

Symposium: BIOLOGY AND CULTURE OF SILVERSIDES (PEJERREYES)

Production of “pejerrey” *Odontesthes argentinensis* fingerlings: A review of current techniques

LUÍS ANDRÉ SAMPAIO

Fundação Universidade Federal do Rio Grande, Departamento de Oceanografia, Laboratório de Maricultura, Caixa Postal 474. 96.201-900 - Rio Grande, RS, Brasil.

Key words: aquaculture, reproduction, larviculture, Atherinopsidae

The marine “pejerrey” *Odontesthes argentinensis* is a valuable marine fish resource in Southern South America, and its culture is considered promising. Several aspects related to the culture of *O. argentinensis* have been studied and the objective of this work is to review the techniques currently available for reproduction, incubation, larviculture and fingerling production.

Reproduction

O. argentinensis is a partial spawner, its breeding season extends from late winter to the end of spring. The eggs, which average 2 mm in diameter and have several attachment filaments, are laid in entangled clutches. Fecundity is low, a 300 g female spawns less than 5,000 eggs per spawning. Fertilized eggs can be obtained: (1) from the wild; (2) through artificial fertilization of wild captured broodstock; or (3) from natural spawning of captive broodstock.

(1) Egg clutches stick to substrates available in the

sea (fishing nets, shells, wood sticks), giving the marine pejerrey the possibility to have its eggs launched to the coast, where they lay in the sand and are exposed to the air (Phonlor and Vinagre, 1989), a unique characteristic among the Southern West Atlantic coast fish. These eggs remain viable for 3-4 days and they can be easily collected by hand, taken to the hatchery and incubated, providing an ample source of larvae.

(2) Wild broodstock are captured by beach seine and carefully stocked into holding tanks, where they are kept until arriving in the hatchery. Artificial fertilization can also be done in the field, and in this case the eggs are transported to the hatchery in small buckets with sea water. In the hatchery, fish are immediately sexed and gametes are hand stripped. No hormonal induction is used for ovulation, as only naturally ovulated females are selected for artificial fertilization. Milt from two males is collected in a syringe and the ova are released into a bowl, the spermatozoa are activated with a few drops of sea water immediately before it is added to the ova. The newly fertilized eggs are washed with running sea water and taken to the incubation room.

The fertilization rate is influenced by the salinity of the spawning media. Fertilization is hampered in fresh water, in salinities of 5‰ the fertilization rate achieves only 12%, but between 10 and 30‰ the fertilization rate averages 90% (Sampaio, 1992).

Address correspondence to: Luís André Sampaio. Fundação Universidade Federal do Rio Grande, Departamento de Oceanografia, Laboratório de Maricultura, Caixa Postal 474, CEP 96201-900, Rio Grande, RS, BRASIL.
Fax: (+55-53) 3236-8042. E-mail: sampaio@mikrus.com.br
Received on December 27, 2004. Accepted on June 1, 2005.

(3) Pejerrey born in captivity were reared outdoors during 18 months. One group of fish was transferred to the laboratory and stocked into a one ton circular tank. After a couple of months, naturally fertilized eggs were obtained on a daily basis. During the spawning period, water temperature was 23-24°C, salinity ranged between 30 and 34‰, and the photoperiod was set to 14 hours of light and 10 hours of darkness.

Incubation

The embryonic development of *O. argentinensis* is slow, depending on the temperature and the salinity larvae will take from 10 up to 16 days to hatch. Time for hatching is inversely proportional to the temperature, eggs maintained at 18°C take 16 days to hatch, and those kept at 26°C will hatch 13 days after the fertilization. The hatching rate at 26°C is about 55%, higher hatching rates are observed at lower temperatures (18-23°C) reaching 80-100% depending on the quality of individual batches (Sampaio, 1992; Sampaio and Pisseti, 2001).

The effects of salinity on *O. argentinensis* eggs resemble those on fertilization. The hatching rates for eggs incubated at salinities between 10 and 30‰ are above 90%, but the hatching rate decreases to 70% in low salinity water (5‰). The negative effect of low salinity water was probably more pronounced up to two days after the fertilization, as no further deaths were observed among embryos that survived this period (Sampaio, 1992).

Considering the results of the studies described above, it is recommended that incubation of *O. argentinensis* eggs should be carried out at 23°C in sea water (30‰).

Larviculture and Fingerling Production

Notochord length at hatching is between 7-8 mm, at this point larvae are already well formed, with pigmented eyes and a functional digestive tract, allowing them to prey directly on *Artemia* nauplii, thus dispensing the labour intensive culture of rotifers (Phonlor and Vinagre, 1989).

Larvae will die of starvation 12 days after hatching if kept without food, but recrudescence of growth will be observed if *Artemia* nauplii are provided as late as 9 days after hatching (Phonlor and Vinagre, 1989). Prolonged starvation induces general cellular atrophy, the

epithelium of the intestine suffers desquamation, a drastic reduction of zymogen granules is observed in the spleen, and necrosis is observed in the liver (Costa, 2001).

The appropriate density of *Artemia* nauplii is proportional to the age of *O. argentinensis* larvae. At a stocking density of 15 larvae/l, the density should increase from 1 nauplius/ml the first day after hatching to 15 nauplii/ml two weeks after hatching (Tesser and Sampaio, 2001).

Dry diets are accepted at first feeding, but larval growth is reduced when compared to larvae preying upon *Artemia* nauplii, thus weaning should be attempted with older larvae (Sampaio *et al.*, 1995). Currently, *O. argentinensis* larvae are weaned 15 to 30 days after hatching (Sampaio and Minillo, 1995a; Sampaio *et al.*, 1998a), this approach seems to give good results, but better techniques for precocious weaning should be attempted in order to reduce the dependence on live food.

The appropriate ration for larvae fed on dry diets decreases from 25% of their live weight per day 15 days after hatching (Sampaio and Minillo, 1995a) to 15% per day for 30 days old individuals (Sampaio *et al.*, 1998a). At these ages, the feeding frequency should be at least six times per day in order to reach maximum growth rates (Sampaio *et al.*, 1998b).

The optimum temperature for larvae and fingerling culture is 23°C, temperatures as high as 26°C reduce the survival rate and lower temperatures result in lower growth rates (Streit, 2000; Sampaio and Pisseti, 2001). However, it is important to emphasize that *O. argentinensis* presents a termolabile sex determination, and its sex rate at 18-21°C is female biased (Strussmann, *et al.*, 1996).

Larvae of *O. argentinensis* do not survive in fresh water, but they can be reared in low salinity water (5‰) from the first day after hatching without compromise of growth and survival, when compared to the performance of larvae reared in salt water (35‰) (Phonlor and Sampaio, 1992). The acute transfer of young juveniles (30 days old) from salt water (30‰) to fresh water resulted in the death of all individuals (Sampaio and Phonlor, 1992). However, when the salinity is gradually reduced during one week, the survival is around 67% for the fish kept in 1‰ during 15 days, but all die within 2-3 days after the transfer to fresh water. Growth and survival are similar for juveniles raised in salinities between 2 or 35‰ (Sampaio *et al.*, 2000).

Larval growth is influenced by the photoperiod, larvae kept without light during the day are unable to prey on an adequate amount of *Artemia* nauplii, result-

ing in a reduced growth rate. Larvae reared under continuous light, or in a 12 hours light regime grow faster than those kept in the dark, but growth is maximized at 18 hours of light per day (Freitas, 2003).

The stocking density can be as high as 90 larvae/l during the first month of life (Sampaio and Phonlor, 1996), but currently lower densities (20-30 larvae/l) have been used. Fingerlings are reared at lower stocking densities, typically 1-2 individuals/l when they are 90 days old.

Ammonia toxicity is influenced by temperature and salinity. Sampaio and Minillo (1995b) determined an inverse relationship between temperature and ammonia toxicity for 15 days old larvae. The LC50-96h (lethal concentration for 50% of the population after 96 hours of exposure) is 0.73 mg/L N-NH₃ at 15°C and 0.96 mg/L N-NH₃ at 23°C. As it is observed for other species, the toxicity of ammonia is lower in saltwater (30‰) than at a lower salinity (10‰) (Sampaio and Minillo, 2000).

Growth of *O. argentinensis* larvae is hampered when they are exposed to 0.18 mg/L N-NH₃ during 15 days, showing that chronic effects can be observed at concentrations easily found in hatcheries. On the other side, it is not likely that nitrite toxicity could be a problem for the culture of *O. argentinensis*, as the LC50-96h is equal to 88 mg/L N-NO₂⁻ and no chronic effects were observed at concentrations as high as 25 mg/L N-NO₂⁻ (Peres, 2002).

Information on the grow-out phase of “pejerrey” is still scarce, but the current knowledge on reproduction, larviculture and fingerling production should be enough to start up the commercial culture of this species.

References

- Costa MPV (2001). Organogênese, cinética digestiva e efeitos da inanição em larvas de peixe-rei marinho, *Odontesthes argentinensis* (Valenciennes, 1835) (Teleostei: Atherinopsidae). Fundação Universidade Federal do Rio Grande, Rio Grande, 103p. (MSc. Thesis).
- Freitas LS (2003). Efeito do fotoperíodo sobre a sobrevivência e o crescimento de larvas do peixe-rei marinho *Odontesthes argentinensis*. Fundação Universidade Federal de Rio Grande, Rio Grande, 30p.
- Peres MMS (2002). Toxicidade aguda e crônica de amônia e nitrito sobre larvas do peixe-rei marinho *Odontesthes argentinensis*. Fundação Universidade Federal de Rio Grande, Rio Grande, 26p.
- Phonlor G, Sampaio LA (1992). Effects of salinity on growth and survival of *Odontesthes argentinensis* larvae. *Arquivos de Biologia e Tecnologia* 35: 153-155.
- Phonlor G, Vinagre LEC (1989). Efeito do retarde da primeira alimentação sobre o crescimento e a sobrevivência da larva de *Odontesthes argentinensis*. *Atlântica*. 11: 63-75.
- Sampaio LA (1992). Fertilização artificial, incubação e crescimento larval de *Odontesthes argentinensis*. Efeitos da salinidade e densidade de estocagem. Rio Grande, Fundação Universidade Federal do Rio Grande, 58p. (MSc Thesis).
- Sampaio LA, Minillo A (1995a). Alimentação de larvas do peixe-rei marinho *Odontesthes argentinensis* com diferentes taxas de arraçoamento. Ibirubá, III Encontro Sul Brasileiro de Aqüicultura, pp. 34-43.
- Sampaio LA, Minillo A (1995b). Acute toxicity of ammonia to marine silverside larvae (*Odontesthes argentinensis*) under different temperatures. *European Aquaculture Society Special Publication* 24: 390-393.
- Sampaio LA, Minillo A (2000). Viabilidade do uso de larvas do peixe-rei *Odontesthes argentinensis* em testes de toxicidade: efeitos da salinidade e da temperatura. In: Ecotoxicologia: perspectivas para o século XXI. Espíndola ELG, Paschoal CMRB, Rocha O, Boher MBC and Oliveira Eds. Neto AL São Carlos, RiMa Editora, pp. 545-553.
- Sampaio LA, Phonlor G (1992). Freshwater tolerance of marine and estuarine metamorphic larvae of *O. argentinensis* (Pisces: Atherinidae). *Arquivos de Biologia e Tecnologia* 35: 85-90.
- Sampaio LA, Phonlor G (1996). Effects of stocking density on growth and survival of the marine silverside *O. argentinensis* (Pisces: Atherinidae) larvae. *Arquivos de Biologia e Tecnologia* 39: 443-449.
- Sampaio LA, Pisseti TL (2001). Efeito da temperatura sobre o desenvolvimento embrionário e larval do peixe-rei marinho *Odontesthes argentinensis*. Rio Grande, XIV Semana Nacional de Oceanografia. CD-ROM.
- Sampaio LA, Tesser MB, Pickersgill AR (1998a). Efeitos de diferentes taxas de arraçoamento sobre o crescimento e a sobrevivência de juvenis de peixe-rei *Odontesthes argentinensis*. Rio Grande, XI Encontro Nacional de Oceanografia, pp. 624-629.
- Sampaio LA, Tesser MB, Pickersgill AR (1998b). Effects of feeding frequency on growth of juvenile pejerrey (*Odontesthes argentinensis*). Recife, XI Simpósio Brasileiro de Aqüicultura, pp. 19.
- Sampaio LA, Pisseti TL, Maçada A, Ballester E (2000). Crescimento e sobrevivência de juvenis do peixe-rei marinho (*Odontesthes argentinensis*) em salinidades reduzidas. Itajaí, XIII Semana Nacional de Oceanografia, pp. 690-692.
- Sampaio LA, Sirol RN, Matsumoto R, Phonlor G (1995). Primeira alimentação de larvas de peixe-rei *O. argentinensis* com ração. Peruíbe, VIII Simpósio Brasileiro de Aqüicultura, pp. 130-136.
- Streit D (2000). Influência da temperatura no crescimento de juvenis de peixe-rei (*Odontesthes argentinensis*). Rio Grande, Fundação Universidade Federal do Rio Grande, 30 p.
- Strüssmann CA, Cota JCC, Phonlor G, Higuchi H, Takashima F (1996). Temperature effects on sex differentiation of two South American atherinids, *Odontesthes argentinensis* and *Patagonina hatchery*. *Environ Biol Fishes* 47: 143-154.
- Tesser MB, Sampaio LA (2001). Growth of pejerrey larvae (*Odontesthes argentinensis*) on different prey densities. *Atlântica* 23: 153-159.

