

## CLOSING THE LIFE CYCLE OF THE ATLANTIC BLUEFIN TUNA *Thunnus thynnus* IN CAPTIVITY

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### Introduction

One way to alleviate the pressure on the wild fishery of the Atlantic bluefin tuna (ABFT) and aid in its conservation could be its domestication and the development of a self-sustained aquaculture to rear the larvae, produce juveniles for further grow-out up to the commercial size, and close the life cycle of the species in captivity. The Spanish Institute of Oceanography (IEO) have been carried out several research projects on this target mainly SELFDOTT, TCAR, ATAME, CLARA, NUTRITUNA and PARACIEN.

### Materials and Methods

During 5 years (from 2011 to 2015) fertilized ABFT tuna eggs were collected from spontaneous spawning, following the technique described by de la Gándara et al. (2011), in the broodstock cages of Caladeros del Mediterraneo in El Gorguel Bay (Cartagena, SE Spain). Spawning season usually extended from early-mid June to mid July. Eggs were transferred to the IEO facilities in Mazarrón (SE Spain). The larval rearing was carried out in tanks (40 m<sup>3</sup>) during ~ 40 days. The used system is the so-called pseudogreen water. The larvae are fed sequentially on enriched rotifers, enriched *Artemia*, sea bream yolk sac larvae and finally weaned with artificial food or minced raw fish (de la Gándara et al., 2016). In the last three years, the use of copepods nauplii (*Acartia*) in combination with enriched rotifers has been implemented with better results in terms of growth and survival (Ortega et al., 2015). Survival rates from egg to juvenile 40 days post hatch (dph) ranged between 0.10 and 0.95% with an average of  $0.46 \pm 0.29\%$ ,

ABFT juveniles were transported to cages when their average weight oscillated between 3-5g (~ 36-40 dph). Transportation was carried out in a truck and then in a boat, and it took about two hours. First trials showed that juveniles kept longer in the tanks had an important mortality caused by collision against the tank walls. Besides, moving tunas larger than this size, cause a higher mortality because of handling, so we are carrying out the transport when tunas are smaller than 5g. Nevertheless when the sea conditions are not so good during the first days in the cages, some problems can occur.

In the cages the initial feeding was minced defrosted fish. The tunas were fed to satiety several times per day: at the beginning raw fish was shared in eight times, and frequency was decreasing while they grew. During the winter months, their feed intake was quite low, so the number of feeding times was reduced to once per day. To evaluate the growth, data recorded of dead fish collected in the cages during all the year round were used.

### Results

As result of these projects and from 2011, few thousands ~ 40 dph ABFT juveniles (~ 5g each) have been produced every year and transferred to the cages (Table I).

Tuna mortality is high during the first stages in the net cage, mainly during the first month but also while tunas were smaller than a half kilogram weight. During this period, total mortality ranged between 60-90%. From the 5<sup>th</sup> month, mortality rate decrease to less than 2% monthly (Ortega et al., 2014).

Table I: ABFT juveniles produced in the IEO during last years

Year	2011	2012	2013	2014	2015
N° juveniles	3.900	3.400	3.700	2.300	14.800

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From November 2014 and during 2015, most of the greater tunas were commercialized. At the end of 2015, all the surviving tunas from 2011, 2012 and 2013 cohorts were placed together in a single cage. There were about 100 tunas, and their weight ranged between 12 and 60 kg. After some mortality due to logistic problems during the winter season, a cage containing about 80 2<sup>+</sup>, 3<sup>+</sup> and 4<sup>+</sup> ABFT, were moved to San Pedro del Pinatar (SE Spain) and placed in Fuentes Group facilities at the end of April. At mid June, a PVC tarpaulin was placed surrounding the cage.

On the first week of July, a couple of spawning was collected inside the cage and 60.000 eggs were transported to the IEO facilities in Mazarrón. Fertilization rate was about 70% and egg diameter was  $1.08 \pm 0.02$  mm. Hatching rate was 85% and standard length of just hatched larvae was  $2.75 \pm 0.15$  mm.

### Discussion and Conclusion

This is the first time that closing the life cycle of ABFT in captivity is reported. Egg size, larval size and hatching rate were similar to those observed in wild broodstock in last five years (Ortega, 2015).

This milestone will enable faster development of integrated aquaculture of this species, consolidating the leadership that the IEO and Murcia Region have in the domestication of bluefin tuna, at European and global scale.

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