

First record and new size record for the oceanic species *Psenes sio* (Actinopterygii: Scombriformes: Nomeidae) in the northern Gulf of California, Mexico

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Abstract

The biological information for many species of the family Nomeidae is scarce, given the difficulty of capturing these species in the oceanic environment. A specimen of the twospine driftfish, *Psenes sio* Haedrich, 1970, was collected in the northern Gulf of California with a bottom trawl net at the depth of more than 250 m. This specimen represents the northernmost record of this species to date, and provides valuable information on this fish, such as maximum weight and height recorded, vertical distribution and latitudinal range, in addition to meristic counts and body morphometry.

Keywords

Mexico, oceanic fish, range extension, record size, twospine driftfish

Introduction

Marine fishes of the family Nomeidae, known as driftfishes, primarily inhabit ocean areas outside of the continental shelf in subtropical and tropical waters (Froese and Pauly 2022). This family includes three genera and 18 valid species (WoRMS Editorial Board 2022), five of which are distributed in the eastern Pacific (Haedrich 1995; Froese and Pauly 2022). Nevertheless, there is scarce biological information on many of the species in the family, given the difficulty of capturing these species in the open ocean (Allen and Robertson 1994; Haedrich 1995).

The genus *Psenes* has two slightly separated dorsal fins, the first one located above the pectoral fin; teeth may

be present in the palatine or basibranchial in some species, but never in the glossohyal, and the body is deeply to moderately elongated (Chirichigno 1974).

Particularly, the twospine driftfish, *Psenes sio* Haedrich, 1970, belongs to a group of species that bears small conical recurved teeth in the upper jaw, while the teeth in the lower jaw are laterally flattened and bladelike (Haedrich 1970). This species is distributed in the eastern Pacific, from southern Baja California, Mexico, to Peru, including most of the Gulf of California (Love et al. 2005). However, the records for this species in the Gulf of California come from samples collected by plankton hauls in the central and southern Gulf (Alhstrom et al. 1976; Aceves-Medina et al. 2003; Avendaño-Ibarra et al. 2009).

Materials and methods

One specimen of the twospine driftfish, *Psenes sio*, was collected on February 2017, between 17:08 and 18:40 hours, in the northern region of the Gulf of California in the fishing area known as *La Herradura* (30°19'54.947"N, 113°44'25.548"W) by the hake fishing fleet (Fig. 1). The fishing gear used was a bottom trawl net with 33 m head-rope, 39 m footrope, 12.7 cm body and 10.6 cm codend, pulled by a shrimp boat modified for commercial hake fishing at the depth of ~267 m.

The specimen was identified using keys and specialized catalogs (e.g., Haedrich 1970; Chirichigno 1974; Robertson and Allen 2015). X-ray images were made to observe internal structures such as the hypural plate or pharyngeal sacs. In order to broaden the biological information, body weight (0.1 g) and several body measurements (0.1 mm) were recorded, including total length, standard length, head length, snout length, eye diameter, length of the upper jaw, interorbital width, pectoral length, pelvic length, predorsal distance, preanal distance, body depth, and caudal peduncle depth, as in Horn and Haedrich (1973). Also, the gonads were observed macroscopically considering Saber et al. (2019). Finally, this specimen was fixed in a 10% solution of formaldehyde with sodium borate as a buffer and then preserved in 70% isopropyl alcohol; this

was cataloged and deposited in the ichthyological collection of the Centro Interdisciplinario de Ciencias Marinas, Instituto Politecnico Nacional, with catalog number CICIMAR-CI 8336. A review of the main ichthyological marine collections of Mexico (CICIMAR-CI, IBUNAM, CI-UABC) and the biological databases GBIF (2022), Fishnet2 (2022), and BOLD (2022) was made with the intention of obtaining more biological data.

Results

A review of the ichthyological collections and biological databases indicate that the presently reported specimen of the twospine driftfish, *Psenes sio*, is the only adult specimen of this species registered in Mexican ichthyological collections.

The specimen examined here exceeded the length and weight (335 mm TL, 282 mm SL, 325 g) of any other reported fish of this species (Table 1). The dorsal fin was slightly divided into two portions (XI + II, 27) while the anal fin featured 24 elements (II, 22), the pelvic fin six elements (I, 5), and the pectoral fin had 18 soft rays. Using X-rays it was not possible to observe internal details in the hypural complex of the caudal skeleton but the fragile forked fin comprised 9 dorsal and 8 ventral principal caudal rays.

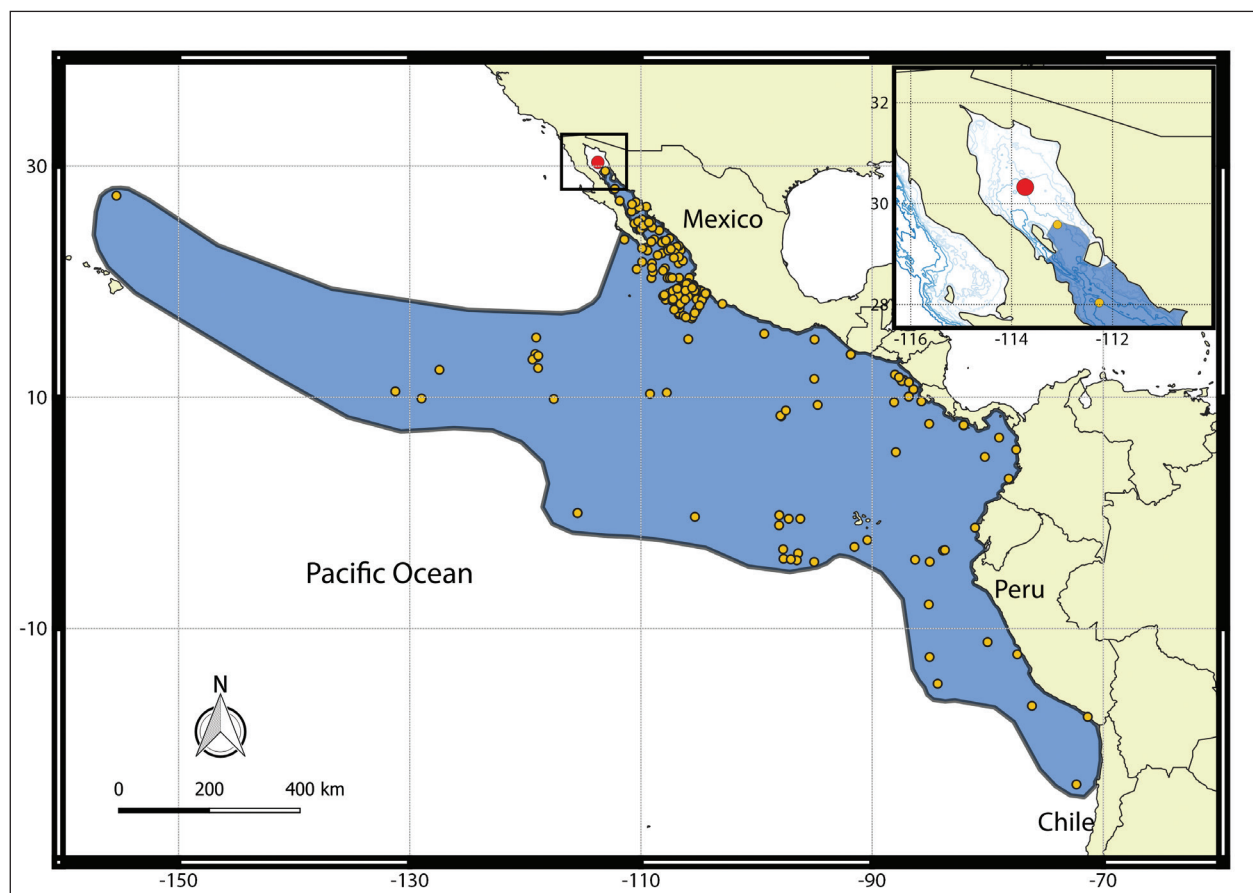


Figure 1. Previous distribution range (shaded area) with capture sites of other specimens deposited in different scientific collections (yellow dots) and collection site of the *Psenes sio* specimen (red dot), using bottom trawling in La Herradura fishing area; Gulf of California, northern zone (NGC).

The body was elongated but not strongly compressed, and the recent postmortem coloration was mainly black including all fins, except for the cephalic region where the color turned grayish (Fig. 2A). Muscles appeared firm, being intensely white below the dermis. According to the macroscopic observation of the gonad in other species of the order Scombriformes described in Saber et al. (2019), the specimen examined presented male structures that

were large, flaccid, and branched with a color from light pink to white. No scales were observed but the insertion points of scales were appreciated. The thoracic pelvic fins were located below the base of the pectoral fin.

The maxilla extended beyond the anterior margin of the pupil. The X-rays reveal two big pharyngeal sacs like a broad bean, considered by Fujita (1991) as an important feature in the cephalic region of this species (Fig. 2B).

Table 1. Morphometric measurements provided by different authors and incorporation of data from the *Psenes sio* specimen in the presently reported study, expressed as a percentage of the standard length.

Reference	Absolute values [mm]		Relative values [% SL]										
	Total length	Standard length	HL	SL	ED	LU	IW	PL	PEL	PD	PAD	BD	CP
Haedrich 1970	74.5	60.3	36.0	9.5	10.8	9.6	9.1	25.2	22.2	36.3	52.2	30.7	7.1
	>75.0	65.8	33.6	8.5	9.4	9.4	—	23.6	—	34.0	51.8	29.6	6.7
	—	43.7	30.9	—	—	—	—	25.2	26.1	35.7	49.0	30.9	7.3
	—	25.7	—	—	—	—	—	26.8	26.5	38.1	51.4	40.1	7.0
	26.5	23.4	35.9	9.0	13.2	12.8	12.0	25.2	26.1	39.7	53.8	41.0	9.4
Horn and Haedrich 1973	—	219.0	31.3	9.7	6.4	8.4	7.6	17.6	8.4	31.6	51.8	21.8	6.8
Chirichigno 1978	237.0	193.0	29.5	9.8	6.7	8.2	7.3	15.5	8.8	32.1	51.8	18.7	6.7
	167.0	134.0	28.4	9.3	7.5	9.0	8.2	18.7	13.4	27.6	52.2	21.6	6.7
	134.0	109.0	32.1	10.1	7.3	9.2	8.3	19.3	14.7	33.9	56.9	24.8	6.4
Fujita 1991	54.3	42.5	36.2	—	9.9	10.8	7.3	25.9	—	—	56.5	31.3	6.1
	54.9	42.5	—	8.5	10.1	12.0	8.9	27.5	27.1	36.0	55.8	28.9	6.6
	61.0	48.2	36.3	9.1	10.4	10.8	9.5	25.7	23.7	37.3	55.8	33.8	6.4
	61.6	49.7	34.2	9.5	11.1	11.3	9.3	25.1	22.5	35.2	—	33.6	7.0
	69.0	55.9	34.0	8.9	10.0	10.0	8.2	22.7	20.9	34.5	—	30.2	6.8
	84.1	66.7	33.6	9.3	10.0	10.3	8.2	22.9	22.9	35.1	51.6	27.9	7.0
	91.0	73.3	33.3	8.7	9.0	9.1	7.1	21.1	18.4	32.5	56.5	28.1	6.7
	172.5	143.1	31.0	9.4	7.1	8.9	8.0	19.4	10.4	32.8	52.1	22.9	7.0
178.0	144.5	28.6	9.4	6.5	7.8	6.9	19.7	10.7	29.1	49.1	22.7	6.0	
Presently reported study	335.0	281.0	28.8	9.3	5.0	9.6	8.5	11.7	5.3	32.7	52.0	27.8	9.6

TL = total length, SL = standard length, HL = head length, SL = snout length, ED = eye diameter, LU = length of upper jaw, IW = interorbital width, PL = pectoral fin length, PEL = pelvic fin length, PD = predorsal distance, PAD = preanal distance, BD = body depth, CP = caudal peduncle depth.

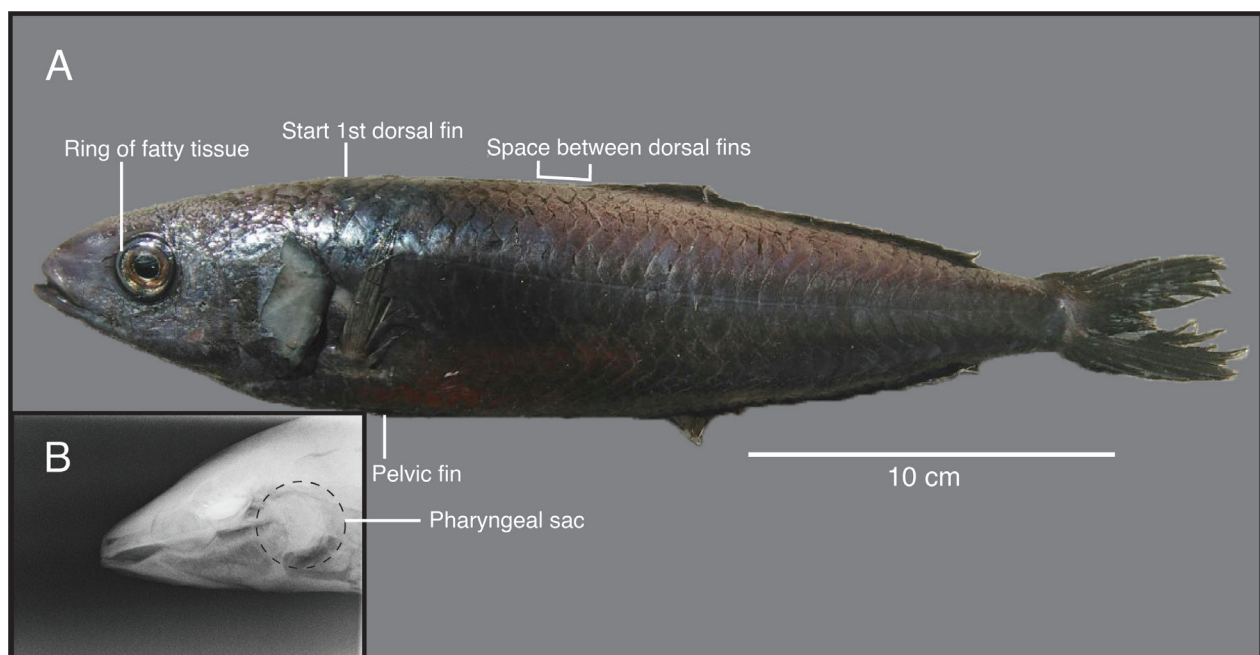


Figure 2. A) New record of *Psenes sio*, deposited in the Ichthyological Collection, Centro Interdisciplinario de Ciencias Marinas, Instituto Politécnico Nacional (CICIMAR-CI 8336), 335 mm TL, 282 mm SL; B) X-ray of the head showing the internal pharyngeal sac.

The teeth were present at both sides of the palatines and absent in the vomer and glossohyal bones. The teeth of the upper jaw were small and conical, and were conspicuously elongated like blades in the dentary, being recurved in the premaxilla. The snout was truncated and elongated (about $\frac{1}{4}$ of cephalic length).

The two dorsal fins of the specimen were divided by a conspicuous space and the iris of the eye was light brown. On the other hand, it was not possible to examine the scales, probably because they were rooted in the dermis, and detached from the skin during the fishing operation (~2 h). However, the insertion points of scales were appreciated; in the dorsal region of the head, these insertion points were evident beyond the anterior edge of the eye.

Discussion

Previous size record. Relevant literature data on the twospine driftfish, *Psenes sio*, started with the description of the species based on specimens measuring 23.4 to 60.3 mm in standard length Haedrich (1970). Subsequently, the maximum size recorded for the species (219.0 mm) was reported by Horn and Haedrich (1973). The specimens included in the Collection of Marine Vertebrates of the Scripps Institute of Oceanography (SIO) correspond to a size range of 10–230 mm in total length.

On the other hand, if the measures of the presently reported specimen are fed into the relation analysis between the body depth/standard length ratio and standard length made by Fujita (1991) with other specimens, the depth of the body decreases with growth until 60–70 mm of SL. However, it is reported by Fujita (1991) that *P. sio* maintains a constant size in the body depth from about 110 mm. With the presently reported finding it becomes evident that the current information regarding 19 specimens can be completed as more specimens are collected.

Previous distribution range. The twospine driftfish, *Psenes sio*, has been reported from the southern part of Baja California, Mexico, to Punta Doña Maria, Peru (Love et al. 2005). The diagnosis of the species was carried out by Haedrich (1970) based on five juveniles collected in the equatorial eastern Pacific Ocean. Subsequently, Horn and Haedrich (1973) recorded another specimen of the same species collected south of Cabo San Lucas, Mexico, which represented an extension of its distribution range. For his part, Fujita (1991) found 9 specimens of *P. sio* in the stomachs of the bigeye tuna, *Thunnus obesus* (Lowe, 1839), captured in equatorial latitudes. Chirichigno and Vélez (1998) examined three juvenile *P. sio* specimens caught in the sea off the Peruvian coast. Finally, there is one record of a small-size specimen with this preserved dark coloration reported in the BOLD Systems public database captured in the Nicaraguan Pacific and that has been considered in the previous distribution in BOLD (2022).

The majority of the records of nomeid fishes throughout their distribution range refer to larval or juvenile stag-

es collected with fishing gear targeting zooplankton, or as part of the stomach contents of other fish (Chirichigno and Vélez 1998; Froese and Pauly 2022). As a result, our knowledge of the biology of this species is scarce.

In Mexico, there have been a number of studies aimed at describing the diversity of the ichthyoplankton in the central area of the Mexican Pacific, near the coasts of Colima, Jalisco, and Sinaloa. These studies make reference to *P. sio* larvae, reporting that this area is part of the distribution range of the species (Franco-Gordo et al. 1999, 2003; León-Chávez et al. 2010). Particularly in the Gulf of California (GC), León-Chávez et al. (2010) report larvae of *P. sio* collected in two different zones; one of them near the coast, at the south of Cabo Corrientes where the sea surface temperature is low and chlorophyll-a concentration, is high and the other in an oceanic area with higher sea surface temperature and low chlorophyll-a concentration, both at the mouth of the GC. Within the GC, Alhstrom et al. (1976) reported a presence of larvae of *P. sio* from the southern zone (south of the Archipelago zone); in addition, these authors report juvenile specimens in the ocean area ranging from 22°N near Colima, Mexico, down to 2°S around the Galapagos Islands. Aceves-Medina et al. (2003) and Avendaño-Ibarra et al. (2014) also reported the presence of *P. sio* larvae within the GC.

Global distribution range. The southernmost capture site recorded was in oceanic waters in front of Antofagasta, northern Chile, with a specimen of 56.5 mm in total length, captured in 1975 and deposited in the Marine Vertebrate Collection of the SCRIPPS Institution of Oceanography. To the west, there is a record near the Hawaiian Islands of one specimen of 8 mm of total length, preserved at the SCRIPPS Institute. Finally, the new locality of this study represents the northernmost capture point to date of the whole distribution of the species, not only at the interior of the Gulf of California.

Another key aspect is the vertical distribution of the species. In some catalogs (i.e., Chirichigno 1978; Froese and Pauly 2022) *P. sio* is classified as an epipelagic or benthopelagic species. However, the review of fish collection databases for references of the species (SIO, MNHN) revealed several specimens collected by trawl between 100 and 479 m. With the exception of the localities when the specimens were in the larval stage, no reference has been found involving juveniles or adult specimens being clearly captured near the surface. Therefore, in addition to the depth of the specimen reported here (>250 m), these references provide evidence that this species inhabits mesopelagic or benthopelagic environments, although such a statement may be deceptive because the fishing nets with which they are captured, are open at different depths and strain the entire water column.

However, the northern zone and the upper Gulf of California show distinct conditions in terms of currents, temperature, and productivity (0.27 ms^{-1} ; $18\text{--}30.5^\circ\text{C}$; $50.40\text{--}623.80 \text{ mg of C} \times \text{m}^{-3} \times \text{d}^{-1}$, respectively) (Lavin and Marinone 2003; Mercado-Santana et al. 2017), as

well as less deep bathymetric depressions relative to other regions such as Guaymas and Carmen basins. These conditions restrain the distribution of mesopelagic ichthyofauna in this area. It has been observed that species such as *Diogenichthys laternatus* (Garman, 1899) or *Vinciguerria lucetia* (Garman, 1899) have a considerably wider distribution along the Gulf, but as far north as 29°N its distribution stops abruptly Robison (1972). Another example occurs with *Triphoturus mexicanus* (Gilbert, 1890), which dominate the mesopelagic community throughout most of the Gulf, but, apparently, on account of a limited tolerance for colder temperatures, its presence decreases significantly in the Northern Gulf (Robison 1972; Sarmiento-Lezcano et al. 2022). The above is a likely explanation for the apparent absence of *P. sio* within the list of ichthyoplankton species in the northern zone and the upper Gulf of California (e.g., Ordoñez-Guillén 2014).

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