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First experience on adult bluefin tuna (BFT), *Thunnus thynnus*: Transportation from rearing cages to inland facilities

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SUMMARY – For the first time, BFT weighing 40 kg has been conveyed from rearing cages at sea to facilities on land, achieving a survival rate of up to 6 days. This article describes the methodology used for the capture, conveyance and stabling of tuna, noting the difficulties observed and the potential application of results.

Keywords: Bluefin tuna, transportation, aquaculture, new finfish species.

RESUME – *"Première expérience sur des adultes de thon rouge,* Thunnus thynnus *: Transport depuis les cages d'élevage jusqu'aux installations à terre". C'est la première fois que des thons rouges pesant 40 kg ont été transportés des cages en mer aux installations en terre, avec un succès de survie de six jours. Cet article décrit la méthodologie utilisée pour la capture, le transport et la stabulation des thons, notant les difficultés observées et l'application potentielle des résultats.*

Mot-clés : *Thon rouge, transport, aquaculture, nouvelles espèces de poissons.*

Introduction

Considerable development of BFT farming and fattening in floating sea cages has occurred in the Murcia Region (SE Spain) over the last five years. This activity entails capturing large sized animals off the Eastern Spanish coast, in the course of their reproductive migrations. From the fishing grounds, BFT are conveyed in mobile floating cages towed by ships to the rearing sites where floating cages or net enclosures are placed close to the shore. It is here where BFT are stabled for 6-8 months, fed on low cost fish (sardine, mackerel, squid) to increase the fat content of their meat. Practically all the production is forwarded to the Japanese market, where BFT is highly appreciated by the consumer, attaining high prices during the winter months.

In the Murcia Region, there are currently five BFT farms, producing around 5000 tonnes per year, providing a considerable number of local direct and indirect jobs. Due to the fact that, for several reasons, the BFT stock is severely depleted, the future of this activity would seem, by necessity, to require controlled reproduction. As it is difficult to collect spawning eggs from the floating rearing cages, it seems more appropriate to convey mature animals to facilities on land where they can be more easily handled.

In order to check the viability of this procedure, an initial experience was carried out involving capturing and conveying mature BFT from the rearing facilities of the company Atunes de Mazarrón S.L., located off Puntas de Calnegre (Lorca, Murcia, SE Spain), to the facilities on land of the Spanish Institute of Oceanography (IEO) in Mazarrón (Murcia, SE Spain).

Materials and methods

The work involved three phases: (i) capture; (ii) conveying by boat; and (iii) transporting overland from the boat to the inland facilities. Capture was performed by means of a sardine baited line with a barbless hook (Photo 1). The line was thrown to the middle of the circular cage (50 m in diameter and 22 m depth) from the ship located alongside the cage. The large sized fish caught (over 100 kg) were released since the objective was to transport the smaller animals. Once the BFT had bitten on the

hook, they were brought to the ship's side (Photo 2) where several divers placed them on a plastic sheet attached to the ship's crane for hoisting on board. Once aboard, the hook was removed and fish was introduced into a 12 cubic meter onboard tank, with a constant supply of pumped seawater (Photo 3).

To avoid any possible aggressive behaviour in BFTs, anaesthetic was dissolved in the ship's water tank (4 ppm of clove oil, 1/10 of the dose required for full anaesthesia in other fish species). Ship travel time to the harbour was approximately one hour. BFT was conveyed to the IEO facilities by lorry, in a tank fitted with a pump, which provided water flow through a nozzle specifically designed for the BFT mouth (Photo 4). The trip from the harbour to the IEO laboratory took 10 minutes. Once there (Photo 5), fish were stocked in an 80 cubic meter concrete tank, sufficient to guarantee a near-saturation level of oxygen, fitted with a tangential water inlet (Photo 6).

Photo 1

Photo 2

Photo 3

Photo 4

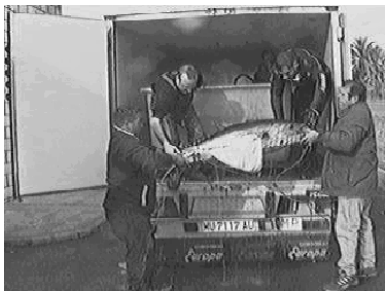

Photo 5

Photo 6

Results and discussion

Two transportation trials were conducted on 3 BFT, with an average of 40 kg body weight and 1 m length, in January-February 2000. Although, the first initial reaction of the BFT after biting the hook was violent and swam quickly, after being immobilised and turned on its belly by the divers, it remained apparently calm, thus making it possible to hoist them aboard ship. Air exposure elapsed time from the sea to the tank was about 2 minutes. Use of anaesthetics was dismissed, after noting clear signs in one individual of an acute response to anaesthesia. At this point, all the water inside the tank was replaced and a water hose was inserted near the mouth in order to reanimate. After five minutes, fish returned to their normal behaviour, swimming in circles around the tank. The rest of the BFT showed no signs of struggle to escape, swimming calmly in the tank. At the entrance to Puerto de Mazarrón fishing harbour, water flow inside the tank was shut off to avoid any influx of polluted seawater. Oxygen concentration in the water was kept at a suitable level by using pure oxygen administered by a diffuser.

From the ship, BFT were removed from the tank with the help of a purpose-built stretcher. No resistance was noted, and they were then introduced into a tank mounted on the lorry. A nozzle was then fitted over the BFT mouth, providing sufficient water flow through the gills to meet oxygen

requirements. On arrival at the facilities on land, BFT were again removed and placed on the stretcher with no resistance.

In the first trial, once inside the tank, the two BFT specimens transported started to swim in circles and counter-clockwise, near the walls, drawing to a halt when obstacles were found in the way (i.e. overflow pipes). Due to their inability to ventilate gills when static (tuna is a ram ventilator fish), BFT died by suffocation 12 hours after their arrival. It was further noted that the lighting system over the tank was inadequate, probably causing a degree of nervousness.

In order to solve these problems, prior to the second attempt, modifications were incorporated into the tank. Hydrodynamism was improved by fitting air-lift pipes shielded on the corners by curved PVC plates to remove all interference inside the tank. Also, a system was installed for turning the light on and off with a dimmer control. As a result of this, the BFT specimen transported in the second trial remained alive inside the tank for 6 days. Death occurred by injuries inflicted due to constant scraping of the right side against the tank walls, when swimming in circles at a relatively constant speed (approximately 1 m per second) counter-clockwise.

Previous similar experiences with this and other Tunid species, conducted mainly by aquariums, such as Monterrey Bay (USA), Tokyo Sea Life Park (Japan) and Two Ocean Aquarium (South Africa), in all cases involved individuals of less than 12 kg (Farwell *et al*., 1997; Garret *et al*., 1997; Masuma and Oka, 1997; Sakurai, *et al*., 1997). Observing similar problems on handling the fish (mortality caused by skin abrasions).

Conclusions

It can be concluded from these preliminary results that the transportation of live BFT from sea-based structures to facilities on land is feasible and relatively simple, the use of anaesthetics being unnecessary and inadvisable. When keeping BFT in facilities on land, there is an evident need for large sized, circular tanks, to avoid scraping of individuals against the walls.

The time that BFT was kept alive inside the tank in the second attempt leads to the possibility of obtaining controlled spawns of small size mature fish at facilities on land, since in terms of experience with other marine finfish species, 2 or 3 days are sufficient for hormonal induction of spawning in mature animals (Donaldson and Hunter, 1983; Abraham, 1988), usually kept in farming cages from June to August. So, studies on artificial fertilisation and larval rearing may be started for this commercially important species

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