (usually first 5 chaetigers) 13
 - Large median simple tridentate hooded hooks absent 15
- 13 (12). All pseudocompound hooded falcigers tridentate ... 14
 - Pseudocompound hooded falcigers bi- and tridentate in the first 4–5 chaetigers *M. bidentata* sp. nov.
- 14 (13) Tridentate pseudocompound hooded hooks present in the first 3 chaetigers; compound spinigers present in chaetigers 4–16 *M. stigmatis* (Treadwell, 1922)
 - Tridentate pseudocompound hooded hooks present in the first 5 chaetigers; compound spinigers present in chaetigers 6–11 *M. bajacalifornica* De León-González, 1988
- 15 (12). Pseudocompound hooded falcigers bi- and tridentate in the first 4 or 5 chaetigers 16
 - All pseudocompound hooded falcigers tridentate 17
- 16 (15) Cirriform ventral cirri on the first 3 chaetigers; bidentate subacicular hooded hooks from chaetigers 12–13 *M. guadalupensis* (Fauchald, 1968)
 - Cirriform ventral cirri on the first 4–5 chaetigers; bidentate subacicular hooded hooks from chaetigers 15–17 *M. dangrigae* (Fauchald, 1980)
- 17 (15). Branchiae start on chaetigers 14–17 18
 - Branchiae start on chaetiger 25 *M. intermedia* (Kinberg, 1865)
- 18 (17) Cirriform ventral cirri in the first 6 chaetigers. *M. cirrata* (Hartman, 1944)
 - Cirriform ventral cirri in the first 3–4 chaetigers *M. exigua* (Shisko, 1981)

ACKNOWLEDGEMENTS

Thanks are due to all those who helped in the sampling trip to Chinchorro Bank in 2008, especially Laura Sanvicente who was a full partner in this project, together with her research group; Mari-Carmen García head of Chinchorro National Park who allowed our stay there and helped with all the logistics involved and Roberto Iglesias, head of the UASA–ICML–UNAM who facilitated the work of one of us (V.S.W.) in the Puerto Morelos area, are also thanked. Amauri Mendoza led the boat to the sampling area in Puerto Morelos. We also thank Ismael N. Cruz Pérez for the review of the specimen from Chinchorro Bank, Yolanda Hornelas for the electronic microscope photographs, and Andrea Gutiérrez Martínez and Luis E. Salgado Valverde for preparing the edition of the figures. The two anonymous referees are thanked for their comments. This research was totally financed by the Instituto de Ciencias del Mar y Limnología, UNAM.

REFERENCES

- Budaeva N. and Fauchald K. (2010) Larval development of *Mooreonuphis stigmatis* (Treadwell, 1922) (Polychaeta: Onuphidae) from the north-east Pacific. *Marine Biology Research* 6, 6–24.

- Budaeva N. and Fauchald K.** (2011) Phylogeny of the *Diopatra* generic complex with a revision of *Paradiopatra* Ehlers [sic], 1887 (Polychaeta: Onuphidae). *Zoological Journal of the Linnean Society* 163, 319–436.
- Carrasco F.D. and Palma M.** (2003) Two new species of polychaetes from the sublittoral bottoms off Antofagasta, Northern Chile: *Clymenella fauchaldi* n. sp. (Maldanidae) and *Mooreonuphis colosensis* n. sp. (Onuphidae). *Hydrobiologia* 496, 35–39.
- Carrera-Parra L.F.** (2009) Onuphidae Kinberg, 1865. In De León-González J.A., Bastida-Zavala J.R., Carrera-Parra L.F., García-Garza M.E., Peña-Rivera, Salazar-Vallejo S.I. and Solís-Weiss V. (eds) *Poliquetos (Annelida: Polychaeta) de México y América Tropical. Volumen 2*. Dirección de Publicaciones, Universidad Autónoma de Nuevo León, pp. 363–378.
- De León-González J.A.** (1988) *Mooreonuphis bajacalifornica* n. sp. a new onuphid (Polychaeta: Onuphidae) epizoic on the thorny oyster *Spondylus princeps unicolor*. *Revista de Biología Tropical* 36, 443–436.
- De León-González J.A.** (1994) Soft bottom polychaetes from the western coast of Baja California Sur, Mexico. 4. Onuphidae. *Cahiers de Biologie Marine* 35, 57–67.
- Fauchald K.** (1968) Onuphidae (Polychaeta) from Western Mexico. *Allan Hancock Monographs in Marine Biology* 3, 1–82.
- Fauchald K.** (1972) Benthic polychaetous annelids from deep waters off western Mexico and adjacent areas in the eastern Pacific Ocean. *Allan Hancock Monographs in Marine Biology* 7, 1–575.
- Fauchald K.** (1980) Onuphidae (Polychaeta) from Belize, Central America, with notes on related taxa. *Proceedings of the Biological Society of Washington* 93, 797–829.
- Fauchald K.** (1982a) Revision of *Onuphis*, *Nothria*, and *Paradiopatra* (Polychaeta: Onuphidae) based upon Type Material. *Smithsonian Contributions to Zoology* 356, 1–109.
- Fauchald K.** (1982b) Description of *Mooreonuphis jonesi*, a new species of onuphid polychaete from shallow water in Bermuda, with comments on variability and population ecology. *Proceedings of the Biological Society of Washington* 95, 807–825.
- Gathof J.M.** (1984) Family Onuphidae Kinberg, 1865. In Uebelacker J.M. and Johnson P.G. (eds) *Taxonomic guide to the polychaetes of the Northern Gulf of Mexico. Volume 6*. Mobile, AL: Barry A. Vittor and Associates, Inc., pp. 39.1–39.25.
- Glémarec M.** (1991) Bathymetric and latitudinal distribution of onuphid Polychaeta in the Bay of Biscay (north-east Atlantic). *Ophelia* Supplement 5, 547–554.
- Gonzalez-Ortiz L., Hernández-Alcántara P. and Solís-Weiss V.** (1997) Onuphidae of the Gulf of California and the Gulf of Tehuantepec, Mexican Pacific. *Bulletin of Marine Science* 60, 389–395.
- Granados-Barba A. and Solís-Weiss V.** (1994) New records of polychaetous annelids (Order: Eunicida) from the Southern Gulf of Mexico. *Bulletin of Marine Science* 54, 420–427.
- Hartman O.** (1944) Polychaetous Annelids, Pt. 5: Eunicida. *Allan Hancock Pacific Expeditions* 10, 89–95.
- Hartman O.** (1965) Deep-water benthic polychaetous annelids off New England to Bermuda and other North Atlantic areas. *Allan Hancock Foundation: Occasional Papers* 28, 1–378.
- Hartman O.** (1968) *Atlas of the errantiate polychaetous annelids from California*. Los Angeles, CA: Hancock Foundation and University of Southern California, 828 pp.
- Hernández-Alcántara P.** (2002) *Composición y estructura de las comunidades de poliquetos (Annelida: Polychaeta) bénticos de la plataforma continental del Golfo de California*. Tesis doctorado. Facultad de Ciencias, Universidad Nacional Autónoma de México, México (<http://132.248.9.9:8080/tesdig/Procesados-TESTDF/0306512/Index.html>).
- Hernández-Alcántara P., Frontana-Uribe S.C. and Solís-Weiss V.** (2003) Commented checklist of the polychaetes (Annelida: Polychaeta) from areas adjacent to islands of the Mexican Pacific and Gulf of California. *Bulletin of the Southern California Academic Science* 102, 1–16.
- Hilbig B.** (1995) Family Onuphidae Kinberg 1865. In Blake J.A., Hilbig B. and Scott P.H. (eds) *Taxonomic atlas of the benthic fauna of the Santa Maria Basin and the Western Santa Barbara Channel. Volume 5*. Santa Barbara, CA: Santa Barbara Museum of Natural History, pp. 229–244.
- Hsieh H.L. and Simon J.L.** (1987) Larval development of *Kinbergonuphis simoni*, with a summary of development patterns in the family Onuphidae (Polychaeta). *Bulletin of the Biological Society of Washington* 7, 194–210.
- Kinberg J.G.H.** (1865) *Annulata nova. Ofversigt af Kongliga Vetenskaps-Akademiens Forhandlingar (Stockholm)* 21, 559–574.
- Lana P.** (1991) Onuphidae (Annelida: Polychaeta) from south-eastern Brazil. *Bulletin of Marine Science* 48, 280–295.
- Laverde-Castillo J.J.A.** (1986) Annotated list of polychaetes (Annelida) from the Pacific Coast of Colombia, with preliminary notes on their zoogeography. *Actualidades Biológicas* 15, 123–130.
- Monro C.C.A.** (1933) The polychaeta errantia collected by Dr. C. Crossland at Colón, in the Panama Region, and the Galapagos Islands during the Expedition of the S.Y. St. George. *Proceedings of the Zoological Society of London* 1933, 1–96.
- Moore J.P.** (1911) The polychaetous annelids dredged by the U.S.S. Albatross off the coast of Southern California in 1904, III: Euphrosynidae to Goniadidae. *Proceedings of the Academy of Natural Sciences of Philadelphia* 63, 234–318.
- Paterson G.L.J., Glover A.G., Frojan C.B., Whitaker A., Budaeva N., Chimonides J. and Doner S.** (2009) A census of abyssal polychaetes. *Deep-Sea Research II* 56, 1739–1746.
- Paxton H.** (1986) Generic revision and relationships of the family Onuphidae (Annelida: Polychaeta). *Records of the Australian Museum* 38, 1–74.
- Paxton H.** (1998) The *Diopatra chiliensis* confusion—redescription of *D. chiliensis* (Polychaeta, Onuphidae) and implicated species. *Zoologica Scripta* 27, 31–48.
- Paxton H.** (2000) Family Onuphidae. In Beesley P.L., Ross G.J.B. and Glasby C.J. (eds) *Polychaetes & allies: the southern synthesis. Fauna of Australia. Volume 4A. Polychaeta, Myzostomida, Pogonophora, Echiura, Sipuncula*. Melbourne, Victoria: CSIRO Publishing, pp. 99–104.
- Perkins T.H. and Savage F.** (1975) A bibliography and checklist of polychaetous annelids of Florida, the Gulf of Mexico and the Caribbean region. *Florida Marine Research Publications* 14, 1–62.
- Reish D.J.** (1968) A biological survey of Bahía de los Angeles, Gulf of California, Mexico. II. Benthic polychaetous annelids. *Transactions of the San Diego Society of Natural History* 15, 67–106.
- Rioja E.** (1962) Estudios Anelidológicos. XXVI. Algunos anélidos poliuetos de las costas del Pacífico de México. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México* 1/2, 131–229.
- Rodríguez-Villanueva V., Martínez-Lara R. and Macías-Zamora V.** (2003) Polychaete structure of the northwestern coast of Mexico: patterns of abundance and distribution. *Hydrobiologia* 496, 385–399.
- Salazar-Vallejo S.I.** (1990) Poliuetos (Annelida: Polychaeta) de fondos blandos de Isla Rasa, Golfo de California. *Ciencias Marinas* 16, 75–85.

Shisko J.F. (1981) Five new polychaetes of the families Eunicidae and Onuphidae, collected in 1975 and 1976 during the Southern California Baseline Project. *Proceedings of the Biological Society of Washington* 94, 968–983.

and

Treadwell A.L. (1922) Polychaetous annelids collected at Friday Harbor, State of Washington in February and March, 1920. *Publication of the Carnegie Institute of Washington* 312, 171–181.

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