

RESEARCH NOTE

Abundance of early life stages of the surf silverside *Notocheirus hubbsi* (Teleostei, Atheriniformes) in the coastal nearshore of central Chile

Abundancia de estadios tempranos del pejerreicillo *Notocheirus hubbsi* (Teleostei, Atheriniformes) en las costas de Chile central

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Abstract. The abundance of early stages of the surf silverside *Notocheirus hubbsi* in nearshore waters of central Chile, collected in samplings set up to assess the lunar cycle during austral spring and summer is reported. A total of 19 specimens were collected with light traps, 16 larvae (7.89-16.20 mm SL) in austral spring and 3 juveniles (30.70-34.60 mm SL) in summer. Capture per unit effort (CPUE) varied from 0.33 to 2.00 ind. light trap⁻¹ night⁻¹ during the entire study period (September 2015-February 2016, and September 2016-February 2017). *N. hubbsi* catches recorded maximum abundance during the new moon and no catches during full moon.

Key words: Moon cycle, Atheriniformes, light trap, sandy beach

INTRODUCTION

The surf silversides *Notocheirus hubbsi* are small, laterally compressed and deep-bodied fish that feature singular morphological traits, such as high-positioned pectoral fins and the presence of odontodes on the dermal bones of their heads and scales (Saeed *et al.* 1994, Dyer 2000). This species is distributed from Coquimbo, Chile (south-eastern Pacific Ocean) and Puerto Deseado, Argentina (south-western Atlantic Ocean), to the southernmost limit of Tierra del Fuego (Dyer & Chernoff 1996, Carrasco *et al.* 2017, Díaz-Astudillo *et al.* 2019). In Chile, *N. hubbsi* is considered as a rare species because it has been collected only on a few occasions and unexpectedly, in light traps or intertidal pools in southern Chile (Dyer & Chernoff 1996), and from the surf zone in Argentinean Patagonia (Gosztanyi 1972). No further attempts have been reported to collect them in the surf zone. There are a few reports about the phylogeny and adult morphology for this species (Saeed *et al.* 1994, Dyer & Chernoff 1996, Saeed *et al.* 2006, Bloom *et al.* 2012). There is no available literature

on the early life history stages of this species, and the knowledge of this species' biology is sparse at best, mostly based on the Gosztanyi's works (1972) who collected 22 all female specimens, which was the highest number fished from the surf zone. This author described that this fish feeds primarily on copepods and has a reduced reproductive potential. He also described the eggs as having filaments, but none have ever been found *in situ* attached to coastal rocky reefs. Hence, there is no clue about where this species spawns nor its development at hatching.

The coastal ichthyoplankton assemblages can vary in composition and abundance, influenced by environmental factors such as the moon cycle, through tidal currents and luminosity variations (Díaz-Astudillo *et al.* 2017, 2019), therefore, it is expected that the lunar cycle may have an impact on the abundance of larval *N. hubbsi* in temperate waters. In this short communication, the temporal variation in collections of larval and juvenile *N. hubbsi*, in nearshore waters of a bay off central Chile, are described for the first time.

MATERIALS AND METHODS

Specimens were collected in the sandy El Quisco Bay (33°24'S, 71°42'W), central Chile, using light traps (CARE, Ecocean, Montpellier, France), set up weekly on a lunar basis (collected in first quarter, full moon, third quarter, and new moon) between September 2015 and February 2016 (n=16), and between September 2016 and February 2017 (n=3). Each Ecocean light trap consists of a buoyant water-tight block containing a 12 V battery and a 55 W 90 LED light, under which a 2 m long conical net was attached vertically with a 2 mm mesh and a narrow funnel in the middle.

Three light traps were deployed on the surface at sampling depths of ~20 m using a moored buoy, ~300 m from shore, and ~500 m apart from each other. The codends were removed at the end of each evening's catch (after ~8-9 hours) and treated with benzocaine (BZ-20, Veterquímica S.A., Chile) before preservation in 96% ethanol. Abundance was standardized to CPUE (capture per unit of effort, specimens per light trap⁻¹ night⁻¹). During these samplings, oceanographic, meteorological and satellite data were also registered. A detailed explanation of the sampling design is given by Díaz-Astudillo *et al.* (2019).

In the laboratory, larvae were sorted and identified according to the descriptions from Dyer (2000). All individuals were dissected for stomach content analysis, but only a few presented highly digested remains that were of no use to conduct further analyses. The largest collected individual (34.60 mm SL) was illustrated (Fig. 1).

RESULTS AND DISCUSSION

A total of 19 specimens were collected in the light traps: 16 larvae (7.89-16.2 mm SL; collected during October-December 2015) and 3 juveniles (30.70-34.60 mm SL; captured during January 2016, December 2016 and February 2017), respectively (Fig. 1).

Two specimens were severely damaged by crustacean megalopae after light-trap recovery and were not included in further analyses.

CPUE of early stages of *N. hubbsi* varied from 0.33 ± 0.57 (mean \pm SD) to 2 ± 1.73 ind. light trap⁻¹ night⁻¹, varying from 0 to 4 ind. light trap⁻¹ night⁻¹. Larvae were collected between October 20th and December 10th of 2015 (Fig. 2) and had the highest CPUE during the dark phase of the lunar cycle (new moon) (Fig. 3). No larvae were collected during the spring (September to December) of 2016. Only a few juveniles were collected, between January 19th and February 29th 2016. These catches occurred during new moon and first quarter moon (Figs. 2 and 3). The collection of *N. hubbsi* larvae and juveniles could not be attributed to any of the meteorological or oceanographic conditions registered during the samplings (see Díaz-Astudillo *et al.* 2019 for a complete description of the environmental conditions).

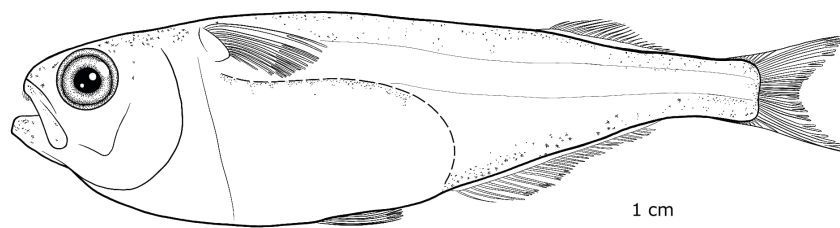


Figure 1. Specimen of surf silverside *Notocheirus hubbsi*. Drawing by Francisca Zavala-Muñoz / Ejemplar de pejerreicillo *Notocheirus hubbsi*. Dibujo de Francisca Zavala-Muñoz

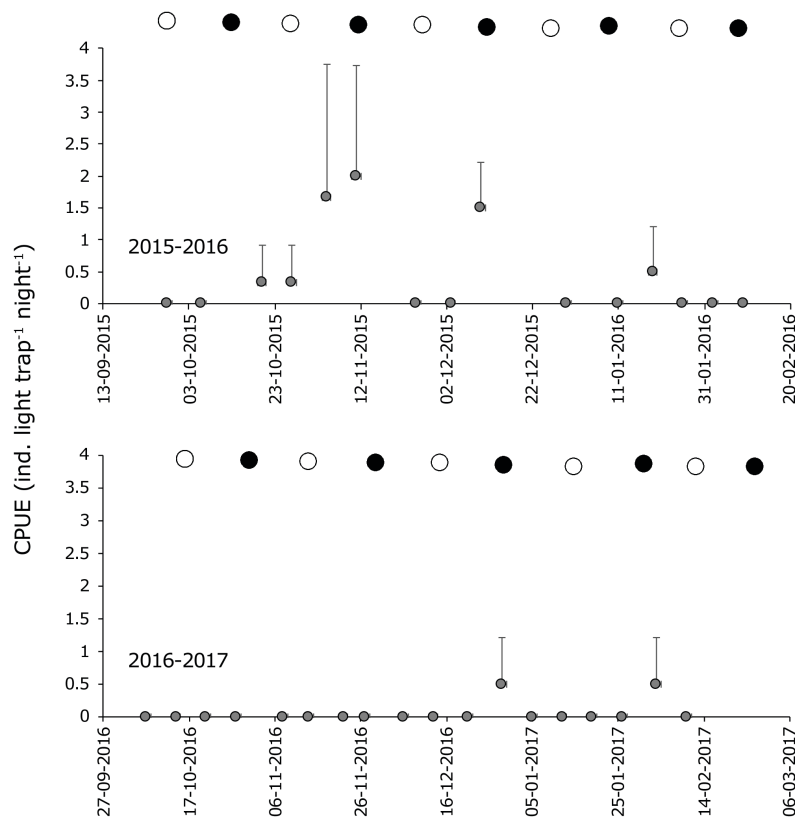


Figure 2. Temporal variation of the Capture Per Unit of Effort (CPUE, mean \pm SD) of the surf silverside, during austral Spring and Summer 2015-2016 and 2016-2017. White and black circles represent full and new moon, respectively / Variación temporal de la Captura Por Unidad de Esfuerzo (CPUE, media \pm DE) del pejerreicillo, durante primavera y verano austral de 2015-2016 y 2016-2017. Los círculos blanco y negro representan a la luna llena y nueva, respectivamente

The early stages of *N. hubbsi* were collected more frequently in mid-spring and during new moon, when there was less luminosity and the signal of the light trap could have been perceived more clearly. Clark (1937) described this species based on two adult specimens “taken around light” during February in Valparaiso harbor. Therefore, this species seems to show a positive phototaxis throughout its life history.

Larvae of *N. hubbsi* are rarely obtained in plankton samples collected in nearshore waters (~500-300 m from coast) off central Chile (Landaeta *et al.* 2009, 2015). It is plausible that their early life stages may be retained or aggregated in the surf zone of sandy beaches, where Gosztanyi successfully collected the individuals he described (Gosztanyi 1972). Due to the large physical disturbance generated by breaking waves, the surf zone creates a suitable environment for fish larvae, sheltered from predators and with an abundance of food resources (Patrick & Strydom 2014). Reportedly, *N. hubbsi* individuals have a series of morphological features that possibly reflect their adaptation to this type of environment, such as a

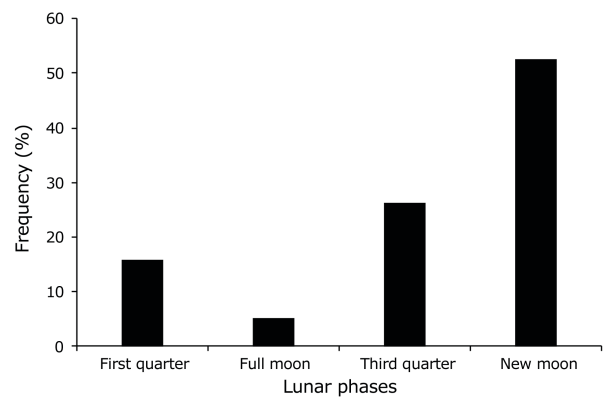


Figure 3. Frequency (%) of CPUE of the surf silverside on a lunar scale / Frecuencia (%) de la CPUE del pejerreicillo en una escala lunar

tear-drop body shape, high positioning of pectoral fins and a ventral abdominal keel (Saeed *et al.* 1994). These body-shape features were present even in the smallest collected individual (B Dyer, pers. obs.). Nonetheless, there is a lack of information about the exploitation of that habitat by *N. hubbsi* and other marine fish species from sandy beaches.

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