Technical contribution

Length–weight relationship and parameters of growth for the checkered puffer *Sphoeroides testudineus* from a karstic tropical coastal lagoon: La Carbonera, Yucatan, Mexico

By J. Tzeek-Tuz[1], J. L. Bonilla-Gómez[1], M. Badillo-Alemán[2] and X. Chiappa-Carrara[2]

[1]*Posgrado en Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, México D. F., México;* [2]*Unidad Multidisciplinaria de Docencia e Investigación, Facultad de Ciencias, UNAM-Sisal, Yucatán, México*

Summary

This study reports length–weight relationships and growth parameters for *Sphoeorides testudineus* from La Carbonera, a karstic tropical coastal lagoon on the northwestern coast of the Yucatan Peninsula, Mexico. A total of 461 specimens were collected between April 2009 and March 2010. The length–weight relationship was $W = 0.061Lt^{2.98}$. Model parameters of the von Bertalanffy growth equation were: $L_\infty = 29.50$ cm, $k = 0.77$ year^{-1} and $t_0 = -0.168$ years.

Introduction

Sphoeroides testudineus, a member of the Tetraodontidae family, is known colloquially as checkered puffer and locally as 'xpu' (Mayan) and 'pez globo' (Spanish). It is an important estuarine-dependent fish species of ecological and commercial importance. The checkered puffer is the dominant species in many Yucatan coastal lagoons (Arceo-Carranza and Vega-Cendejas, 2009).

The aim of this study was to present the LWR and to estimate the parameters of growth of *S. testudineus* from La Carbonera lagoon in northwestern Yucatan Peninsula.

Materials and methods

Samples of *S. testudineus* 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). 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 when there were prevailing north winds (November–February).

To determine parameters a and b, a regression analysis of log-converted total weight and total length was used. 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-ICLARM Fish Fisheries Stock Assessment Tools (FiSAT II) (Gayanilo et al., 1997), using length frequency distribution with class intervals of 2 cm of total length. The VBGF is expressed as: $Lt = L_\infty[1 - exp^{-k(t-t_0)}]$, where Lt 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 zero. The growth performance index (φ') proposed by Munro and Pauly (1983) was used.

Results and discussion

From a total of 461 of *S. testudineus* collected during the study period, 33.8% were collected in the dry season, 30.2% in the rainy season and 36% during the season when north winds prevailed (Table 1). The exponent b in the combined LWRs was not statistically different from the isometric value ($t = -0.5825$; P > 0.05); similar results for the same species were obtained by Vega-Cendejas et al. (2012). Since b is close to 3, a is the condition factor (Froese, 2006), which showed differences between climatic seasons whereby it was significantly higher in the dry season.

Table 1
Seasonal descriptive statistics and estimated parameters of length–weight relationship of *Sphoeroides testudineus* in La Carbonera lagoon, Yucatan, Mexico, April 2009–March 2010

| Season | N | Total length (cm) | | Total weight (g) | | Regression parameters | | | | | |
		Min	Max	Min	Max	a	b	SE (b)	CI 95% (a)	CI 95% (b)	r^2
Dry	156	4.09	25.60	1.70	367.60	0.0790	3.043	0.031	0.0149–0.1431	2.982–3.104	0.9843
Rainy	139	10.05	26.00	29.20	430.00	0.0437	2.918	0.048	0.0096–0.0970	2.824–3.012	0.9647
North Winds	166	4.82	26.50	2.20	388.40	0.0570	2.947	0.033	0.0144–0.1284	2.882–3.012	0.9799
Total	461	4.09	26.50	1.70	430.00	0.0611	2.978	0.020	0.0264–0.0958	2.938–3.017	0.9792

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

Growth parameters for *S. testudineus* have not been previously reported for Yucatan. The VBGF parameters were estimated as: $L_\infty = 29.50$ cm, $k = 0.77$ year^{-1} and $t_0 = -0.168$ years. Estimated equation of the VBGF for total length was: $Lt = 29.5 \, [1 - \exp^{-0.77(t - 0.168)}]$. The growth performance index (φ') was 2.75. According to these results, estimates of growth of *S. testudineus* along the northwestern coast of the Yucatan are higher than those found by Pauly (1991) in the Biscayne Bay, Florida population ($k = 0.51$ year^{-1}; φ' = 2.66). This could be related to the uncertainty associated with the growth rate (k) estimates by the length frequency analysis, or by variations in the growth rates for populations inhabiting different latitudes with particular environmental and ecological conditions.

Acknowledgements

References

Arceo-Carranza, D.; Vega-Cendejas, M. E., 2009: Spatial and temporal characterization of fish assemblages in a tropical coastal system influenced by freshwater inputs: northwestern Yucatan peninsula. Rev. Biol. Trop. **57**, 89–103.

Froese, R., 2006: Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. J. Appl. Ichthyol. **22**, 241–253.

Gayanilo, F. C., Jr; Sparre, P.; Pauly, D., 1997: The FAO-ICLARM Stock Assessment Tools (FiSAT). FAO Computerized Information Series (Fisheries). No. 8. FAO, Rome, Italy, 168pp.

Munro, J. L.; Pauly, D., 1983: A simple method for comparing growth of fishes and invertebrates. ICLARM Fishbyte **1**, 5–6.

Pauly, D., 1991: Growth of the checkered puffer Sphoeroides testudineus: postscript to papers by Targett and Pauly & Ingles. ICLARM Fishbyte **9**, 19–22.

Vega-Cendejas, M. E.; de Santillana, M. H.; Arceo, D., 2012: Length-weight relationships for selected fish species from a coastal lagoon influenced by freshwater seeps: Yucatan peninsula, Mexico. J. Appl. Ichthyol. **28**, 140–142.

Author's address: J. L. Bonilla-Gómez, Posgrado en Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Circuito exterior S/N, Ciudad Universitaria, Delegación Coyoacán, C. P. 04510, México D. F., México.
E-mail: jose.bonilla@comunidad.unam.mx