



European Fisheries and Aquaculture Research Organisations

Farming Bluefin tuna Closed life cycle coming to a solution



UN OCÉANO, UN FUTURO



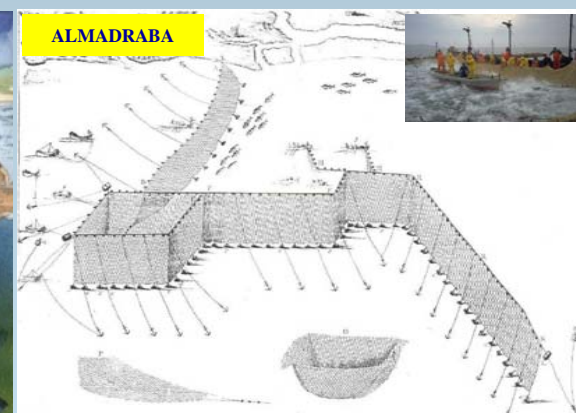
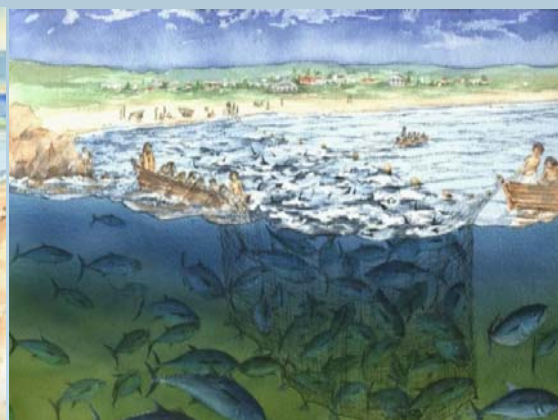
Fernando de la Gándara

fernando.delagandara@mu.ieo.es





The fisheries





The fattening activity





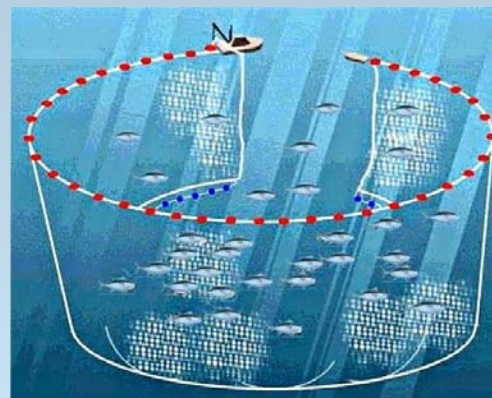
Capture





Capture

- **PURSE SEINE**



- **DETECTION METHODS**





Towing





Farming -Fattening





Farming -Fattening





Slaughtering





Slaughtering





Marketing

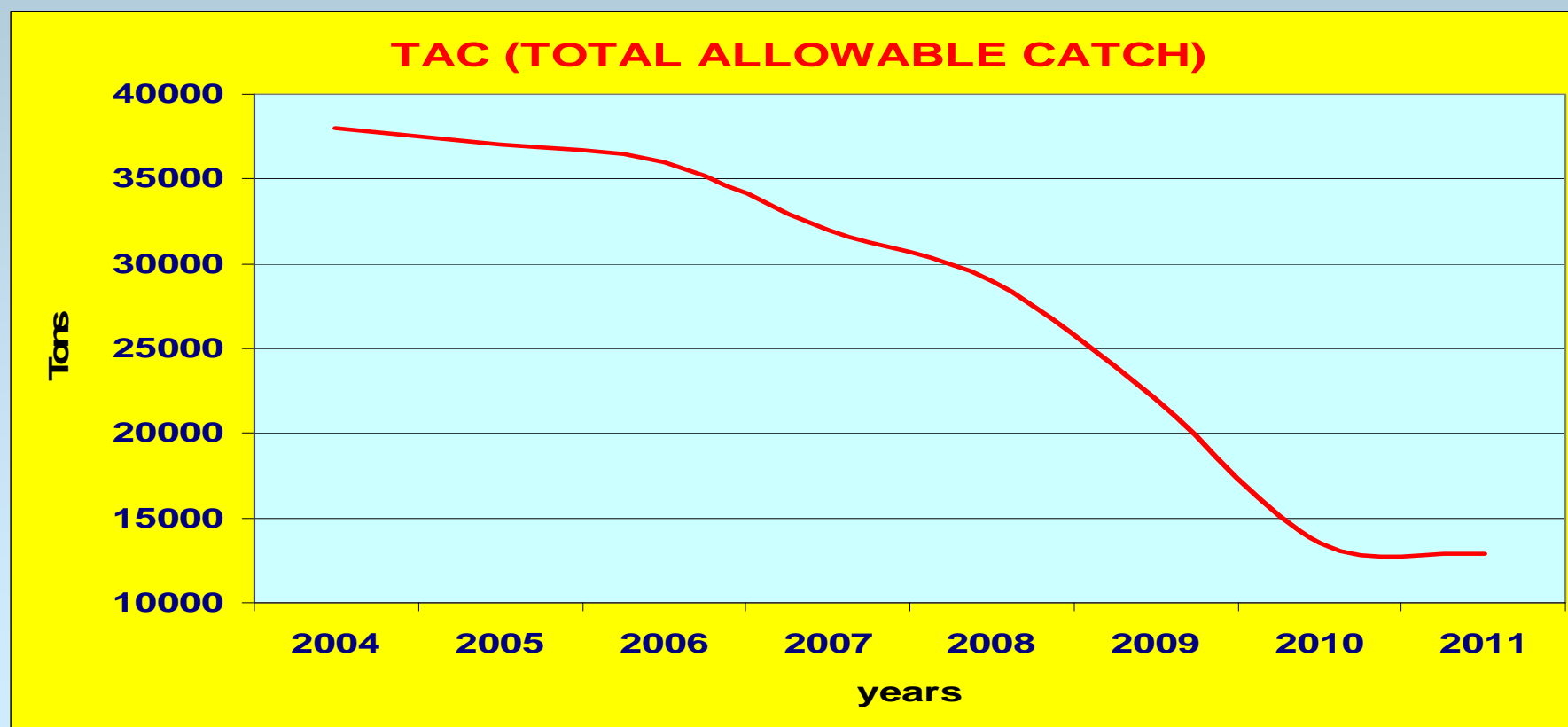




OVERFISHING



International Commission for the
Conservation of Atlantic tunas





WILD STOCKS



FISHERIES



MARKETS

JAPANESE MARKET

FATTENING



RAW FISH



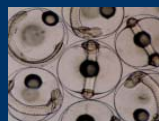
ARTIFICIAL FOOD



EUROPEAN MARKET



DOMESTICATION





WORLD INITIATIVES FOR CLOSING TUNA LIFE CYCLE IN CAPTIVITY

JAPAN: KINKI UNIV. CLOSED THE PBFT LIFE CYCLE IN 2002

AUSTRALIA: CLEANSEAS & SARDI SBFT

USA: MIAMI AND BALTIMORE UNIVERSITIES

PANAMA: ACHOTINES / IATTC / KINKI UNIVERISTY YFT

BALI (INDONESIA) YBFT

EUROPEAN INITIATIVES FOR CLOSING TUNA LIFE CYCLE IN CAPTIVITY

DOTT GROUP

ITALY: ALLOTUNA PROJECT: UNIV. BARI / PANITTICA PUGLIESE

TRANSDOTT: UNIV. DUSSELDORF / FUTUNA BLUE / MALTA / ISRAEL

SPANISH INITIATIVES: IEO / RICARDO FUENTES GROUP



PREVIOUS PROJECTS

2001 - 2002: DOTT (Domestication of *Thunnus thynnus*, the Blue Fin Tuna. Strategies for European Development in the Context of a Global Market). (Q5AM-2001- 00063). UE (FP5-QoL)



2003 - 2006: REPRODOTT (Domestication of *Thunnus thynnus*, the bluefin tuna BFT. A Feasibility Study on its Reproduction in captivity). (EU, Q5RS-2002-01355)



2006 - 2007: ADAR (Advances in Domestication of Bluefin tuna. Capture and Domestication of the bluefin tuna juveniles). IEO-FUENTES GROUP-MURCIA REGIONAL GOVERNMENT.





FROM CAPTURE BASED TO SELF-SUSTAINED AQUACULTURE AND DOMESTICATION OF BLUEFIN TUNA, *THUNNUS THYNNUS*

7th Framework Programme of the European Commission (KBBE-2007-1-2-09 Cooperation Work Programme: Food, Agriculture and Fisheries, and Biotechnology)



SELFDOTT

The challenge of domesticating bluefin tuna (project SELFDOTT)

PROJECT

From capture based to SELF-sustained aquaculture and Domestication of bluefin tuna, *Thunnus thynnus*. (SELFDOTT) funded by the 7th Framework Programme of the European Commission (KBBE-2007-1-2-09 Cooperation Work Program: Food, Agriculture and Fisheries, and Biotechnology): 4.2 million euros.

OBJECTIVES

- Implementing the knowledge on the reproduction of bluefin tuna in captivity
- Establish the knowledge-base required for controlled development of eggs, larvae
- Establish the knowledge-base required for developing suitable and environmentally performing feeds

PARTICIPANTS

IEO (Spain), HCMR (Greece), IFREMER (France), University of Düsseldorf (Germany), TUNA GRASO S.A. (Spain), MRAE (Malta), IOLR-NCM (Israel), University of Cádiz (Spain), University of Bari (Italy), CNRS (France), SARC (Norway), University of Montpellier II (France) and Malta Fishfarming Ltd (Malta)



Broodstock maintenance, SPAIN



SELFDOTT



Species	Origin	Initial weight	Cage	number
<i>Thunnus thynnus</i>	Captured in Balearic area in June 2007	80 kg	R1	35
<i>Thunnus thynnus</i>	Captured in Balearic area in June 2008	60 kg	R2	25



SITE ONE:
CARTAGENA (SPAIN)

R1 (2007)



R2 (2008)



The broodstock was fed once a day with raw fish, mainly mackerel (*Scomber scombrus*) and Spanish mackerel (*S. japonicus*).





SELFDOTT, EU 7th FP

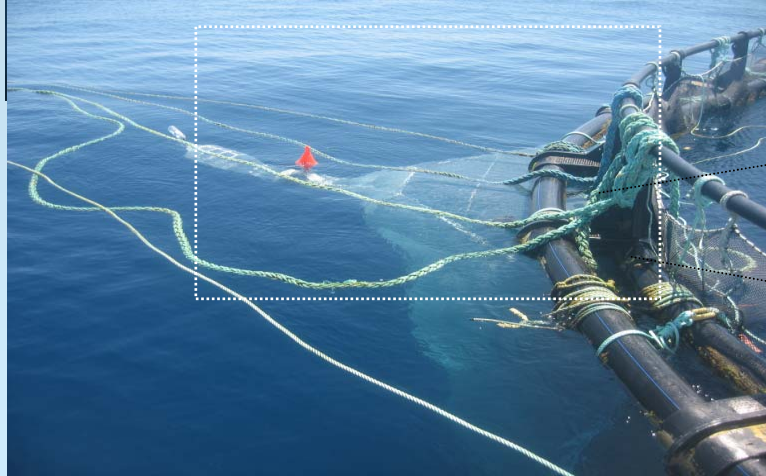




Broodstock maintenance, MALTA

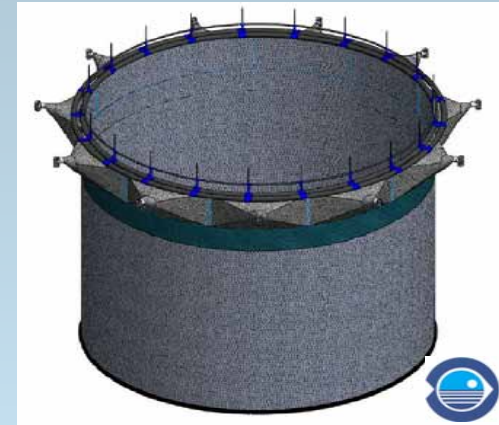


Egg collector designs



CARTAGENA

- Perimetric curtain 6 m deep
- Perimetric sieve with traps along the current axis

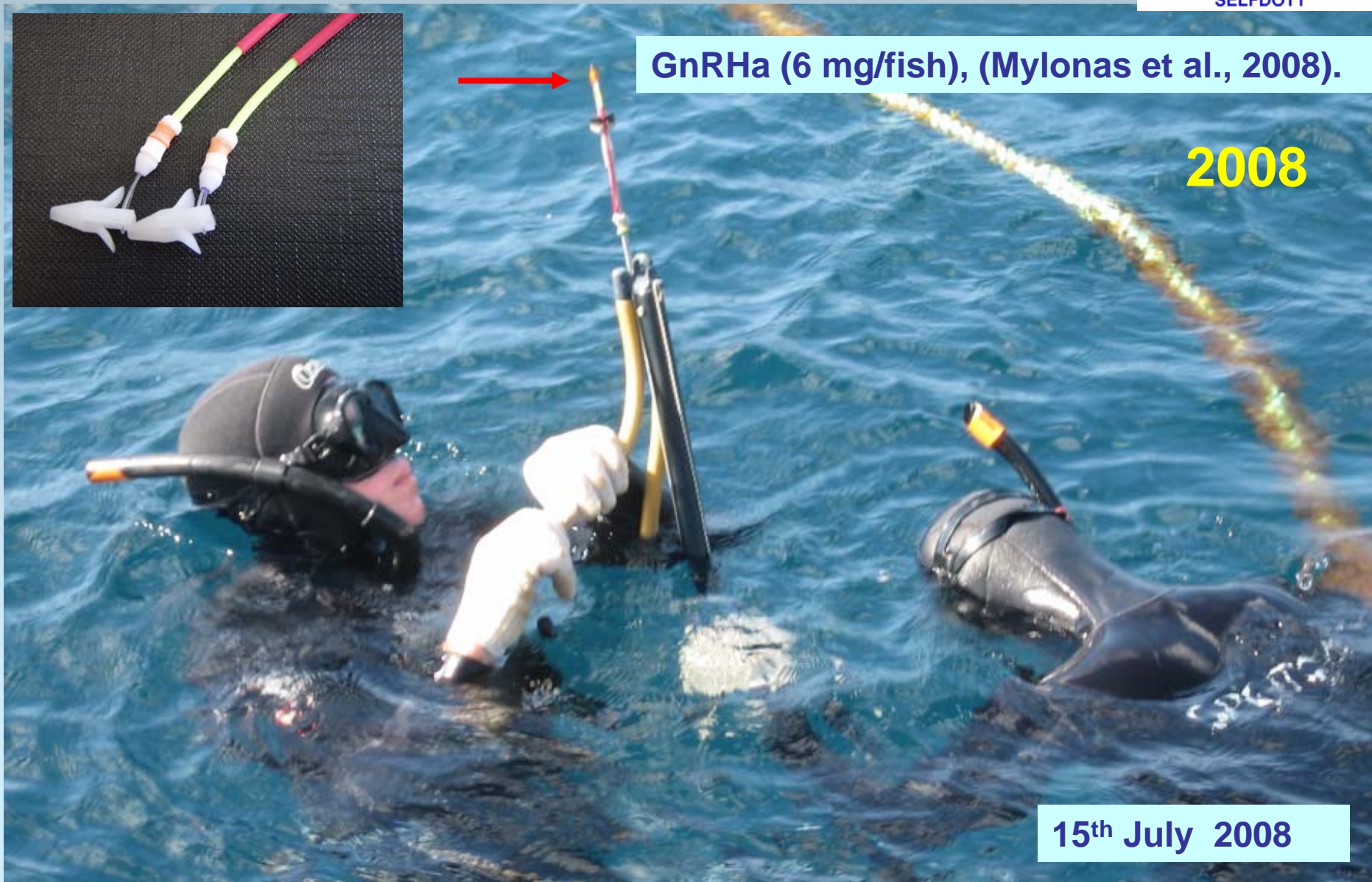


HORMONAL IMPLANTS (GnRH α)



GnRH α (6 mg/fish), (Mylonas et al., 2008).

2008



15th July 2008

HORMONAL IMPLANTS (GnRHa)

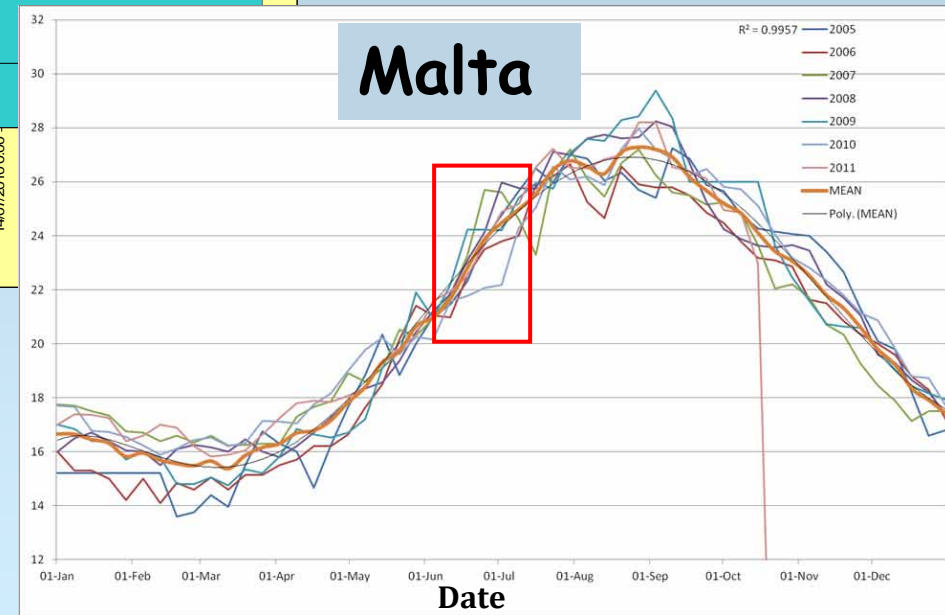
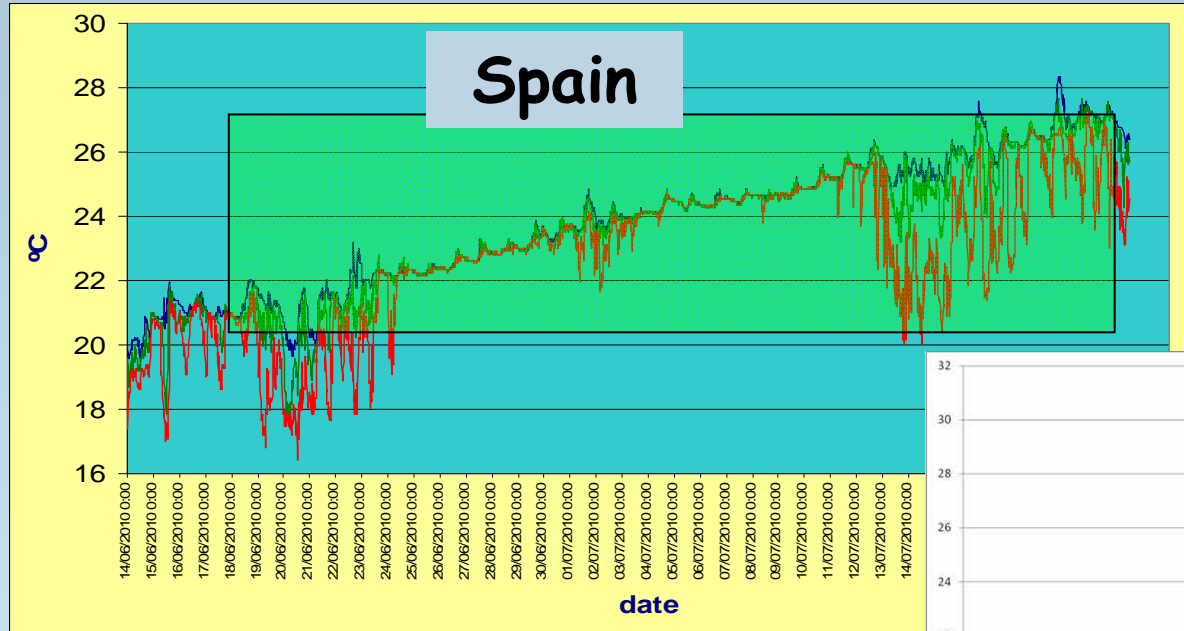




SPAWNING TEMPERATURES



SELFDOTT



Natural spawning
season
May - July



EGG COLLECTION



Aurelio Ortega

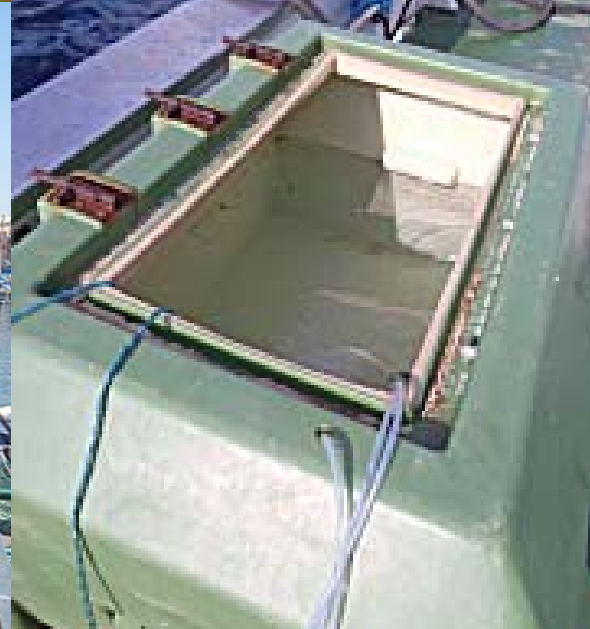
IEO

Antonio Belmonte

Tuna Graso S.A.

EGG COLLECTION

19th/06/2010 Spontaneous spawning - Egg collection



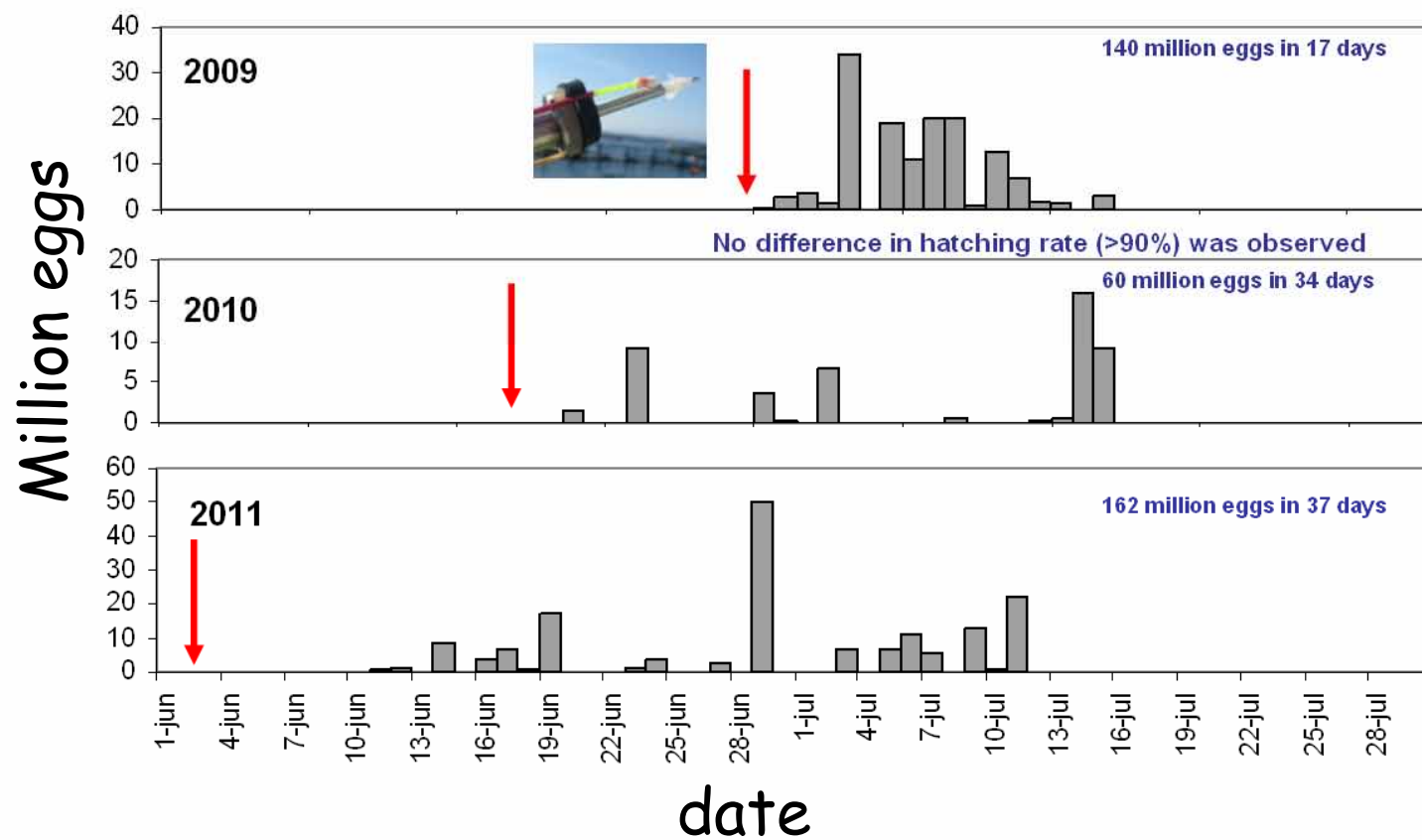
SPAWNING IN SPAIN

SPAIN

2008

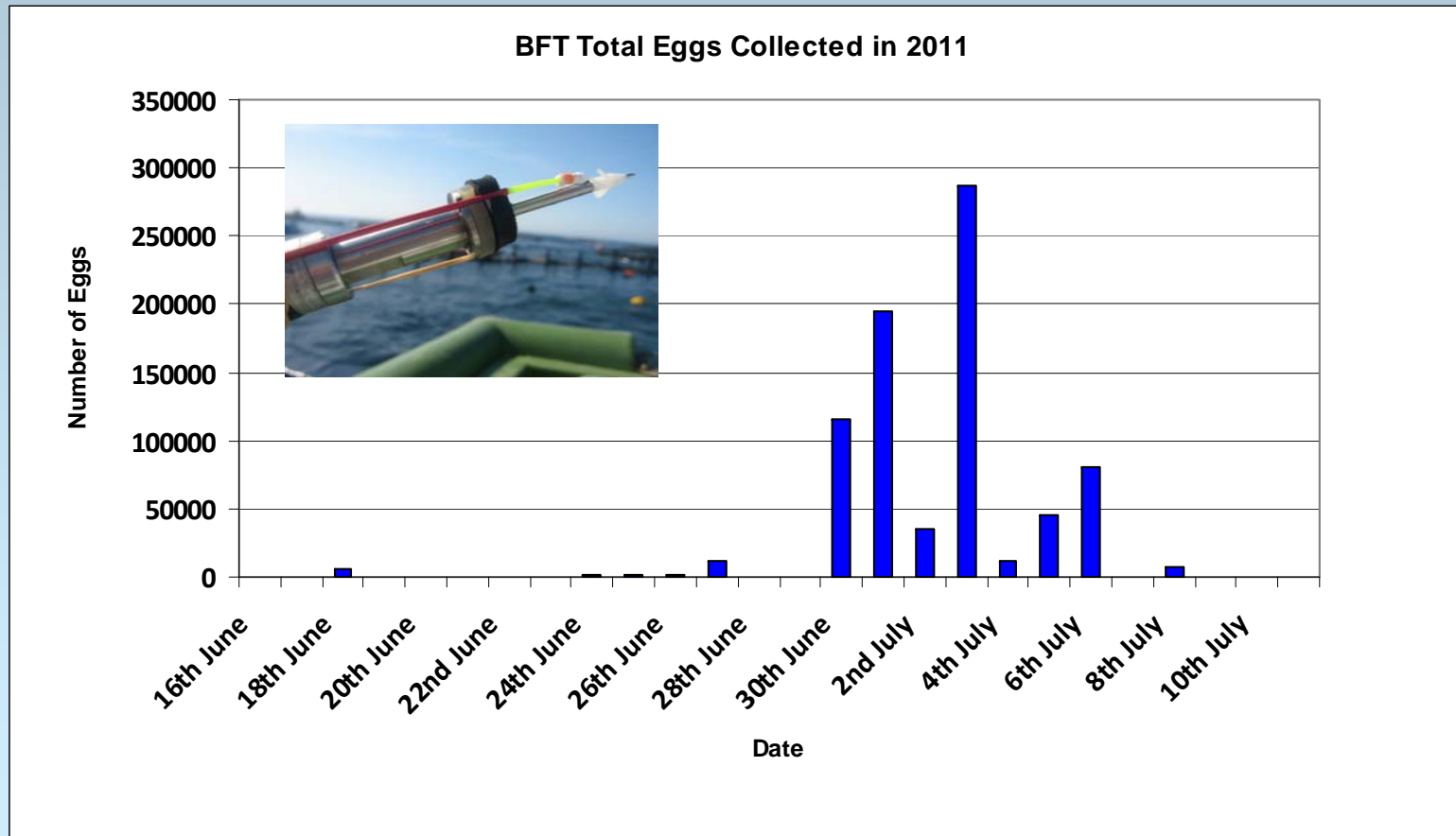


No eggs were collected



SPAWNING IN MALTA

MALTA





EGG SHIPMENT





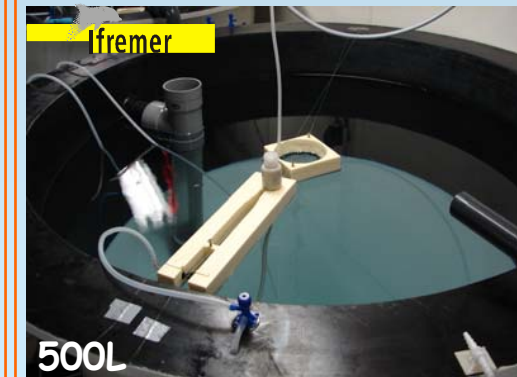
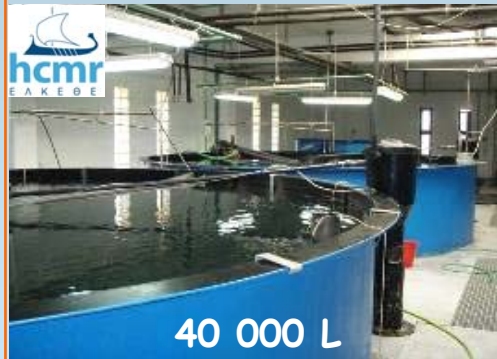
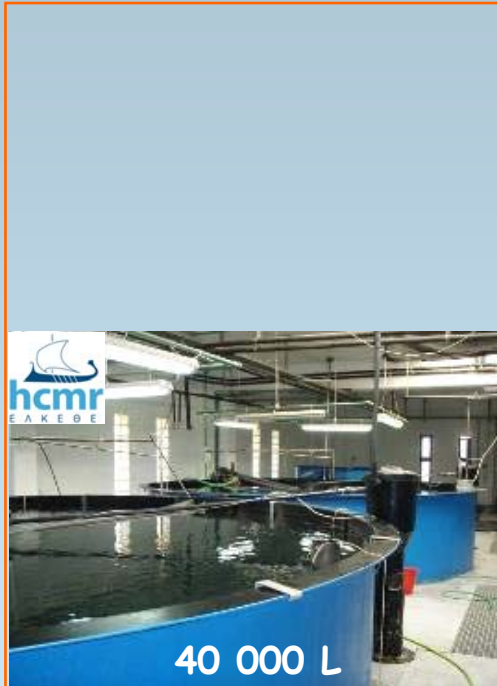
Larval rearing. Methods used



Mesocosm

Pseudo Green water

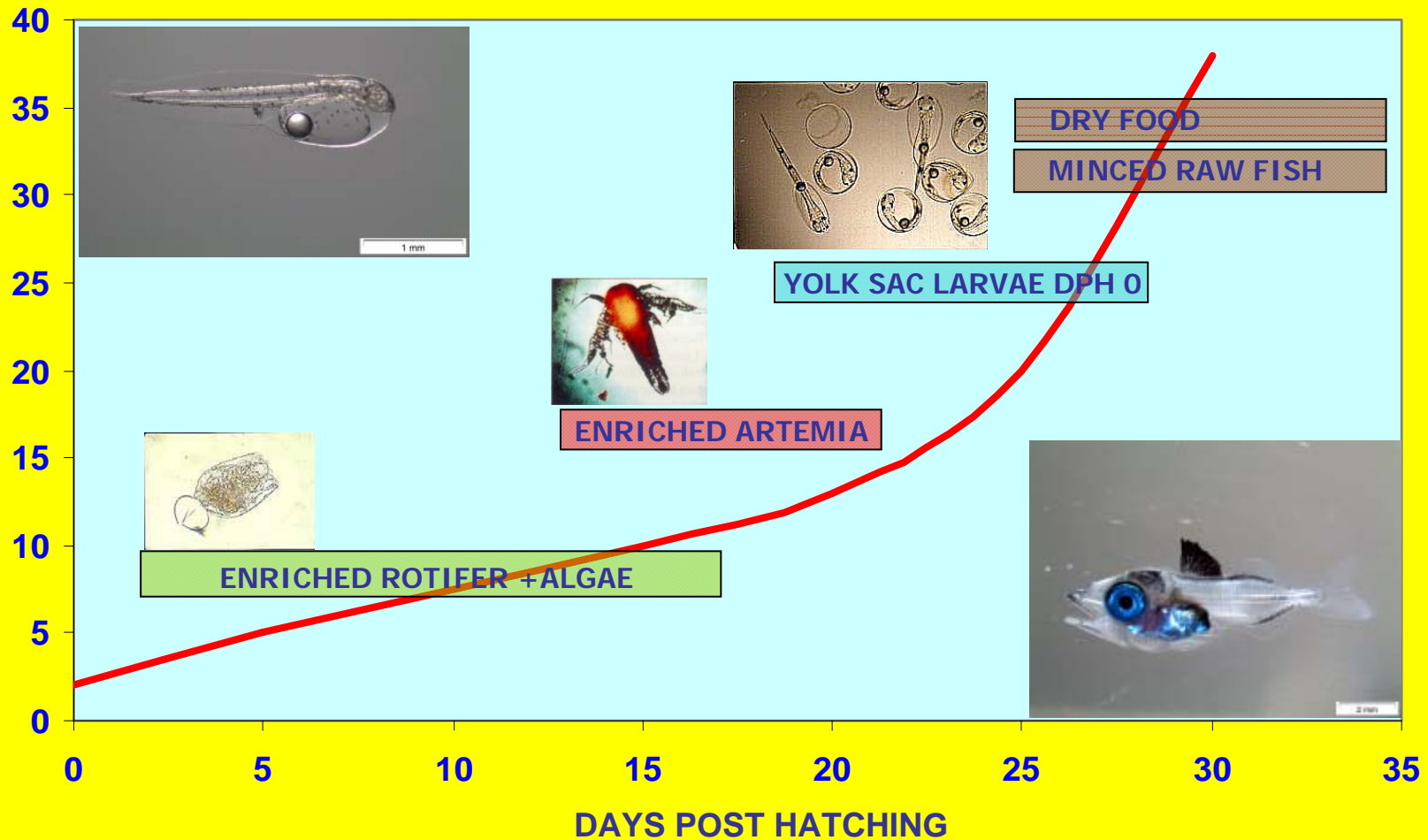
Clear water



WP3 Larval rearing

LT (mm)

FEEDING SCHEDULE AND GROWTH IN PGW IN SPAIN



Larval rearing



Weaning

- Tanks: 40 m³ round tanks
- Stocking density: 10 eggs / l
- Upwelling water inlet and aeration
- Fish oil
- Surface skimmer from 3 DPH
- T^a 23 - 26°C
- 14hL:10hD

- Weaning starts at 25 DPH.
- Tanks: 20 m³ with a dim light during night time
- Stocking density: 100-200 fish/m³
- Skretting formulation
- Raw fish (*Ammodytes* sp.)





Juvenile production in Spain

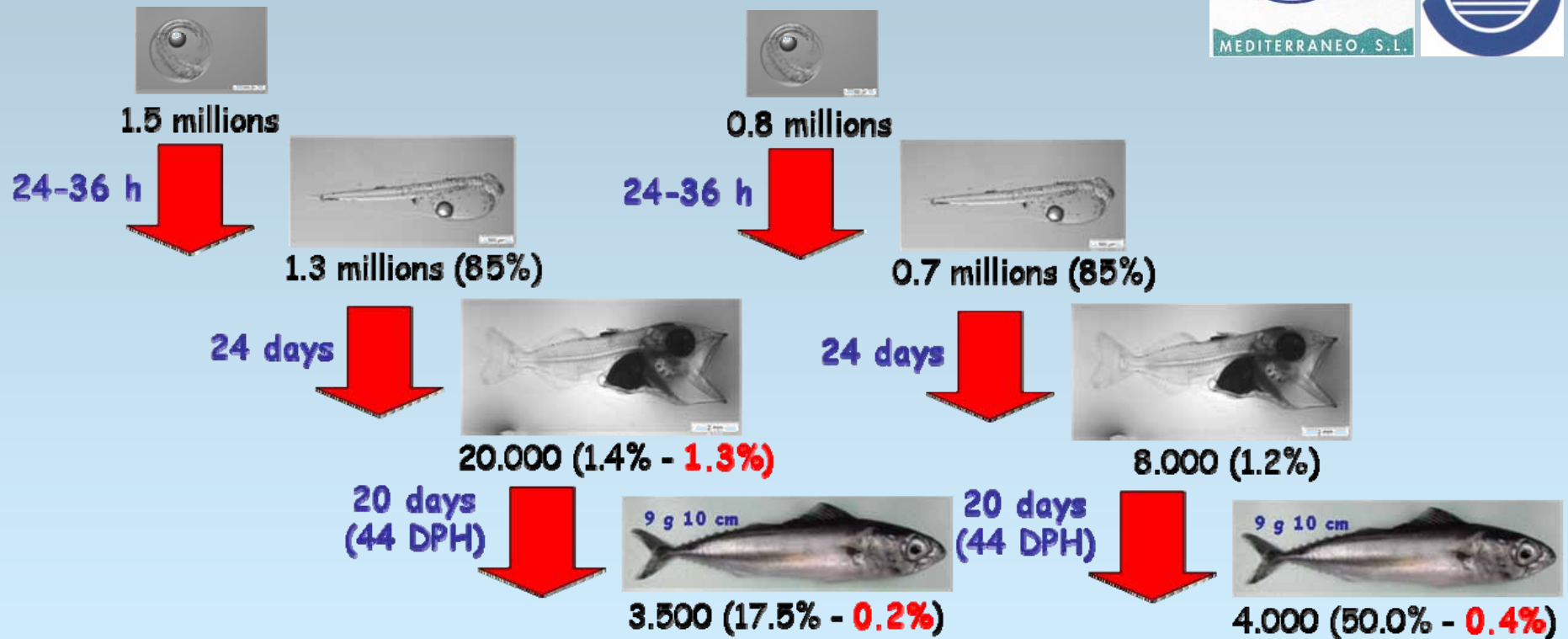


Juvenile production in Spain



2011

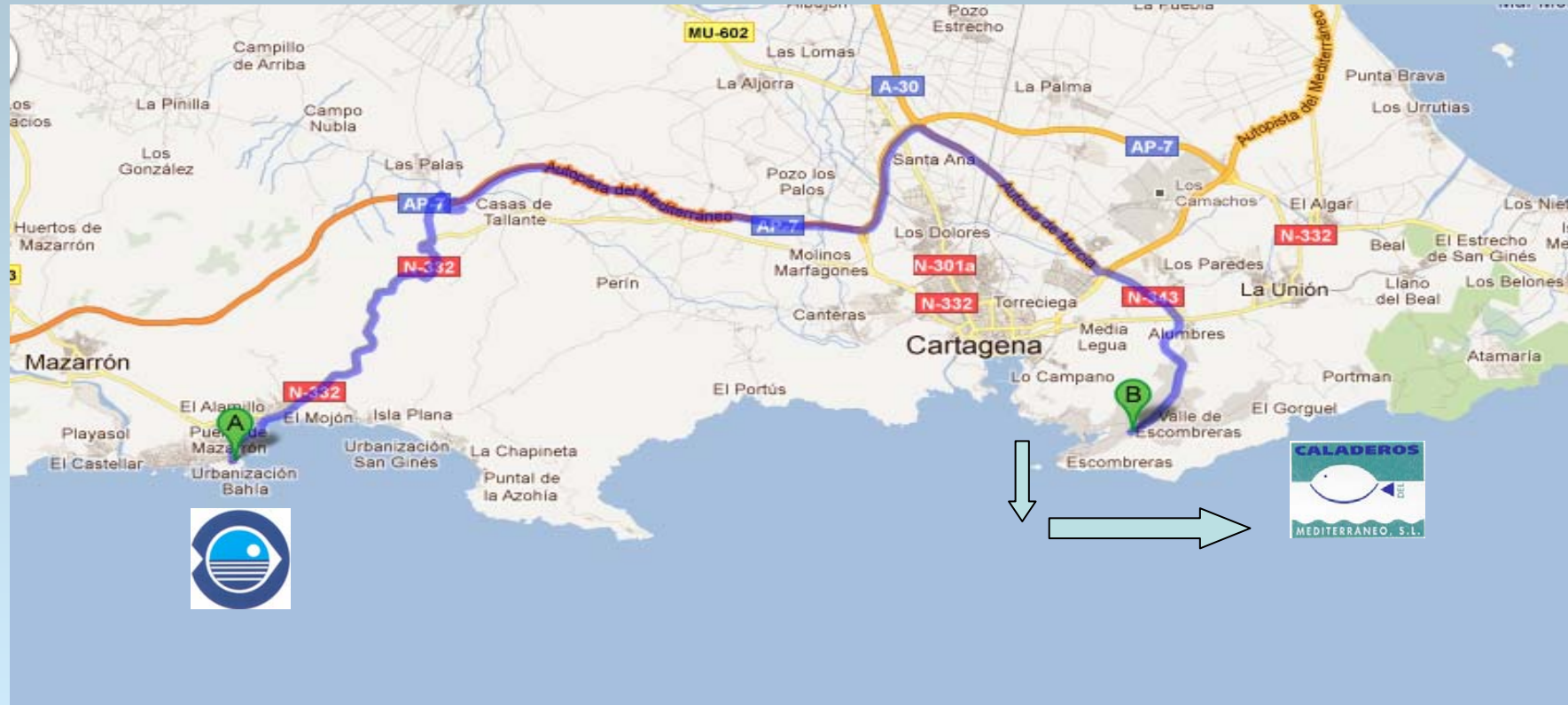
2013



Juvenile production in Spain



Transport



The duration of transport was about 3 hours.

One hour from Mazarrón to Escombreras (Cartagena) by truck (50 Km).

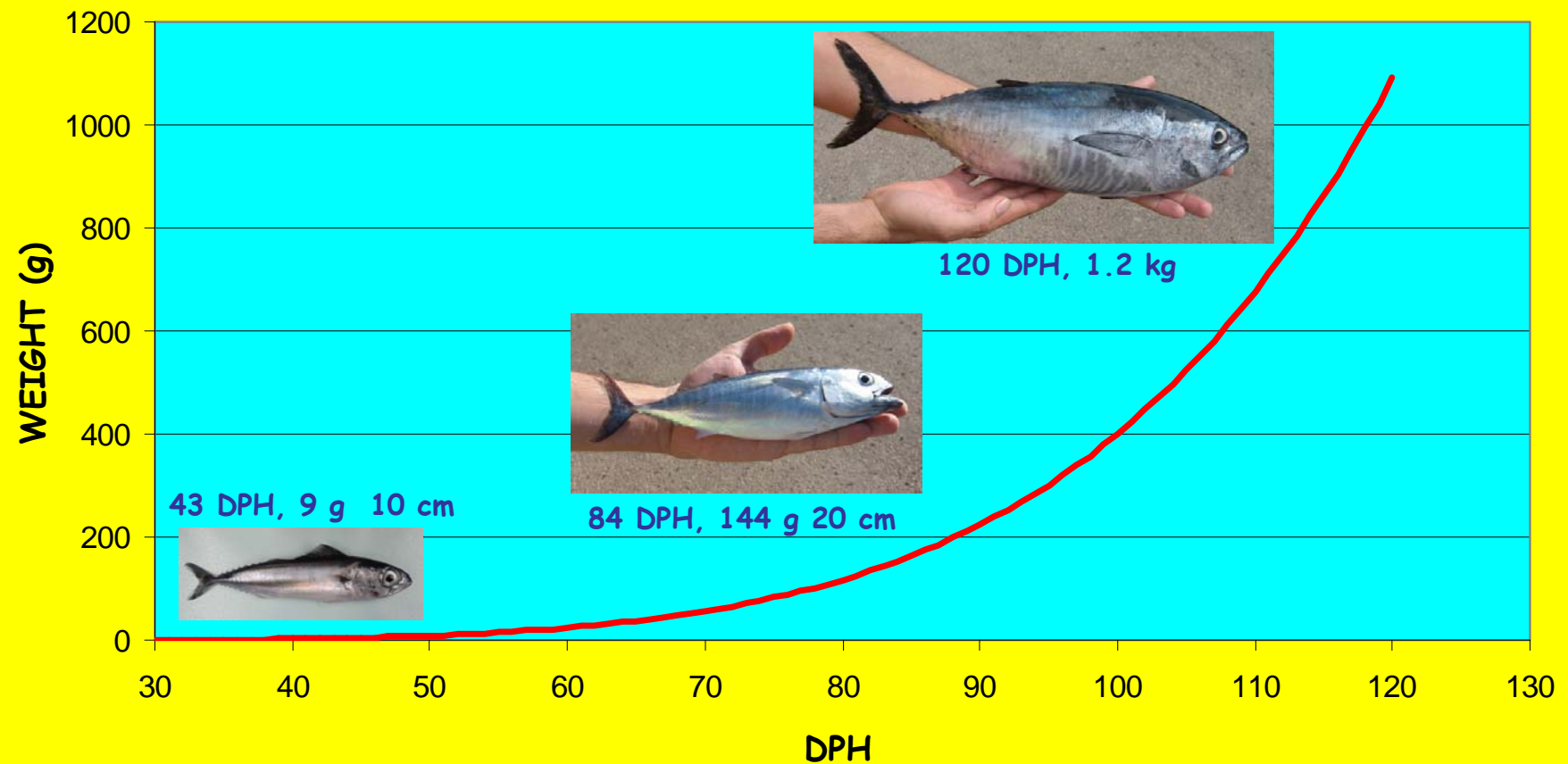
One hour to move the tanks with the help of a crane.

And another hour by boat to the cages and transfer of fingerlings to net cage in El Gorguel.

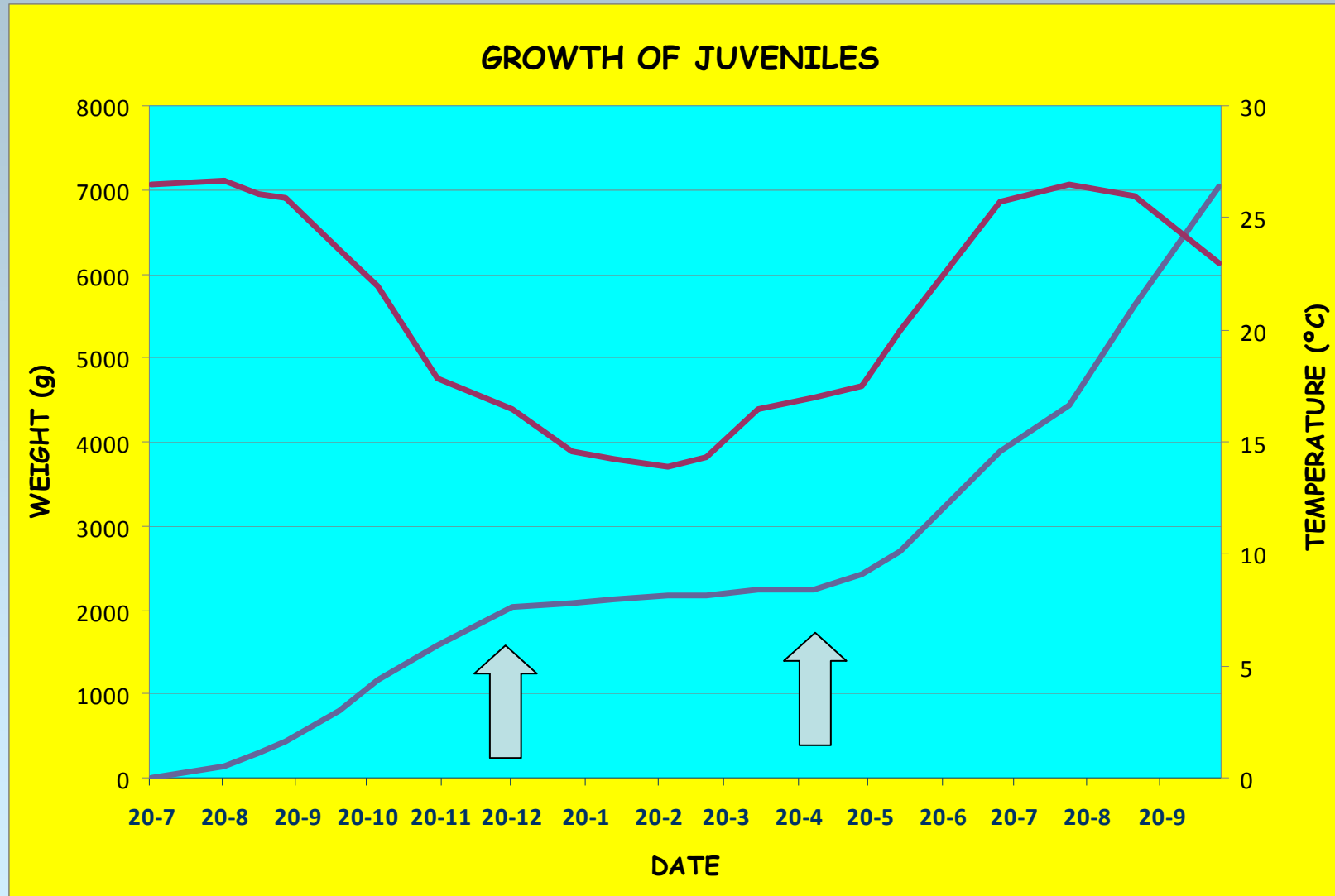
Juvenile production in Spain



GROWTH OF JUVENILES IN THE CAGES



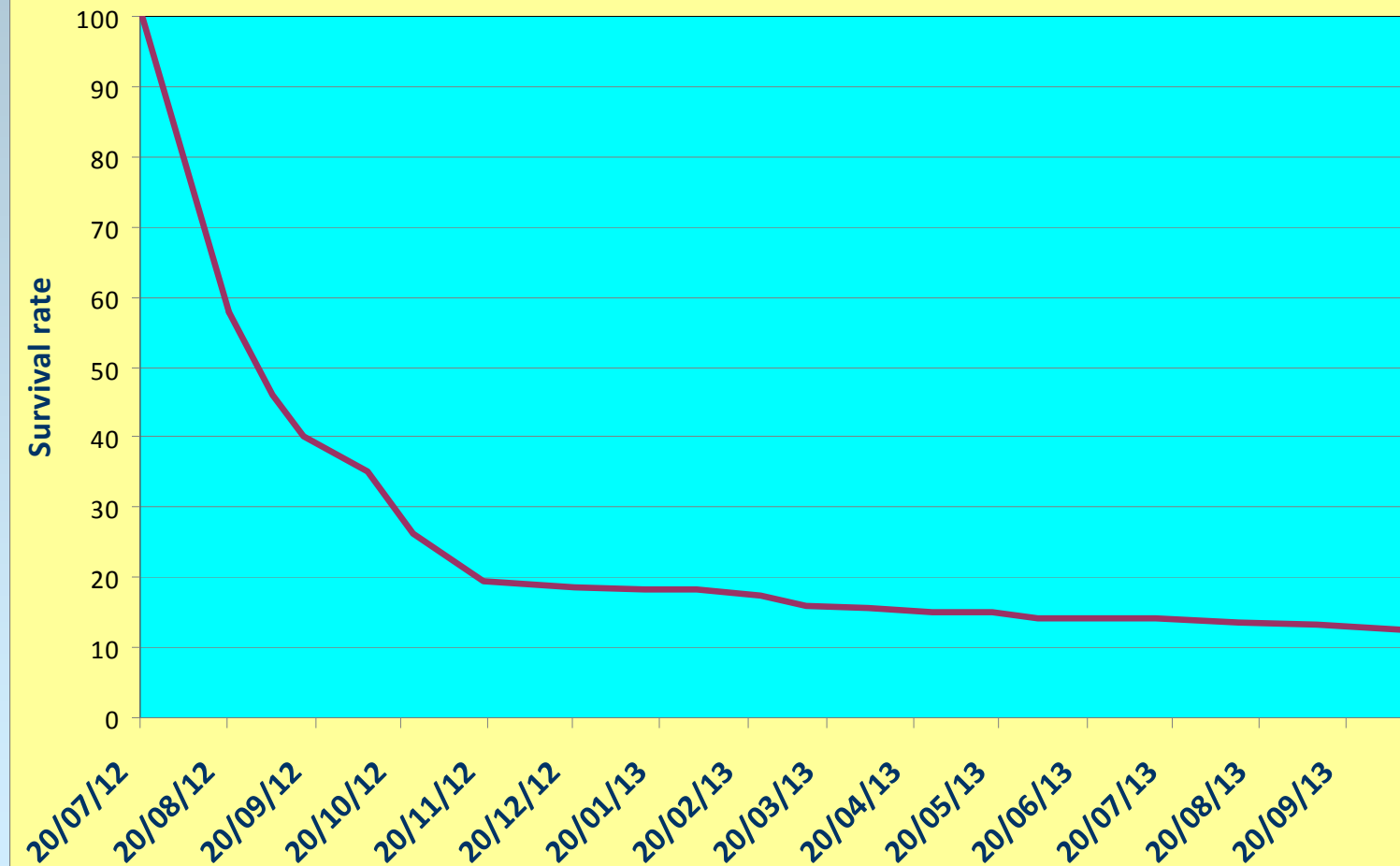
Juvenile production in Spain



Juvenile production in Spain



Survival rate of cultured bluefin tuna



Juvenile production in Spain



144 g

84 DPH

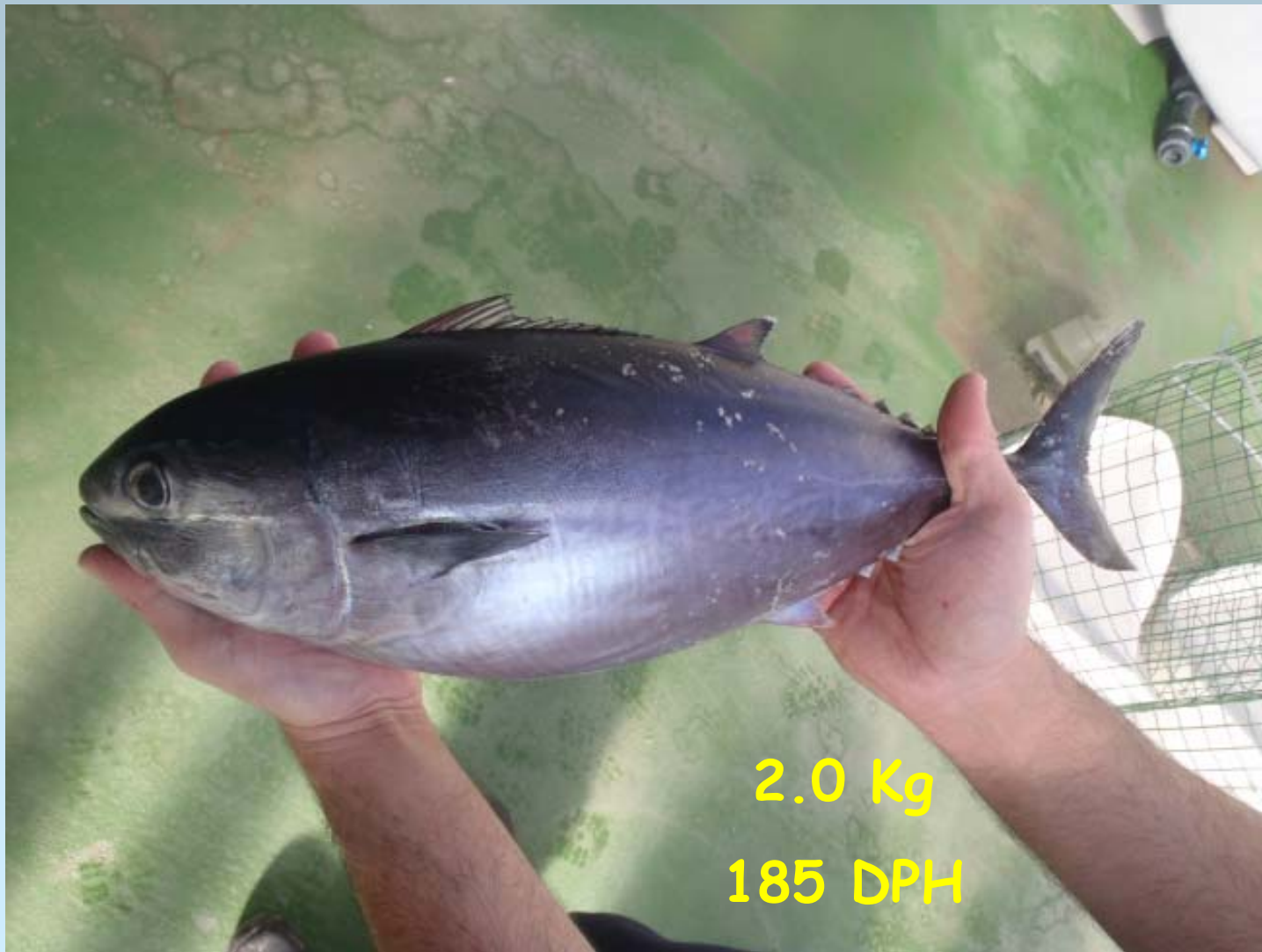
Juvenile production in Spain



1.2 Kg

125 DPH

Juvenile production in Spain



2.0 Kg

185 DPH

Juvenile production in Spain



4.0 Kg

395 DPH

Juvenile production in Spain



Juvenile production in Spain



2009 batch	73 DPH	0 BFT	30 g
2010 batch	120 DPH	0 BFT	100 g
2011 batch	2 years 6 months DPH	15 BFT	20 kg
2012 batch	1 year 6 months DPH	150 BFT	10 kg
2013 batch	6 months DPH	400 BFT	3 kg



Juvenile production in Spain



2 Year 6 months DPH 20 Kg



Juvenile production in Spain

Mortality causes

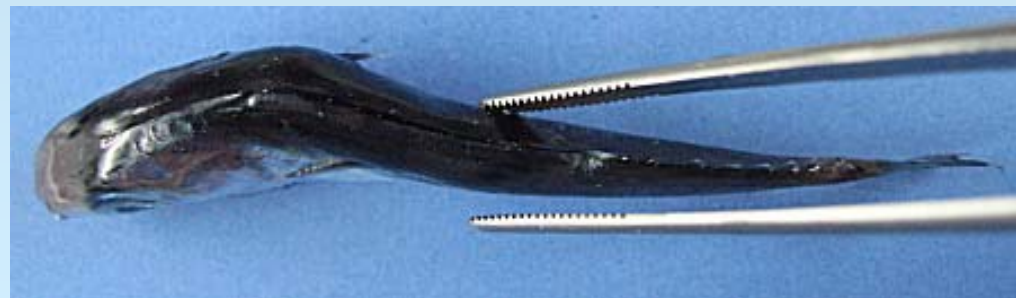
MALNUTRITION



CANIBALISM



COLLISIONS





NEW PROJECTS IN 2012-2014

**IMPROVEMENT OF THE
TECHNIQUES FOR
ENRICHMENT OF LIVING
PREYS AND WEANING
DIETS FOR BLUEFIN
TUNA (*Thunnus thynnus*)**

MALT

Skretting, IEO, Caladeros del
Mediterráneo y UPCT

Skretting contract

Advancing in the knowledge on
nutrition and requirements of
bluefin tuna larvae and juveniles

**IMPROVEMENT OF THE
TECHNIQUES OF
BLUEFIN TUNA (*Thunnus
thynnus*) AQUACULTURE**

TCAR

Caladeros del Mediterráneo
IEO, UPCT

CDTI (Spanish National Funding)

Advancing in the knowledge on
bluefin tuna larval rearing, and
juveniles transport and on-growing

**ASSESSMENT OF THE
ATLANTIC BLUEFIN
TUNA POPULATION
BREEDING IN THE
WESTERN
MEDITERRANEAN**

ATAME

IEO, UCA, AZTI and others.

Spanish National RTD Funding

Knowing several aspects of the
biology and ecophysiology of the
bluefin tuna eggs and larvae using
controlled conditions.



CONCLUSIONS

1.- The fact that the captive BFT broodstock spawned massively in a spontaneous way from 2010 up to now, far from the BFT natural spawning areas shows that :

(a) the conditions present in the area are sufficient to allow completion of the reproductive cycle

(b) the fish have reached an important degree of domestication as a result of their stay at the experimental farm for several years

2.- The sea weather and currents have a crucial influence on the amount of collected eggs

PROBLEMS

1.- The natural spawning period is too short (1.5 months) for maintaining a commercial activity

2.- Bad sea conditions could avoid the egg collection

3.- The bluefin tuna eggs comes with eggs of another species, some of them predators



ICRA

(Infrastructure for the Control of the Reproduction of Atlantic bluefin tuna)

FUNDED BY

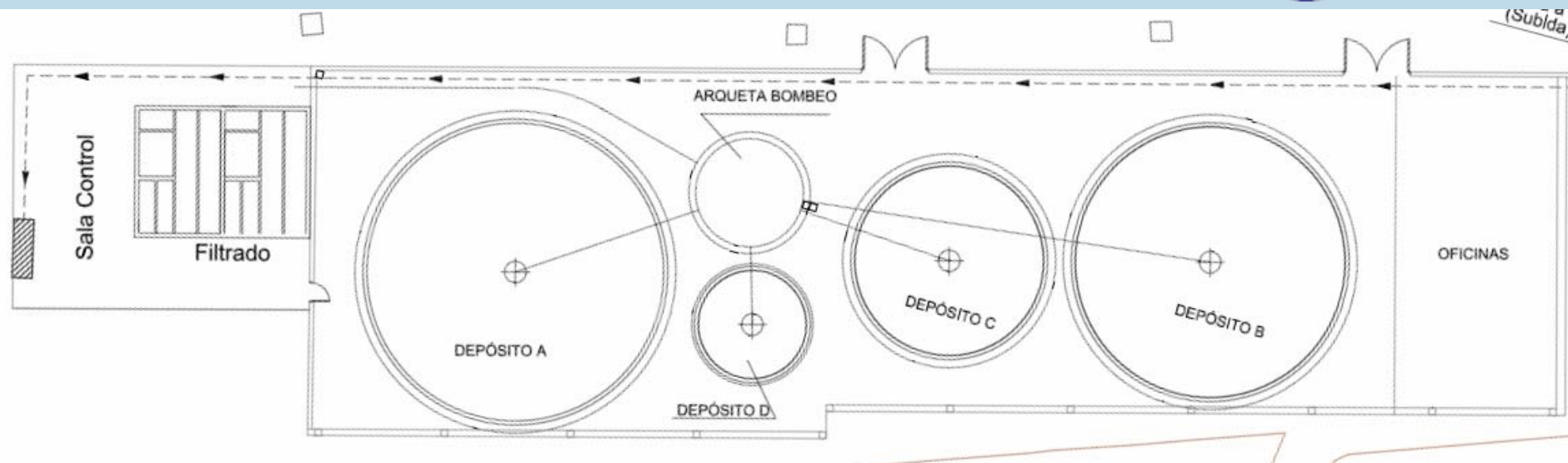
European Regional
Development Fund –FEDER
funded 70% , 4,25 M €
IEO contribute 30%, 1,75 M €
Duration: 2011 - 2013

PARTICIPANTS

IEO (Spain)
SCIENCE MINISTRY (Spain)
REGIONAL GOVERNMENT
OF MURCIA (Spain)

RESEARCHERS

Aurelio Ortega IEO
Fernando de la Gándara IEO



- 2 BROODSTOCK TANKS: 22 y 20 m Ø y 9 m depth 3.500 and 2.500 m³ 25 and 30 individuals
- 2 JUVENILES TANKS: 14 and 8 m Ø, 3 m depth. 900 and 150 m³



El futuro de la investigación

Grandes tanques en tierra (total 7.000 m³) para reproductores de atún rojo de 50-150 kg en Isla Plana, Cartagena (Murcia)



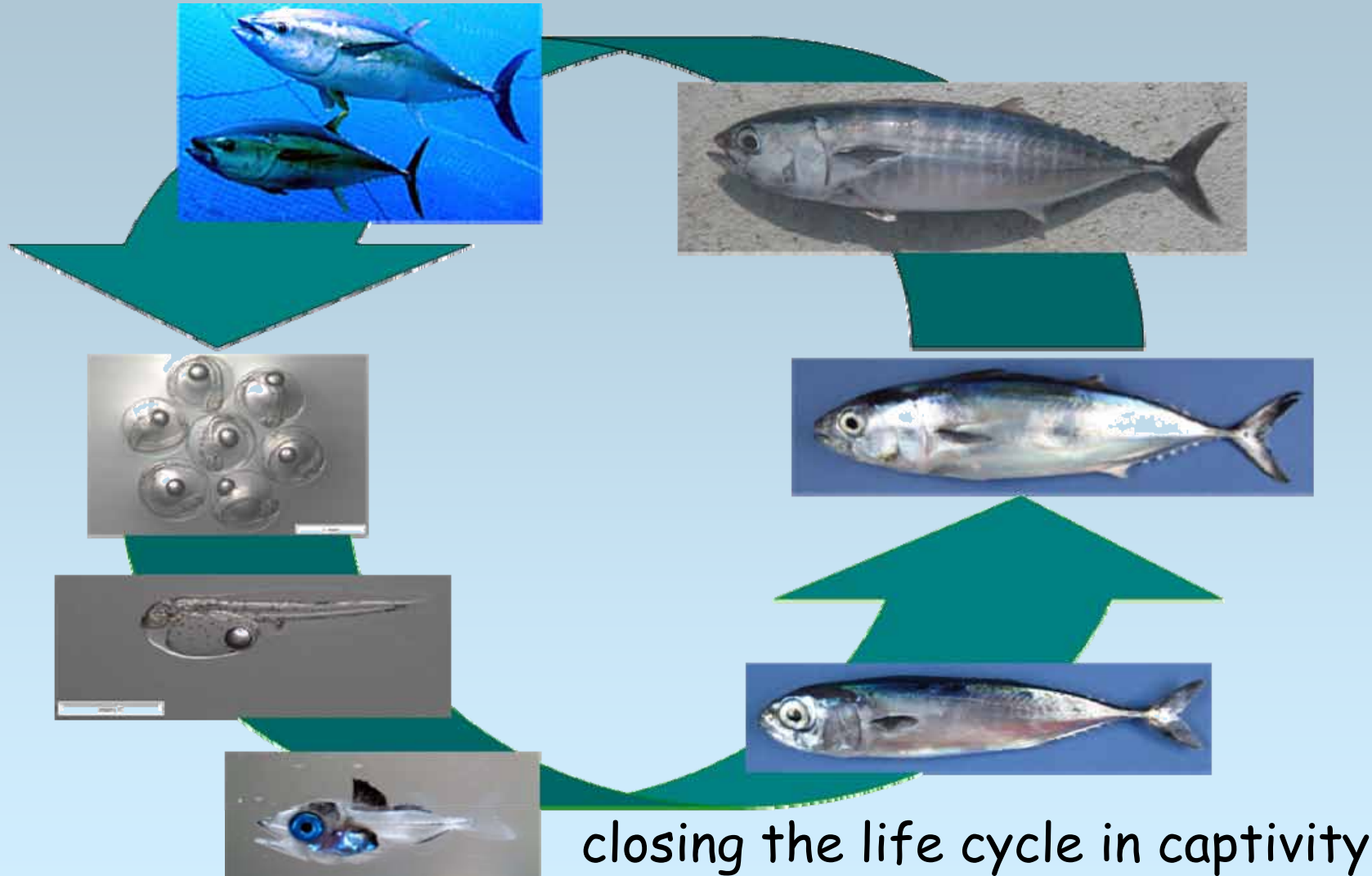
ICRA (Infrastructure for the Control of the Reproduction of Atlantic bluefin tuna)



ICRA (Infrastructure for the Control of the Reproduction of Atlantic bluefin tuna)



Juvenile production in Spain





References: www.repositorio.ieo.es

Spontaneous spawning of Atlantic bluefin tuna *Thunnus thynnus* kept in captivity <http://hdl.handle.net/10508/375>

SELFDOTT REPORT 2009 <http://hdl.handle.net/10508/356>

SELFDOTT REPORT 2008 <http://hdl.handle.net/10508/355>

SELFDOTT REPORT 2010-2011 <http://hdl.handle.net/10508/1118>

SELFDOTT Final report (Abstract) <http://hdl.handle.net/10508/1119>

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Preliminary results of capture, transport and adaptation to captivity of young of the year bluefin tuna (*Thunnus thynnus*). <http://hdl.handle.net/10508/1008>

Eight years of research on bluefin tuna (*Thunnus thynnus*) culture at the Spanish Institute of Oceanography (IEO). <http://hdl.handle.net/10508/1011>

Using an echosounder system to study the vertical movements of captive bluefin tuna (*Thunnus thynnus*) in floating cages. <http://hdl.handle.net/10508/1009>.

REPRODOTT Final Report (Reproduction of the Bluefin Tuna in Captivity - feasibility study for the domestication of *Thunnus thynnus*). <http://hdl.handle.net/10508/1010>

Domestication of *Thunnus thynnus* - DOTT. Proceeding of the first international Symposium held at the University of Cartagena, Spain, 3rd - 8th February, 2002. <http://hdl.handle.net/10508/1131>



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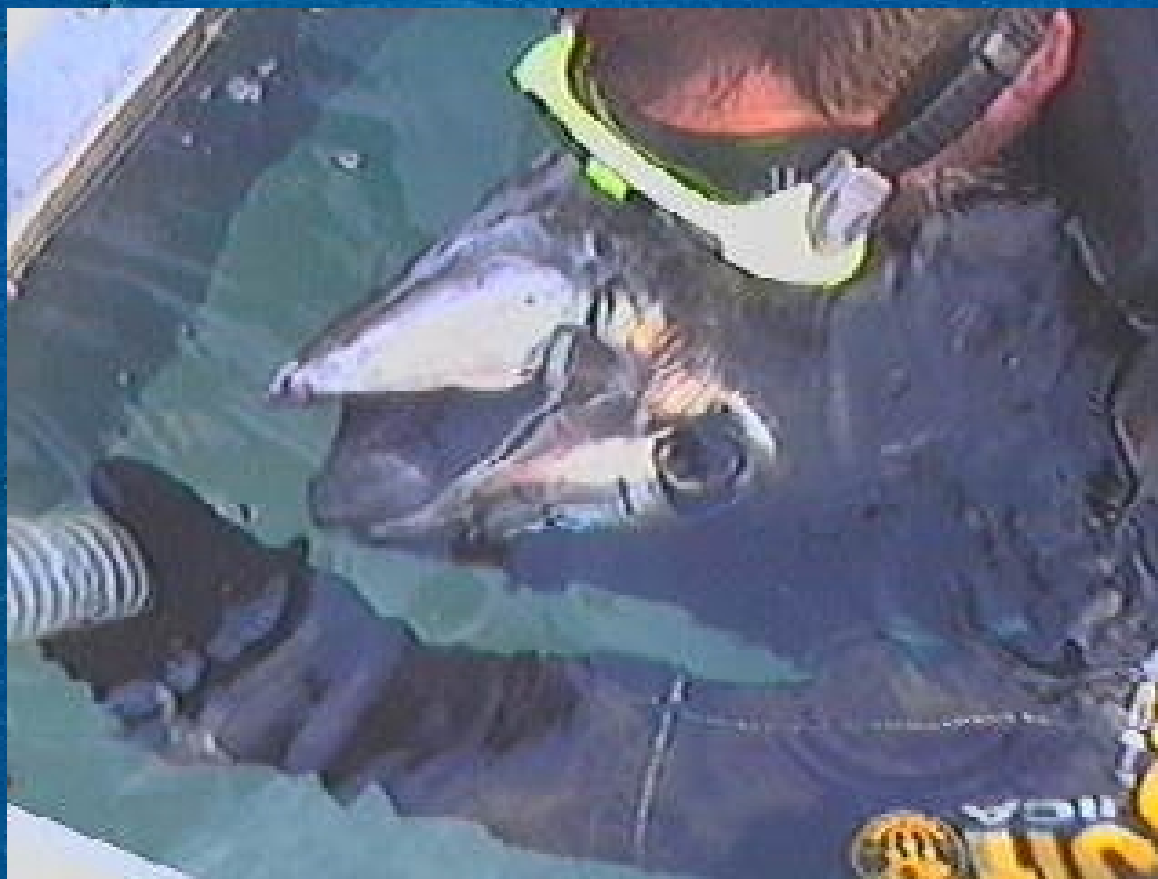
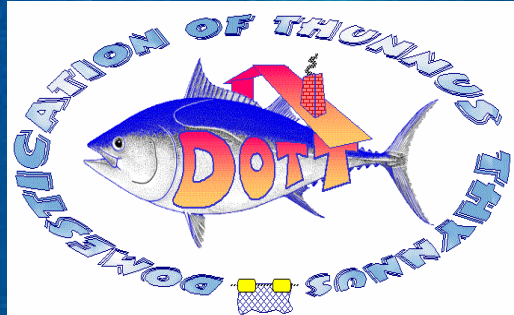


UN OCÉANO, UN FUTURO

1914-2014



I CENTENARIO
INSTITUTO ESPAÑOL
DE OCEANOGRAFÍA



THANKS FOR YOUR ATTENTION