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## New bathymetric record for the fish bighead mora, *Laemonema verecundum* (Gadiformes: Moridae) in the Gulf of California, Mexico

### Nuevo registro batimétrico para el pez carbonero cabezón *Laemonema verecundum* (Gadiformes: Moridae) en el Golfo de California, México

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#### ABSTRACT

**Background.** The presence of *Laemonema verecundum* (Jordan & Cramer, 1897) had not been previously reported at depths less than 666 m. **Goals.** The objective of the research was to study the bathymetric distribution of *L. verecundum*. **Methods.** In the eastern continental shelf of the Gulf of California, 648 specimens of *L. verecundum* were collected during two experimental research cruises in September 2004 and February 2005. **Results.** Specimens were collected at depths between 165 and 483 m, where temperatures ranged between 9.5 and 19.9° C, and average oxygen concentration was 1.7 mg/l. **Conclusions.** This new record expands the known bathymetric distribution range of this species inhabiting shallow waters in the gulf.

**Key words:** Depth, distribution, Eastern Central Pacific, *Laemonema verecundum*, Mexico.

#### RESUMEN

**Antecedentes.** La presencia de *Laemonema verecundum* (Jordan & Cramer, 1897) no había sido reportada a profundidades menores de 666 m. **Objetivos.** El objetivo de esta investigación fue estudiar la distribución batimétrica de *L. verecundum*. **Métodos.** Se recolectaron 648 ejemplares de *L. verecundum* del talud continental oriental del Golfo de California, durante dos cruceros de investigación realizados en septiembre de 2004 y febrero de 2005. **Resultados.** Los organismos fueron colectados en un rango de profundidad de 165 a 483 m, donde la temperatura varió de 9.5 a 19.9 °C y la concentración de oxígeno disuelto promedio fue de 1.7 mg/l. **Conclusiones.** Este nuevo registro

extiende el intervalo de distribución batimétrica de esta especie, habiendo aguas menos profundas del golfo.

**Palabras clave:** Distribución, *Laemonema verecundum*, México, Pacífico oriental central, profundidad.

The bighead mora *Laemonema verecundum* (Jordan & Cramer, 1897) is a relatively poorly-known species belonging to the order Gadiformes, family Moridae. This family currently has 111 species, 17 of which belong to the genus *Laemonema* (Paulin, 1995). *L. verecundum* is an oviparous species with planktonic larvae and to date has a maximum recorded size of 11 cm (Paulin, 1995). It is mesopelagic and endemic to the Eastern Central Pacific with a distribution from 28° N to 14° N (Inada, 1995; Ambrose, 1996). Previous studies have reported the species in marine waters off Sinaloa and Jalisco, Mexico (Inada, 1995; Ambrose, 1996) and in the outer shelf and continental slope of the Gulf of California (Castro-Aguirre & Balart, 1996).

López-Martínez *et al.* (2012) have recently mentioned that the species is relatively abundant in the Gulf of California. However, a record of bathymetric distribution had only been found in deep waters from 666 to 2600 m (Bogutskaya, 2007) where hypoxia and anoxic conditions have prevailed (Hendrickx, 2001; Allen, 2008). Until now, the presence of bighead mora had not been reported at depths less than 666 m (Robertson & Allen, 2002).

The specimens (N= 648) of *L. verecundum* were captured during two research cruises onboard the BIP XII vessel in the Gulf of California in September 2004 and February 2005 (Fig. 1). Trawls were carried out at depths of 85-251, 252-419, 420-585, and 587-752 m, with a bottom trawl net of 96.5/86.4 cm length, head rope of 38 m, mesh size of 2.54

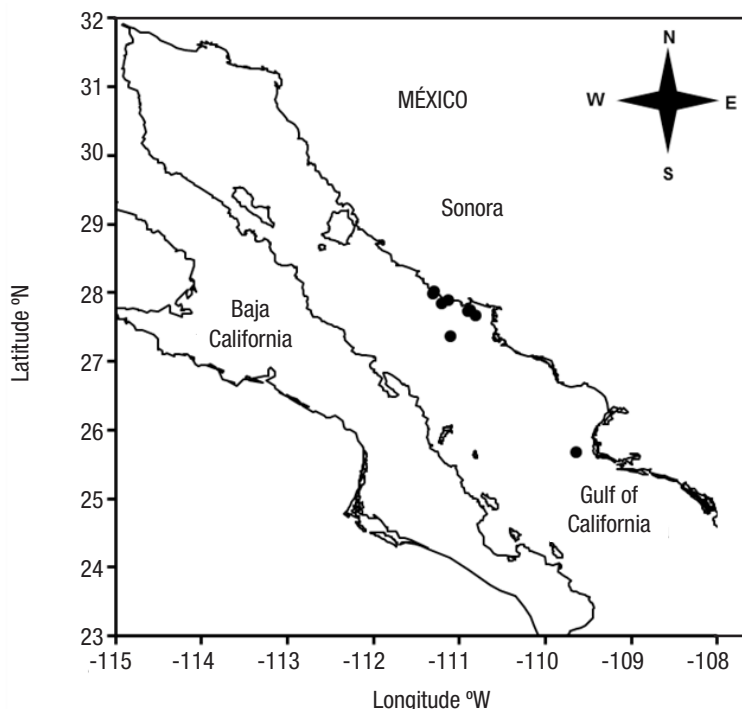


Figure 1. Study area of *Laemonema verecundum* during the exploration cruises in the Gulf of California, Mexico, during September 2004 and February 2005. Black points represent sampling stations.

cm, and mouth perimeter of 68 m; duration of hauls were about an hour at an average speed of 5 km per hour. Environmental variables, such as temperature and concentration of dissolved oxygen in the water column, were measured at each station with a CTD. A subsample of 20 kg was taken randomly and kept frozen until subsequent processing in the laboratory. Members of the family Moridae were separated and identified to species level using keys and descriptions by Fitch & Barker (1972); Paulin (1995), and Robertson and Allen (2002). *Laemonema verecundum* differs from the other members of the family in the area for having a microscopic chin; it also has a row of vomerine teeth, and the pelvic fins are reduced to two rays; the belly is without spots and devoid of scales (Inada, 1995).

Voucher specimens were fixed in 10% formaldehyde and were subsequently preserved in 70% ethanol (Fig. 2). The material was deposited at the fish collection of the Laboratory of Fisheries of the Centro de Investigaciones Biológicas del Noroeste, Unidad Sonora, Guaymas campus.

Specimens of *L. verecundum* ranged in size from 75 to 247 mm total length (TL), with an average size of 157.5 mm TL, and a modal size of 150 mm TL. Females (N = 226) ranged in size from 100 to 240 mm TL and males (N = 80) from 70 to 200 mm TL, two folds greater than the maximum length reported by Paulin (1995); 324 specimens were immature (Fig. 3, Table 1).

Table 1. Capture dates and geographical coordinates of *Laemonema verecundum* during the two research exploration cruises in the Gulf of California, Mexico. O<sub>2</sub> = oxygen, T= temperature; material examined in number of organisms, and TL = total length.

Cruise date	Throws number	Latitude °N	Longitude °W	Depth (m)	O <sub>2</sub> (mg/l)	T (°C)	Material examined
01/09/2004	6	28°09'05"	111°18'10"	165	3.70	19.9	100 (TL 75-247 mm)
01/02/2005	3	25°40'12"	109°35'21"	483	0.29	9.5	1 (TL 160 mm)
09/01/2005	11	27°45'27"	110°52'31"	214	1.81	15.0	67 (TL 87-170 mm)
11/02/2005	18	27°40'24"	110°48'28"	278	0.58	12.4	100 (TL 112-113 mm)
12/02/2005	19	27°44'26"	110°54'32"	318	0.70	12.7	90 (TL 130-215 mm)
13/02/2005	20	27°54'32"	111°08'04"	198	2.14	14.4	21 (TL 124-175 mm)
13/02/2005	21	27°51'30"	111°12'07"	285	0.47	12.0	100 (TL 115-182 mm)
12/02/2005	22	27°59'35"	111°18'18"	289	6.91	18.1	100 (TL 113-190 mm)
14/02/2005	27	27°22'13"	111°06'06"	245	0.92	11.5	69 (TL 111-240 mm)



Figure 2. Specimen of *Laemonema verecundum* (12.78 cm) collected in the Gulf of California, Mexico, during September 2004 and February 2005.

Specimens of *L. verecundum* were collected at depths from 165 to 483 m and the greatest abundance was recorded at 280 m. Temperature  $\leq 18^\circ\text{C}$  and salinity  $\leq 35.0$  were recorded at these depths, which are characteristic of the subtropical subsurface water mass (Torres-Orozco, 1993). The distribution of organisms was not homogeneous bathymetrically; 60% of the total catch was at a depth range from 260 to 300 m (Fig. 4), which was lower than zero reported by Bogutskaya (2007) by a difference of 500 m. The catch area of the organisms went from  $25^\circ 40'12''\text{ N}$  and  $109^\circ 35' 21''\text{ W}$  up to  $28^\circ 09'05''\text{ N}$  and  $111^\circ 18' 10''\text{ W}$ , based on nine stations where the species was present. The maximum catch was located between  $27^\circ 22'$  and  $27^\circ 59'$  N south of Guaymas, Sonora (Table 1). Temperature and dissolved oxygen fluctuated at these stations from  $9.5$  to  $18.1^\circ\text{C}$ , with an average of  $13.1^\circ\text{C}$ , and from  $0.29$  to  $6.9\text{ mg/l}$ , with an average of  $1.7\text{ mg/l}$ , respectively.

The minimum catch was obtained at greater depths where temperature and dissolved oxygen were at a minimum level,  $9.5^\circ\text{C}$  and  $0.29\text{ mg/l}$  (Table 1). The population structure of *L. verecundum* showed a high presence of young and adult organisms, which suggests that

this species might be established in shallower waters (a still deeper continental shelf) of the Gulf. This type of distribution changes in reports of various marine species has been attributed to the effects of global climate change. However, the presence of this species in adjacent shallower waters suggests an expansion of its distribution.

This new record of *L. verecundum* reveals the distribution and size of its population in shallower waters, contributing to the understanding of the biology and ecology of a relatively poorly known deep-sea species of the Gulf of California.

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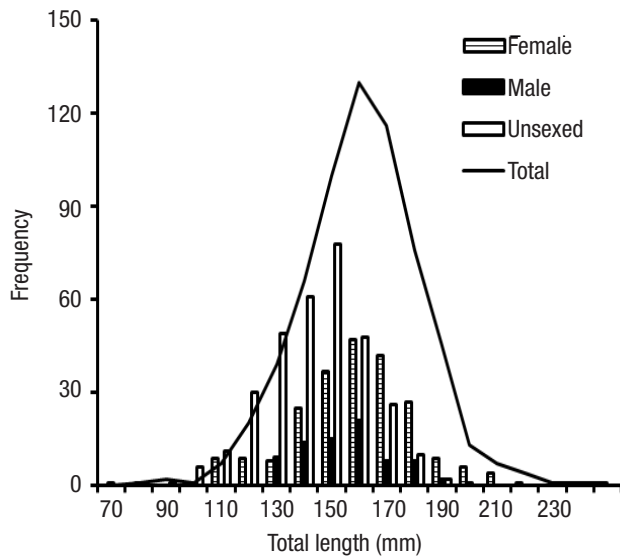


Figure 3. Size frequency by sex of *Laemonema verecundum* during the exploration cruises in the Gulf of California, Mexico, in September 2004 and February 2005.

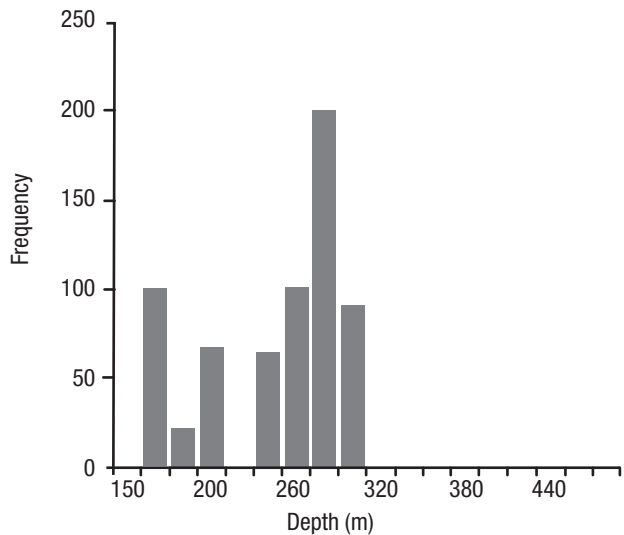


Figure 4. Organisms per hour of throws of *Laemonema verecundum* by depth during the exploration cruises in the Gulf of California, Mexico, in September 2004 and February 2005.

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