



Technical contribution

Length–weight relationship, parameters of growth and mortality for the hardhead halfbeak *Chriodorus atherinoides* Goode & Bean, 1882 (Beloniformes: Hemiramphidae) from Yucatan Peninsula, Mexico

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Summary

This study reports length–weight relationships and growth parameters for *Chriodorus atherinoides* from La Carbonera, a karstic tropical coastal lagoon on the northwestern coast of the Yucatan Peninsula, Mexico. A total of 667 specimens were collected between April 2009 and March 2010. The length–weight relationship obtained was $W = 0.0034L^{3.22}$. This study presents the first estimation of the model parameters of the von Bertalanffy growth equation ($L_{\infty} = 27.30$ cm, $k = 0.76$ year⁻¹ and $t_0 = -0.178$ years), the instantaneous total mortality (2.51 year⁻¹) and the maximum length record (26.0 cm total length), which is greater than previously recorded.

Introduction

Chriodorus atherinoides, a member of the Hemiramphidae family (Nelson, 1994), is known colloquially as the hardhead halfbeak and locally as “pajarito cabezidura” (Spanish). It is an important estuarine-dependent fish species of ecological importance and with a geographic distribution from Florida and the Gulf of Mexico to Cuba and Yucatan (Vega-Cendejas, 2004).

The aim of this study was to present the length–weight relationship (LWR) and to estimate the parameters of growth and mortality of *C. atherinoides* from the La Carbonera lagoon in the northwestern Yucatan Peninsula.

Materials and methods

Samples of *C. atherinoides* were collected during daytime between April 2009 and March 2010 in La Carbonera lagoon, a karstic coastal lagoon in northwestern Yucatan Peninsula, Mexico (21°13′–21°14′N; 89°52′–89°54′W). Fishes were caught with a 40 m long beach seine net (Mexican government permit No. DGOPA/04031/310510.1940). Collected specimens were euthanized in ice slurry, preserved in formaldehyde (4%) and transported to the laboratory where they were measured (± 0.1 mm) and weighed (± 0.01 g). The collected fishes were classified under three climatic seasons representing dry (March–June), rainy (July–October) and

prevailing north winds (November–February) (Bonilla-Gómez et al., 2011; Tzeek-Tuz et al., 2012).

To determine parameters a and b we used a regression analysis of log-converted total weight and total length. The 95% confidence intervals for b (CI 95%) were calculated to determine if the hypothetical value of isometry (3) fell between these intervals (Froese, 2006). Parameters of the von Bertalanffy growth function (VBGF) were determined through the ELEFAN-I software included in the package FAO-ICL ARM Fish Fisheries Stock Assessment Tools (FiSAT II) (Gayanilo et al., 1997), using length–frequency distribution with class intervals of 1.0 cm total length. The VBGF is expressed as follows: $L_t = L_{\infty} [1 - \exp^{-k(t-t_0)}]$, where L_t is the length at age t , L_{∞} is asymptotic length, k is the growth rate (year⁻¹) and t_0 is the hypothetical age of fish at length is zero.

The instantaneous rate of total mortality (Z) was determined by the length converted catch curve, which in the absence of exploitation in the area of study is equivalent to the instantaneous rate of natural mortality (M). Additionally, an independent estimate of M was carried out using the empirical equation proposed by Pauly (1983).

Results and discussion

From a total of 667 specimens of *C. atherinoides* collected during the study period, 42.4% were collected in the dry season, 24.7% in the rainy season and 32.8% during the season when north winds prevailed (Table 1). A maximum length (26.0 cm total length) was recorded in October (Fig. 1), longer than reported (25.0 cm total length) by Froese and Pauly (2013). The exponent b in the combined LWRs was not statistically different from the isometric value (t -test = -0.1932 ; $P > 0.05$). This study presents the first estimation of LWR for *C. atherinoides* on the coast of Yucatan. Since b is close to 3, a is used to interpret differences (Froese, 2006), and showing differences between climatic seasons, it was significantly higher in the north winds season.

Growth parameters for *C. atherinoides* have not been previously reported; this study provides the first report for this species on the Yucatan coast. The VBGF parameters

Table 1
Seasonal descriptive statistics and estimated parameters of length-weight relationships of *Chriodorus atherinoides* in La Carbonera lagoon, Yucatan, Mexico, April 2009–March 2010

Season	N	Total length (cm)		Total weight (g)		Regression parameters					
		Min	Max	Min	Max	<i>a</i>	<i>b</i>	SE (<i>b</i>)	CI 95% (<i>a</i>)	CI 95% (<i>b</i>)	<i>r</i> ²
Dry	283	8.5	24.4	2.37	79.2	2.825E-03	3.28	0.0283	2.687E-03–2.966E-03	3.222–3.333	0.9794
Rainy	165	10.2	26.0	4.67	84.2	4.046E-03	3.30	0.0284	3.782E-03–4.310E-03	3.245–3.357	0.9881
North Winds	219	12.2	22.5	7.81	63.9	5.174E-03	2.97	0.0745	5.033E-03–5.314E-03	2.819–3.112	0.9738
Total	667	8.5	26.0	2.37	84.2	3.457E-03	3.22	0.0206	3.354E-03–3.559E-03	3.180–3.261	0.9735

N, number of specimens considered in analysis; *a*, scaling constant; *b*, slope; CI, confidence intervals; *r*², coefficient of determination.

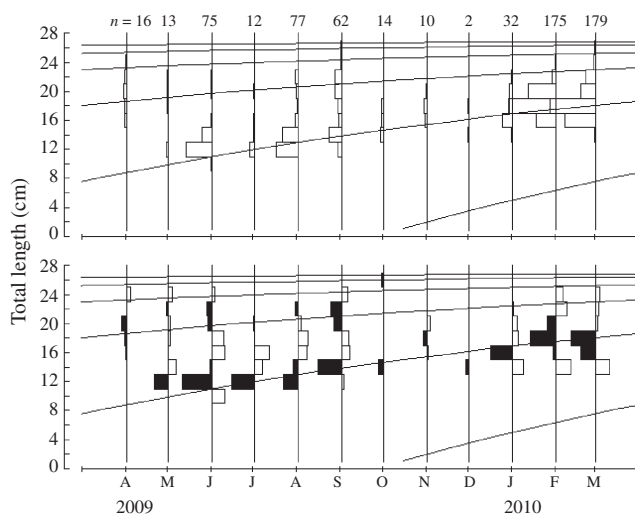


Fig. 1. Monthly growth curve variation of *Chriodorus atherinoides* based on length frequency data (above) and restructured length frequency data (below), La Carbonera, Yucatan, Mexico, computed in ELEFAN-I

were estimated as: $L_{\infty} = 27.30$ cm, $k = 0.76$ year⁻¹ and $t_0 = -0.178$ years.

The total mortality instantaneous rate (*Z*) estimated by the length converted catch curve was 1.51 year⁻¹ (1.14–1.87; 95% confidence interval). The natural mortality instantaneous rate (*M*) was 1.55 year⁻¹ in relation to the average temperature of the sampling period (28.6°C). This is the first estimate of mortality for *C. atherinoides* in the Yucatan Peninsula. Estimates of total mortality by the length converted catch curve (Pauly, 1983) are equivalent to the natural mortality rate ($Z = M$) due to the absence of fishing of this species in the study area.

Acknowledgements

This work was supported by PAPIIT (IN207609, IN213012) and FOMIX-Yucatan (103 229) research grants. Thanks to

Carmen Galindo, Korynthia López, Joel Loera, Juani Tzeek, Daniel Arceo, and Fernando Mex for their technical support during the research. We express our gratitude to Chelsea Combest-Friedman, the useful suggestions and comments from Prof. Harald Rosenthal (Editor-in-Chief, *J. Appl. Ichthyol.*) and an anonymous referee.

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