

## NOTA

### GROWTH OF ARGENTINE SILVERSIDE (*Odontesthes bonariensis*) STOCKED AT LOW DENSITIES IN TWO OLIGOHALINE SHALLOW LAKES (BUENOS AIRES PROVINCE, ARGENTINA)\*

by

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## RESUMEN

**Crecimiento del pejerrey argentino (*Odontesthes bonariensis*) sembrado a bajas densidades en dos lagunas oligohalinas de poca profundidad (Provincia de Buenos Aires, Argentina).** Pejerreyes sembrados como alevines de 45 días, a bajas densidades, en dos lagunas pampásicas oligohalinas alcanzaron el tamaño legal de captura (250 mm de longitud total) en un año y mostraron valores medios de longitud total y peso de 403 mm y 500 g al cabo de 25 meses.

## SUMMARY

Argentine silversides stocked as fry (45 days old) at low densities in two oligohaline pampasic shallow lakes grew to legal harvest size (250 mm, total length) in one year, and averaged 403 mm in length and 500 g in weight after 25 months.

**Key words:** *Odontesthes bonariensis*, Atherinidae, growth, lakes, Argentina.

**Palabras clave:** *Odontesthes bonariensis*, Atherinidae, crecimiento, lagunas, Argentina.

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## INTRODUCTION

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The Argentine silverside or *pejerrey*, a large size atherinid, is one of the most valuable game and food freshwater fish in Argentina. The original range of the species extends from the Río de la Plata and the middle and lower reaches of its main tributaries, the Paraná and Uruguay rivers, to the watercourses and shallow lakes of the Salado river basin, in Buenos Aires Province.

Starting on the first decades of the past century, when techniques for its artificial reproduction were first developed, *pejerrey* was transferred or introduced to many temperate freshwater environments throughout Argentina and its neighbour countries (Bonetto and Castello, 1985). Introduction was also made or attempted overseas. In Japan, where *pejerrey* was introduced in 1966, it is now cultured intensively in small scale for a luxury market (Del Valle, 1991; Grosman, 1995; Toda *et al.*, 1995; Mituta, 2001).

In spite of advances in the husbandry of the species achieved in Japan during the last 38 years, and of some efforts made in Argentina, survival and growth in intensive culture systems are not satisfactory (Luchini *et al.*, 1984; Strüssmann, 1989; Toda *et al.*, 1995; Berasain *et al.*, 2001). Mean weights of 250 g (pan size) are usually reached somewhere between 18 and 30 months of rearing. Extensive and semi-intensive culture alternatives are also being considered in Argentina, where there are large lakes and pond areas in regions with suitable climatic conditions (Toresani *et al.*, 1994; Reartes, 1995; López *et al.*, 2001).

Capacity of growth of *pejerrey* can be estimated from growth rates reported in studies on wild populations. However, such figures are based on indirect determinations of age through scale reading or size distribution methods, both subject to bias from several sources (Sendra and Colautti, 1997).

In this communication we present individual growth results of stocking experiments jointly performed with the aquaculture company Naturtec S. A. in two natural shallow lakes of Buenos Aires Province. Severe droughts caused massive fish kills before harvest, and prevented the obtainment of yield values. However, size at age data were available from several samplings carried out during the culture period.

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## METHODS, RESULTS AND DISCUSSION

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El Tigre (56 hm<sup>2</sup>) and El Carbón (46 hm<sup>2</sup>), two shallow oligohaline water bodies from the Atlantic watershed of Buenos Aires Province (Dangaus, 1988) were selected for the stocking experiment because of several suitable characteristics, including size, isolation, water quality, high initial zooplankton abundance, and absence of *pejerrey* populations prior to stocking. On the other hand, fish assemblages of both shallow lakes included, among other species, the *dientudo* (*Oligosarcus jenynsii*), the *tararira* (*Hoplias malabaricus*), and the *bagre sapo* (*Rhamdia sapo*), which normally prey on *pejerrey*.

Fry (45 days old, 35 mm mean total length) were obtained through artificial spawning of wild brood fish caught at Salada Grande lake (General Madariaga, Buenos Aires Province). Eggs were incubated in plastic jars with recirculating lake water at 18 °C to 21 °C. Larvae hatched between days 10 and 11, and were fed *ad libitum* with *Artemia franciscana nauplii*.

Stocking was performed in late spring in both shallow lakes. Stocking rates were 800 fry hm<sup>-1</sup> at El Tigre shallow lake and 540 fry hm<sup>-1</sup> at El Carbón shallow lake. Fry were transported in plastic bags 1/3 filled with water, inflated with oxygen, and placed in insulated boxes. For planting, bags were kept floating near the shore until temperature equilibrium was reached, and then opened. After slow mixing of transport and lake

water, fry were allowed to swim out.

Fish were sampled on 6 dates (about 8, 10, 12, 14, 19 and 25 months after stocking) with a gill-net gang composed of four meshes (20 mm, 25 mm, 30 mm and 35 mm, bar measure). Larger mesh nets and long lines were also occasionally used to sample large predatory fish (*H. malabarius* and *R. sapo*).

**Environmental conditions**

As a consequence of the exceptional drought conditions that prevailed during the end of the second year and the beginning of the third, maximum water depths dropped from 1.7 m at El Tigre shallow lake and 1.5 m at El Carbón shallow lake to 0.40 m and 0.35 m, respectively. At the same time, the concentration of the dissolved solids produced increases in conductivity from 3,970  $\mu\text{S cm}^{-1}$  to 16,700  $\mu\text{S cm}^{-1}$  at El Tigre, and from 3,600  $\mu\text{S cm}^{-1}$  to 16270  $\mu\text{S cm}^{-1}$  at El Carbón. In both shallow lakes pH values raised from 8.5 to about 9.5.

**Predation**

*Pejerrey* was frequently found in the stomach contents of *tararira* and *bagre sapo* sampled during the experiment. Predation, although not quantified, may have considerably lowered *pejerrey* density in both shallow lakes.

**Individual growth**

Fitting of the von Bertalanffy growth curve to total length (TL) data of fish from El Tigre shallow lake (Figure 1) with the nonlinear procedure provided in the Statistica® package (Newton algorithm), resulted in the equation:

$$TL_t = 525.7 (1 - e^{-0.6019(t+0.1395)})$$

$$r^2 = 0.881; n = 129$$

Data from El Carbón shallow lake were insufficient to fit a growth curve, but available mean

lengths at age were similar to those from El Tigre shallow lake (Table 1).

Final weights of fish sampled at El Tigre shallow lake ranged between 330 g and 800 g, with a mean of 500.3 g; all included in the range of commercial sizes.

The length-weight relationship derived from individuals of both sexes from El Tigre shallow lake was found to be:

$$W(g) = 3.618 \times 10^{-6} \times TL(mm)^{3.123}$$

$$r^2 = 0.960; n = 129$$

The regression of total length on standard length (SL), calculated for comparison purposes with results from other sources, was the following:

$$SL(mm) = 3.733 + 0.8198 \times TL(mm)$$

$$r^2 = 0.994; n = 152$$

Lengths and weights at age from this stocking experiment (Table 1) are similar to the higher values reported in studies on natural populations (Boschi and Fuster de Plaza, 1959; Burbidge *et al.*, 1974; Freyre, 1976; Freyre *et al.*, 1966, 1983, 1997; Loubens and Osorio, 1988, Sverlij and Mestre, 1991; Sendra and Colautti, 1997), in which ages

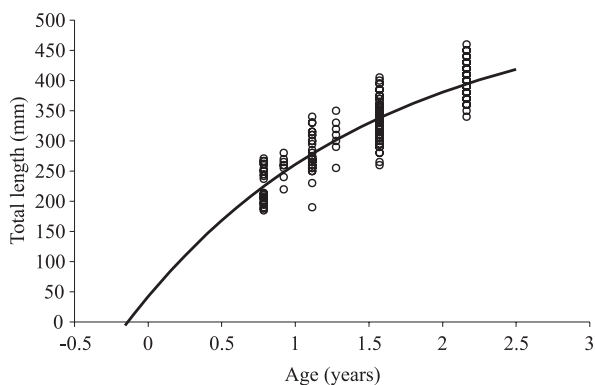


Figure 1. Von Bertalanffy growth curve fitted to *pejerrey* total length data from El Tigre shallow lake.

Figura 1. Curva de crecimiento de von Bertalanffy ajustada a los datos de longitud total de los *pejerreyes* muestreados en la laguna El Tigre.

Table 1. Observed mean lengths and weights of argentine silverside in two shallow lakes of Buenos Aires Province. Range and N between brackets.

Tabla 1. Datos de longitud y peso medio de pejerrey observados en dos lagunas de la Provincia de Buenos Aires. Rango y N entre paréntesis.

Age (years)	El Tigre		El Carbón	
	Mean total length (mm)	Mean weight (g)	Mean total length (mm)	Mean weight (g)
0.78	225.4 (185-271) (24)	89.0 (38-149) (11)	242.4 (217-265) (17)	
0.92	257.5 (220-280) (8)	121.1 (73-163) (8)		
1.12	279.9 (190-340) (32)		286.7 (255-320) (12)	
1.28	307.9 (255-350) (7)		290.7 (250-330) (28)	
1.57	336.3 (260-405) (111)	307.1 (250-400) (111)	355.0 (325-395) (27)	311.1 (200-450) (27)
2.16	403.0 (340-460) (89)	500.3 (330-800) (87)		

were estimated by scale reading or length distribution analysis, and thus supporting their validity.

These results confirm that in favourable conditions, which likely include ample space and good quality natural food availability, *pejerrey* shows a capacity of growth that, although moderate, is comparable to those reported for several other cultured freshwater fish. It is probable, then, that better growth results in culture situations could be attained through the improvement of husbandry procedures. Though conditions were not optimal throughout the present experiment, and higher growth rates may be expected, our results can be used as conditional reference figures for the evaluation of growth performance in *pejerrey* culture trials.

## ACKNOWLEDGEMENTS

The authors gratefully acknowledge the cooperation of Naturtec S. A. We are also indebted to Lauce Freyre and two anonymous reviewers for their useful comments.

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*Recibido: 04-09-03*  
*Aceptado: 16-03-05*