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RESEARCH NOTE

## New depth record of the dappled flounder *Paralichthys woolmani* (Pleuronectiformes: Paralichthyidae) in the Gulf of California, México

Nuevo registro de profundidad del lenguado moteado *Paralichthys woolmani* (Pleuronectiformes: Paralichthyidae) en el Golfo de California, México

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**Abstract.** Ten specimens of the dappled flounder *Paralichthys woolmani* were captured at depths from 109 to 248.1 m in the central Gulf of California in an exploration cruise on board the research ship BIP XII in February 2005. The average temperature and dissolved oxygen concentration were 14.5°C and 1.01 mg O<sub>2</sub> L<sup>-1</sup>, respectively. *P. woolmani* had not been reported at greater depth than 100 m. This new record represents an increase of 148.1 m in its bathymetric distribution in the Gulf of California.

**Key words:** Pleuronectiformes, commercial, bathymetric distribution

### INTRODUCTION

*Paralichthys woolmani* Jordan & Williams in Gilbert, 1897 is an important commercial species captured in the continental shelf mainly from 45-80 m in depth. Its distribution has been reported from 1-100 m [Fishbase (Froese & Pauly 2016), Integrated Taxonomic Information System (ITIS)<sup>1</sup>, Biogeographic Information & Observation System (BIOS)<sup>2</sup>, Robertson & Allen 2015] ranging from southern Baja California and the Gulf of California to Peru (Robertson & Allen 2015). *P. woolmani*'s oviparous form of reproduction is pelagic, a piscivore on benthic fishes occupying a trophic level of 4.5 classified as primary predator (Palacios 2011) from the San Diegan and Panamic provinces in the Eastern-Tropical Pacific (Romero *et al.* 2008, Acevedo *et al.* 2010). It forms part of shrimp by-catch fauna in the Gulf of California fisheries (Rábago *et al.* 2007, López *et al.* 2010, 2012<sup>3</sup>; Herrera *et al.* 2015), which is why its extraction is performed by both artisanal and shrimp fleets.

### MATERIALS AND METHODS

Specimens of *Paralichthys woolmani* were captured in the central Gulf of California on board the research ship BIP XII in an exploration cruise in February 2005, temperature; dissolved oxygen and salinity concentration were recorded with an

autonomous monitoring equipment type CTD SD 204. Each throw was performed with one hour of effective trawling with a bottom trawl made with braided polyethylene with a mesh opening of 2.54 cm size 38/34 m, mouth perimeter of 68 m, and upper ropes of 38 m. The net operated astern at depths from 90-540 m, at a speed of 5.5 km h<sup>-1</sup>. Once on board the capture was emptied on deck, and 20 kg of the sample were taken at random for analyses in the Fisheries Laboratory at CIBNOR-Sonora Unit. For its identification, Hensley (1995) and Robertson & Allen (2002, 2015) keys were used and the specimen vouchers in a collection of fish of Centro de Investigaciones Biológicas del Noroeste, S.C. in La Paz, Mexico.

Main characters used to differentiate *P. woolmani*: body height 43-53% of standard length SL; head length 26-32% of SL, the dorsal fin begins over upper eye, 70-81 rays and lateral line scales 93-110.

The bathymetric distribution at depth: 1-91 m.

*Paralichthys aestuarius*: body height 43-44% of SL; head length 27% of SL; 24-31 gill rakers; dorsal fin 72-85 rays; anal fin 57-67 and the lateral line scales 96-119.

The bathymetric distribution at depth: 0-45 m.

<sup>1</sup><<http://www.itis.gov/>>

<sup>2</sup><<https://www.wildlife.ca.gov/Data/BIOS>>

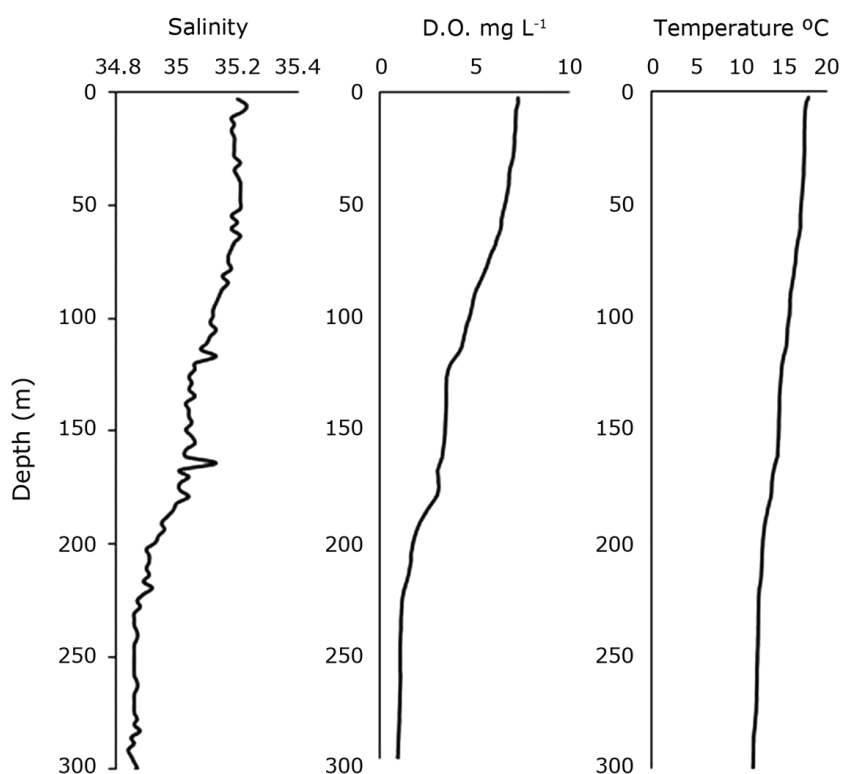
<sup>3</sup>López J, J Rodríguez, A Acevedo, E Herrera & J Rodríguez. 2012. Impacto de las actividades pesqueras en la reserva de la biosfera del Alto Golfo de California. Centro de Investigaciones Biológicas del Noroeste, S.C. Informe Final, 120 pp.

## RESULTS AND DISCUSSION

Ten *Paralichthys woolmani* individuals were captured in the coordinates shown in Table 1. The station at greatest depth (248.1 m) with positive collection was located at 28.374°N, 112.16°W, and 44 km from the coast, representing an increase of 148 m from the previously reported bathymetric distribution. Flounders showed gonads in advanced maturity stage with sizes from 15.0-29.0 cm in total length, considered as adults (Benetti *et al.* 1995). In this location, from the shallowest to the greatest depth (2.54-300 m), sea temperature varied from 17.8 to 11.76°C, while dissolved oxygen showed variations between 7.31-0.092 mL<sup>-1</sup>; also, salinity varied from 35.2 to 34.8 (Fig. 1). At 248 m, the environmental conditions were: temperature 12.01°C, salinity 34.86, and dissolved oxygen 1.01 mg L<sup>-1</sup>, with greater variations in temperature of 5.8°C and minimum variation in salinity of 0.4.

**Table 1. Record of organisms captured by station, depth, number of organisms, size and geographical position in the exploration cruise in the central Gulf of California in February 2005 / Registro de organismos capturados por estación, profundidad, número de organismos, talla y posición geográfica durante el crucero de exploración en el centro del Golfo de California en febrero 2005**

Station	Depth (m)	No. of organisms	Total length (cm)	Coordinates (Latitude - Longitude)
27	248.1	2	27.2-29.0	28.374°N-112.16°W
23	109	2	20.2-26.0	28.111°N-111.34°W
16	171	2	27.2-28.0	27.453°N-110.71°W
12	108	2	15.2-31.0	27.073°N-110.44°W
9	162	2	22.0-26.0	26.872°N-112.23°W



**Figure 1. Vertical distribution of temperature, dissolved oxygen, and salinity in the deepest station where the Dappler flounder *Paralichthys woolmani* was captured in the in-depth exploration cruise in the central Gulf of California in February 2005 / Distribución vertical de la temperatura, oxígeno disuelto, y salinidad en la estación más profunda donde se capturó a la Platija moteada *Paralichthys woolmani* durante el crucero de exploración a profundidad en el centro del Golfo de California en febrero 2005**

Hendrickx & Serrano (2010) found the oxygen minimum zone (OMZ) at 255 m depth in the central Gulf of California, that is, dissolved oxygen concentration lower than 0.5 mg L<sup>-1</sup>, which agrees with the data reported in our study. In the OMZ, the presence of the species is scarce, because species richness can be low in anoxic and hypoxic benthic bands (0-5 mg L<sup>-1</sup>). In this sense, some species have developed physiological adaptations and/or special behaviour to subsist in minimum oxygen conditions because OMZ represents a physiological barrier for vertical migration in the water column limiting these species to inhabit either above or below this zone. On the other hand, *P. woolmani* is a species showing medium resilience and duplicates its population in 4 years (Robertson & Allen 2015), which could be interpreted as reproductive success due to its adaptation to survive in low dissolved oxygen environments. In general, depth species (>200 m) show life histories type K (long life, late maturity, low fecundity, and low growth), which differs from species in the continental shelf (Hendrickx & Serrano 2010). Therefore, it is essential to know as precisely as possible its distribution and abundance to collaborate to its biological knowledge and conservation.

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