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EpoMariNet
HRZZ

New Insights into the Reproductive Maturation and Spawning of Juvenile Atlantic Bluefin Tuna

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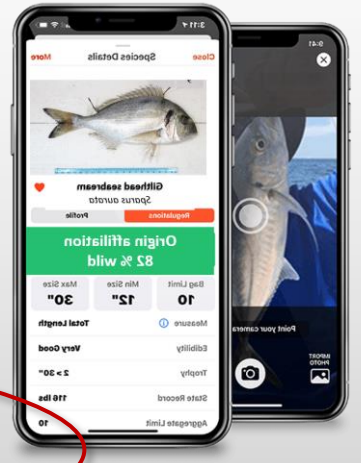
EpoMariNet - Enhancing Environmental Performance of Net-Pen Marine Aquaculture

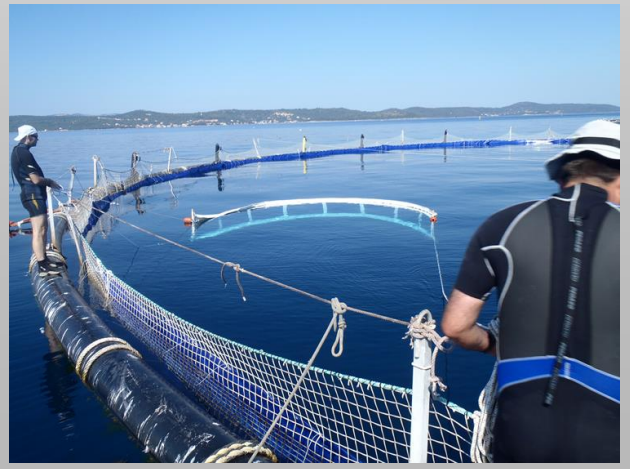
(2023-2027) – Croatian Science Foundation

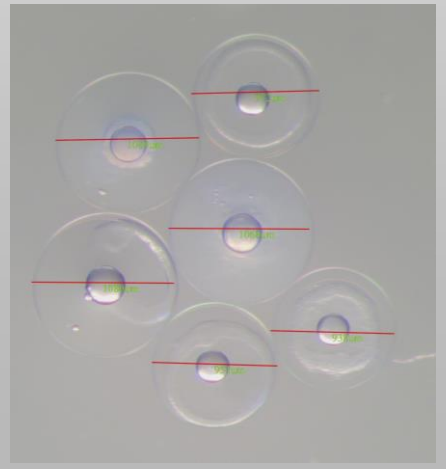
EpoMariNet HRZZ

Three interrelated interdisciplinary research tasks:

- **Develop an algorithm for fish origin** (wild vs. farmed) **traceability** for controlling instances of economic fraud.
- **Investigate biological and geochemical processes** associated with benthic enrichment caused by tuna farms.
- **Study reproductive performance and egg production** of farmed tuna in cages and to assess the impact of repopulating stocks from Adriatic farms.



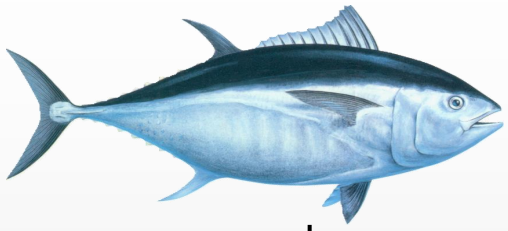




- **Tuna stocks** are managed by the International Commission for the Conservation of Atlantic Tunas – **ICCAT**- regulation of fishing quotas, temporal and spatial limitation of tuna fisheries
- Bluefin tuna **farming** based on stocking of **wild caught individuals**
- Purse seine is the most common capture tool
- Wild tuna are caught at different life-cycle stages (**derogation HR**)
- **Fish is kept alive** and transferred from towing cages to stationary ones – June
- Circular open-sea floating net cages where size vary from 30-50m in diameter, with net depths 20-30

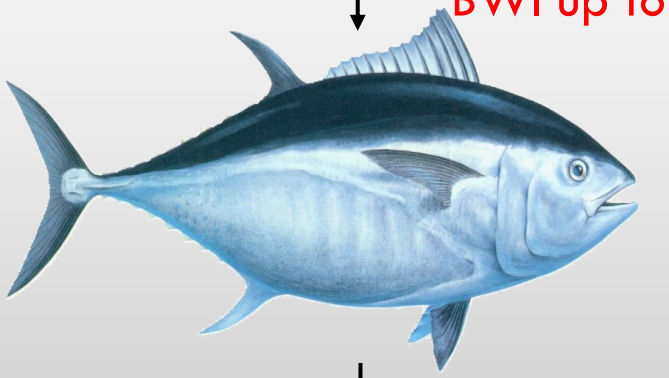
BLUEFIN TUNA FARMING

Started in 2001



18 months

BWI up to 460%

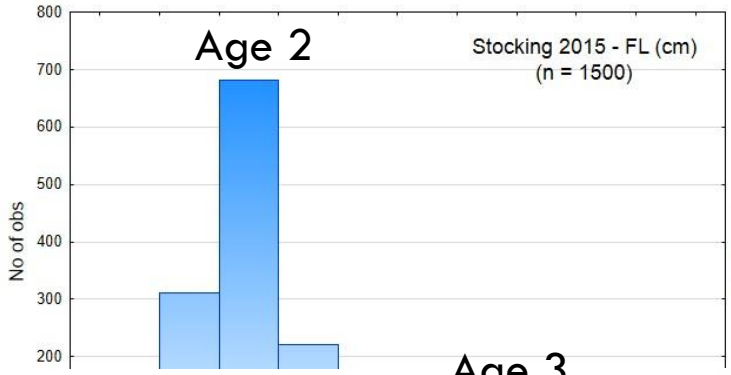


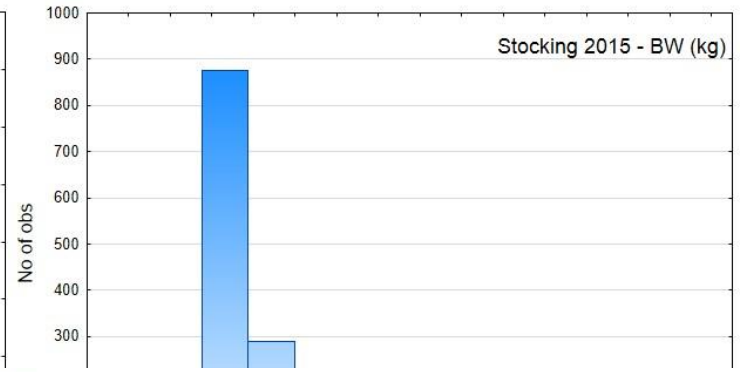
32 months

BWI up to 580%

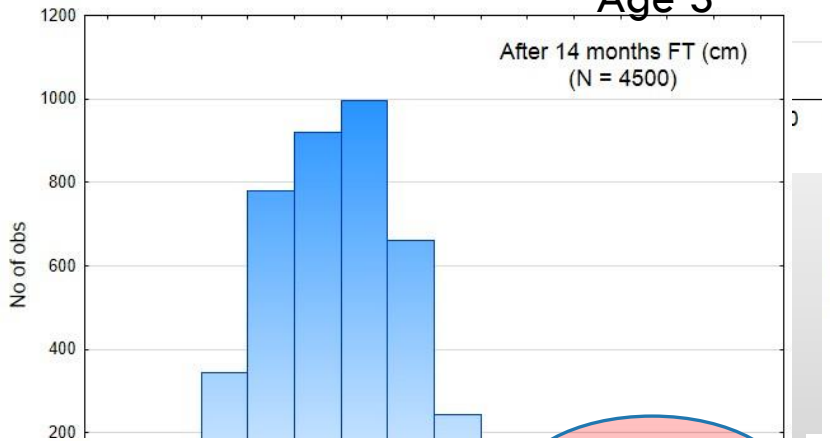
Katavić et al. 2017

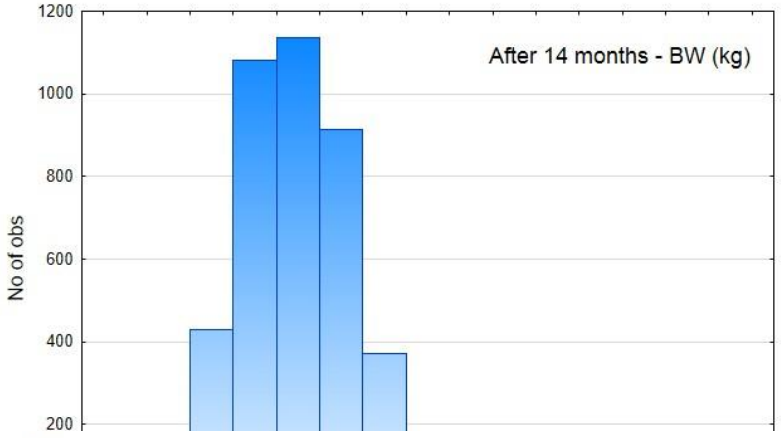
Age 2

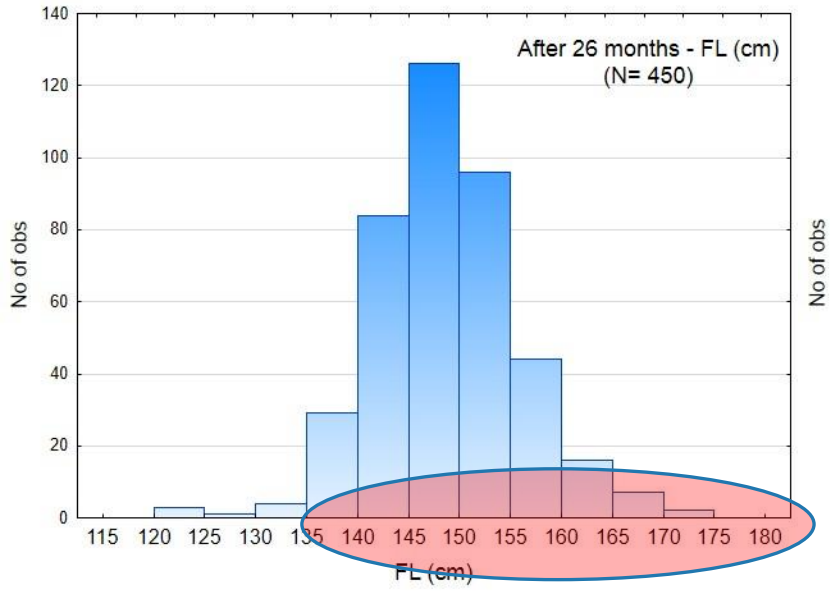


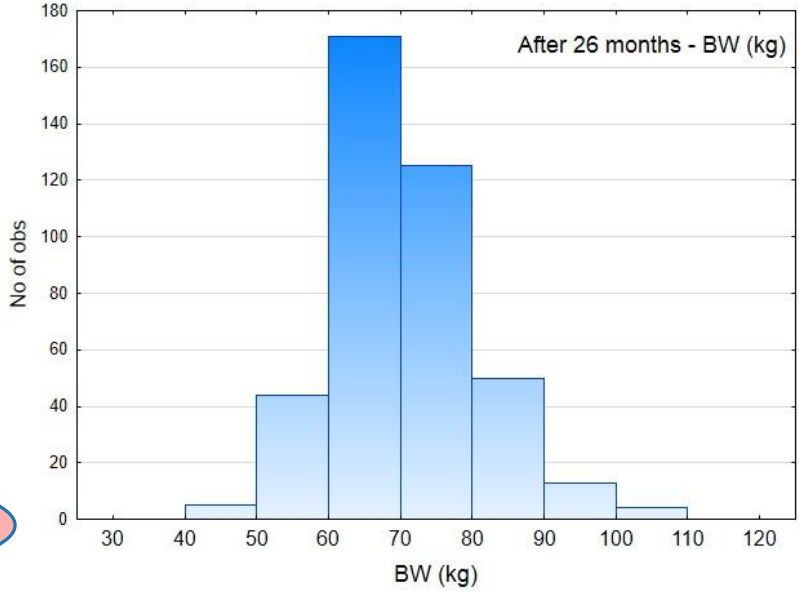


Age 3









- First spontaneous spawning behavior of captive BFT in cages at an Adriatic facility in summer 2011

Fisheries

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Morphological and Genetic Identification of Spontaneously Spawned Larvae of Captive Bluefin Tuna in the Adriatic Sea

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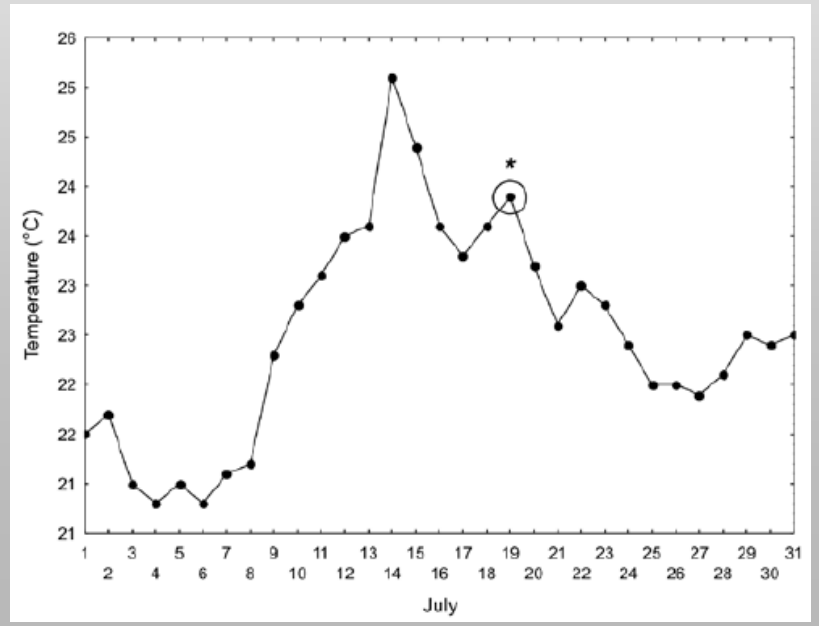


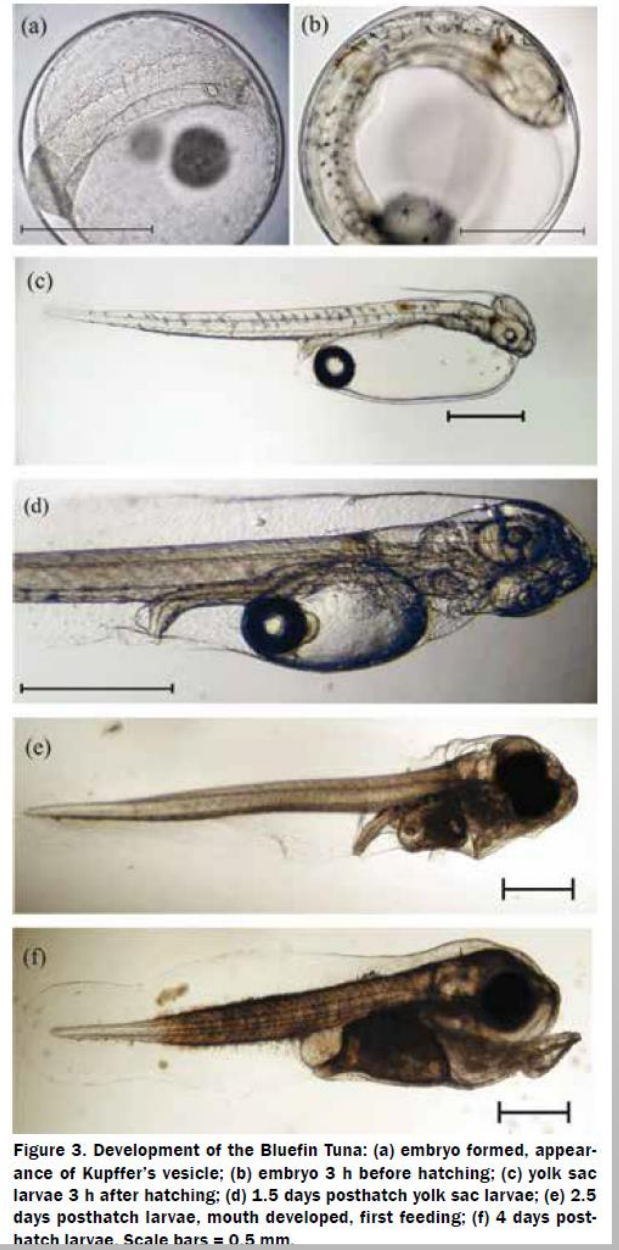
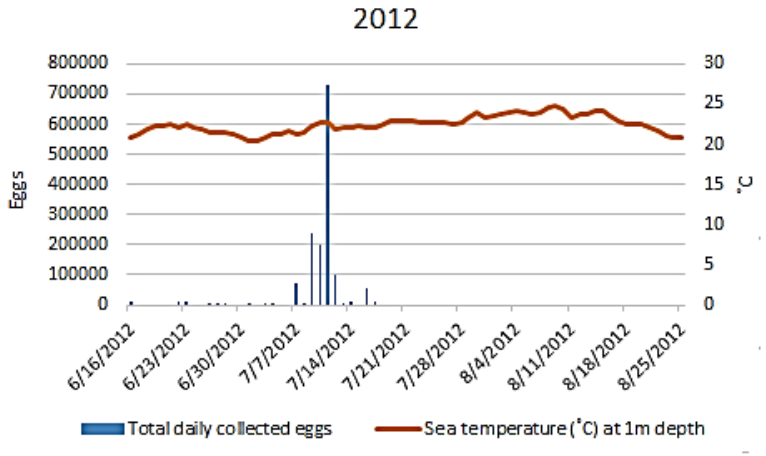
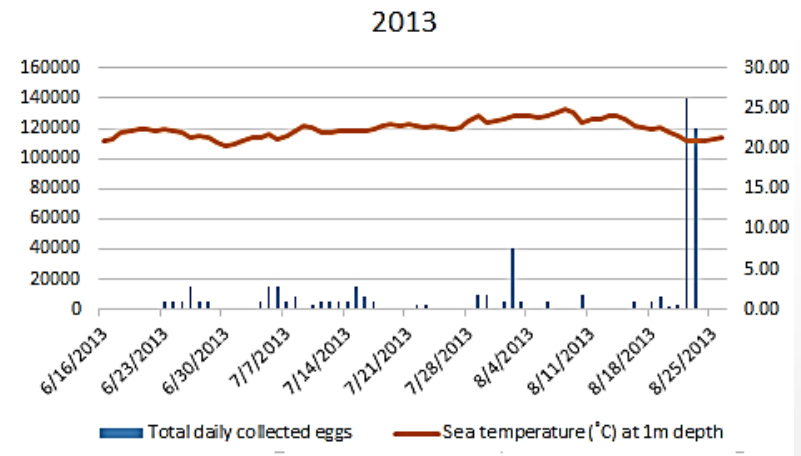
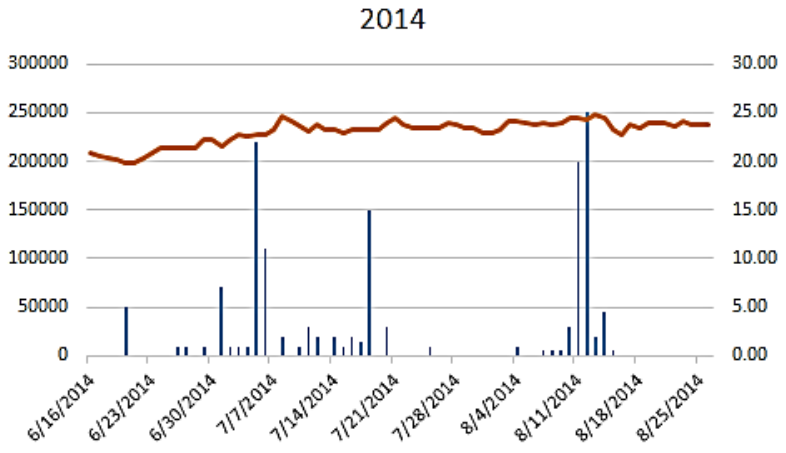
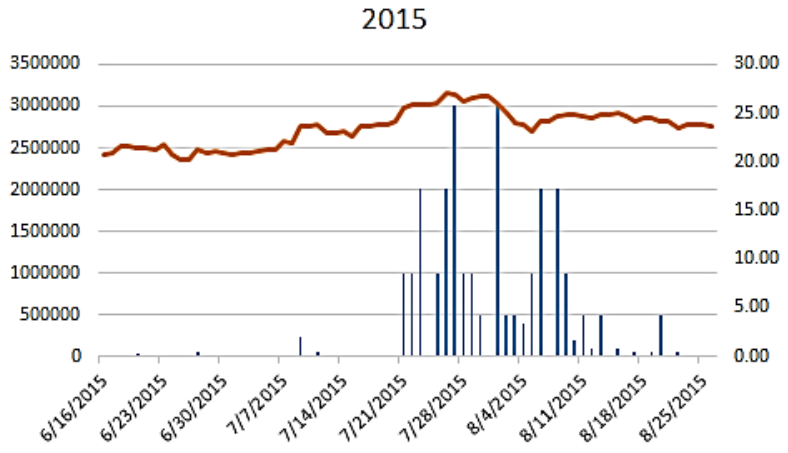


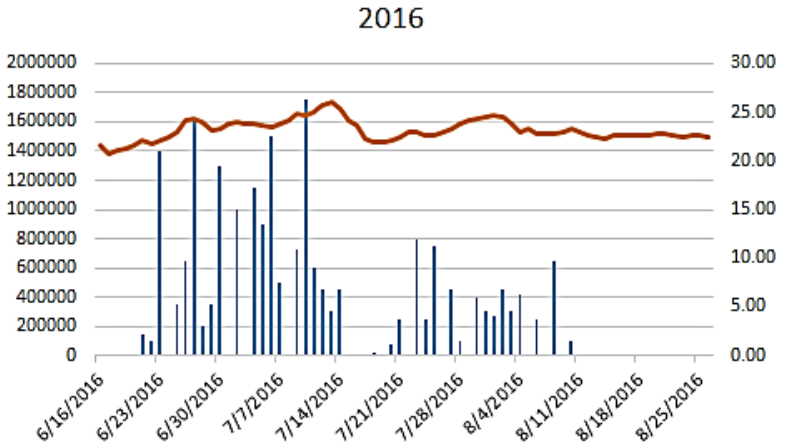
Figure 3. Development of the Bluefin Tuna: (a) embryo formed, appearance of Kupffer's vesicle; (b) embryo 3 h before hatching; (c) yolk sac larvae 3 h after hatching; (d) 1.5 days posthatch yolk sac larvae; (e) 2.5 days posthatch larvae, mouth developed, first feeding; (f) 4 days posthatch larvae. Scale bars = 0.5 mm.

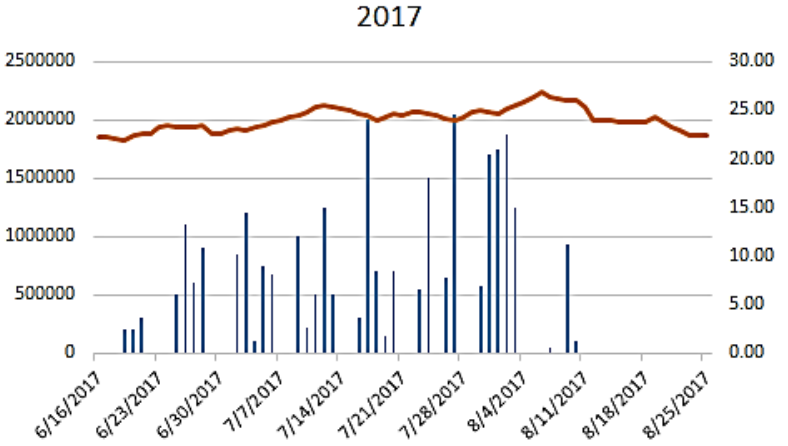




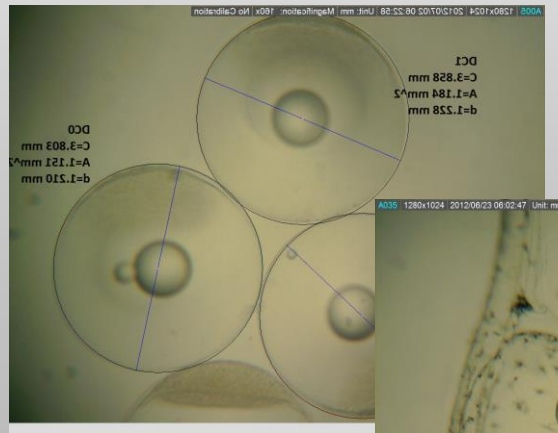








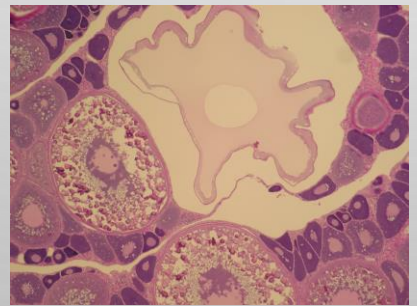
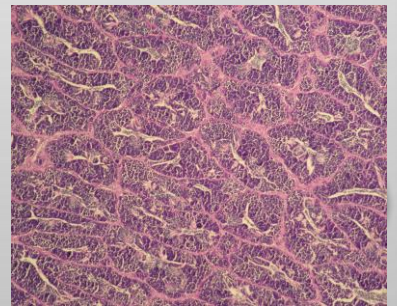
"CROATIAN SUCCESS" KALI TUNA d.o.o.



REPRODUCTIVE PERFORMANCE AND THE EGG PRODUCTION CAPACITY OF FARMED BFT STOCKS

- **Reproductive condition –** Evaluation of the gonadosomatic index (April–August 2024, FL > 135 mm)
- Gonad histology analysis during the spawning season **– Classification of gonads** and estimation of **batch fecundity**
- **Tuna egg survey** and collection during the reproductive season
- **Monitoring** of incidental catches **of YOY tuna** species in the **Adriatic Sea –** Estimation of spatial distribution, age-length, and length-weight relationships

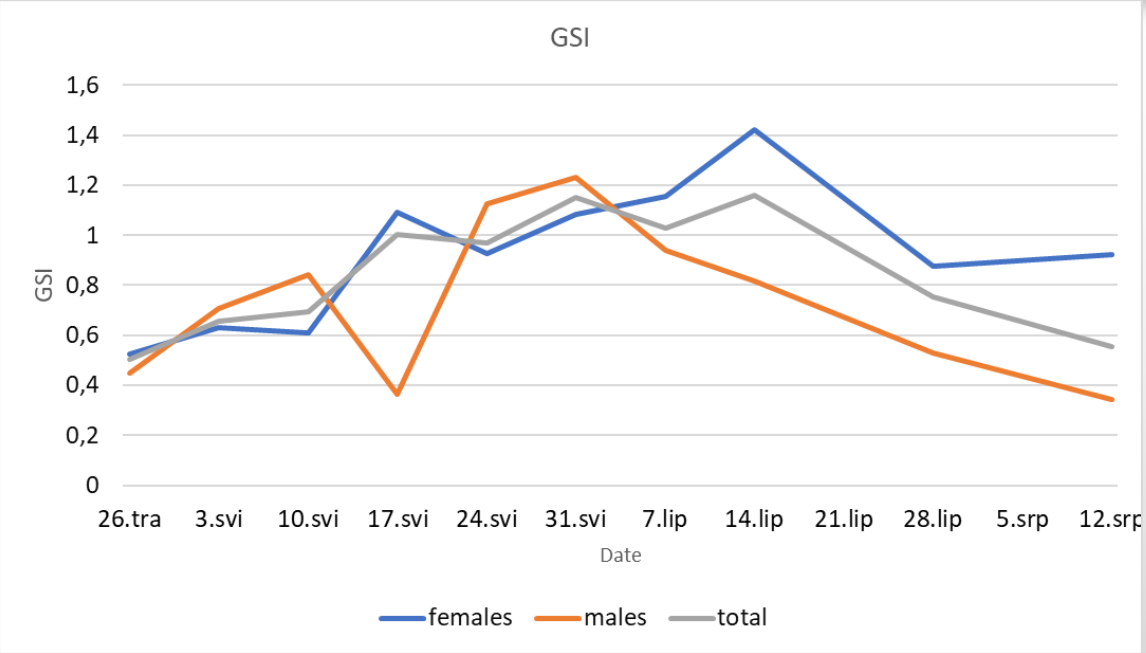


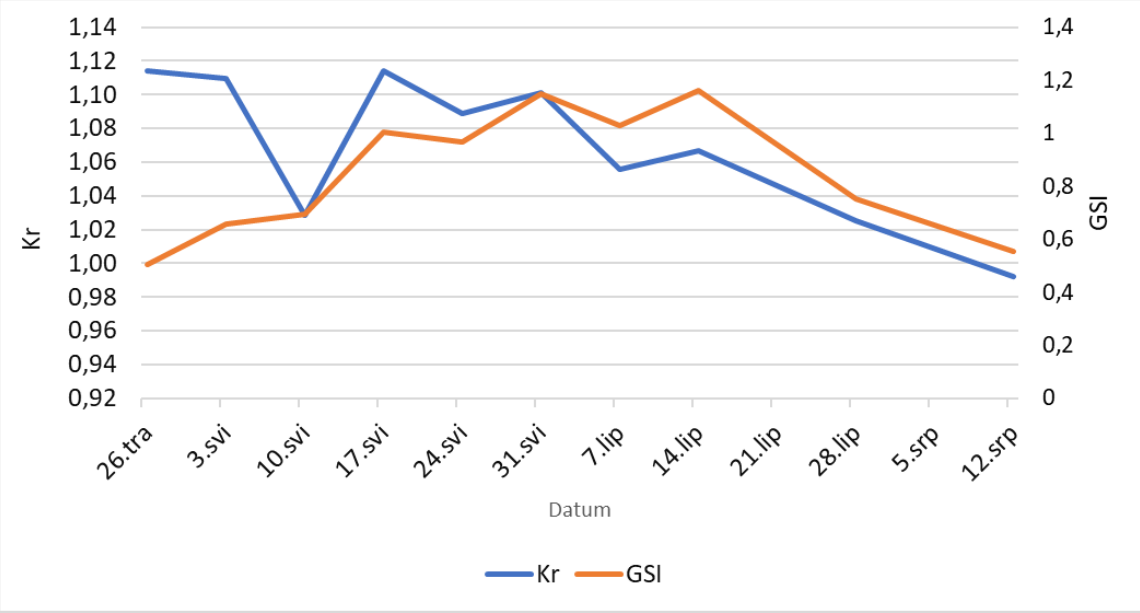



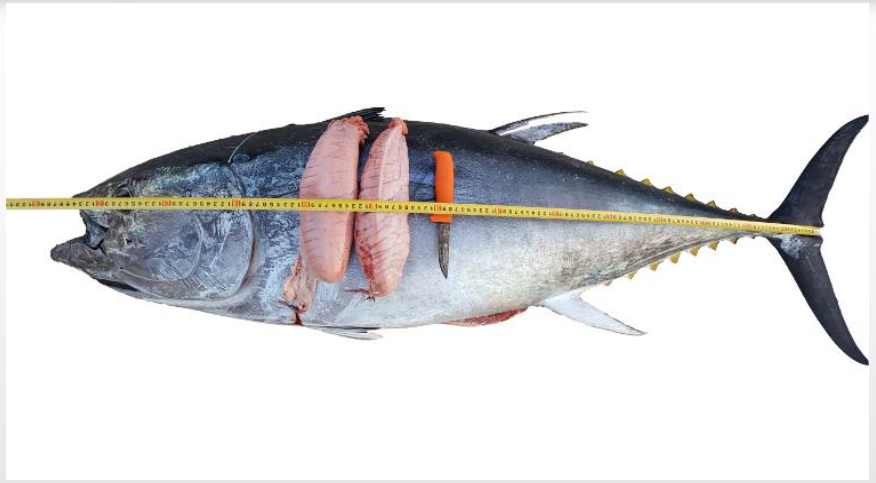
➢ Biometric data from the farmed Atlantic Bluefin tuna, *Thunnus thynnus*, weakly sampled from April to end of July 2024

	No samples	FL(cm)	FL(cm) Std.Dev.	WT (kg)	WT(kg) Std.Dev.
Farmed tuna	317	154,65	7,36	75,97	10,33
Wild tuna	105	144,03	13,54	68,21	43,43
Total	422	152,015	10,35	74,04	23,61

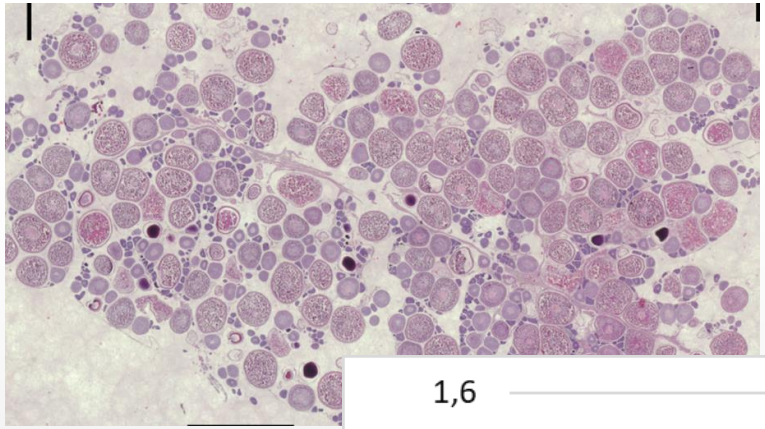
➢ Gonadosomatic index variation (GSI %) of females and males sampled from Croatian tuna farm

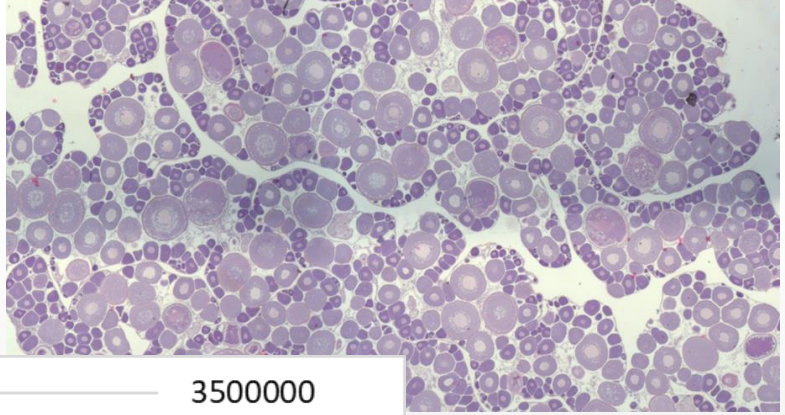


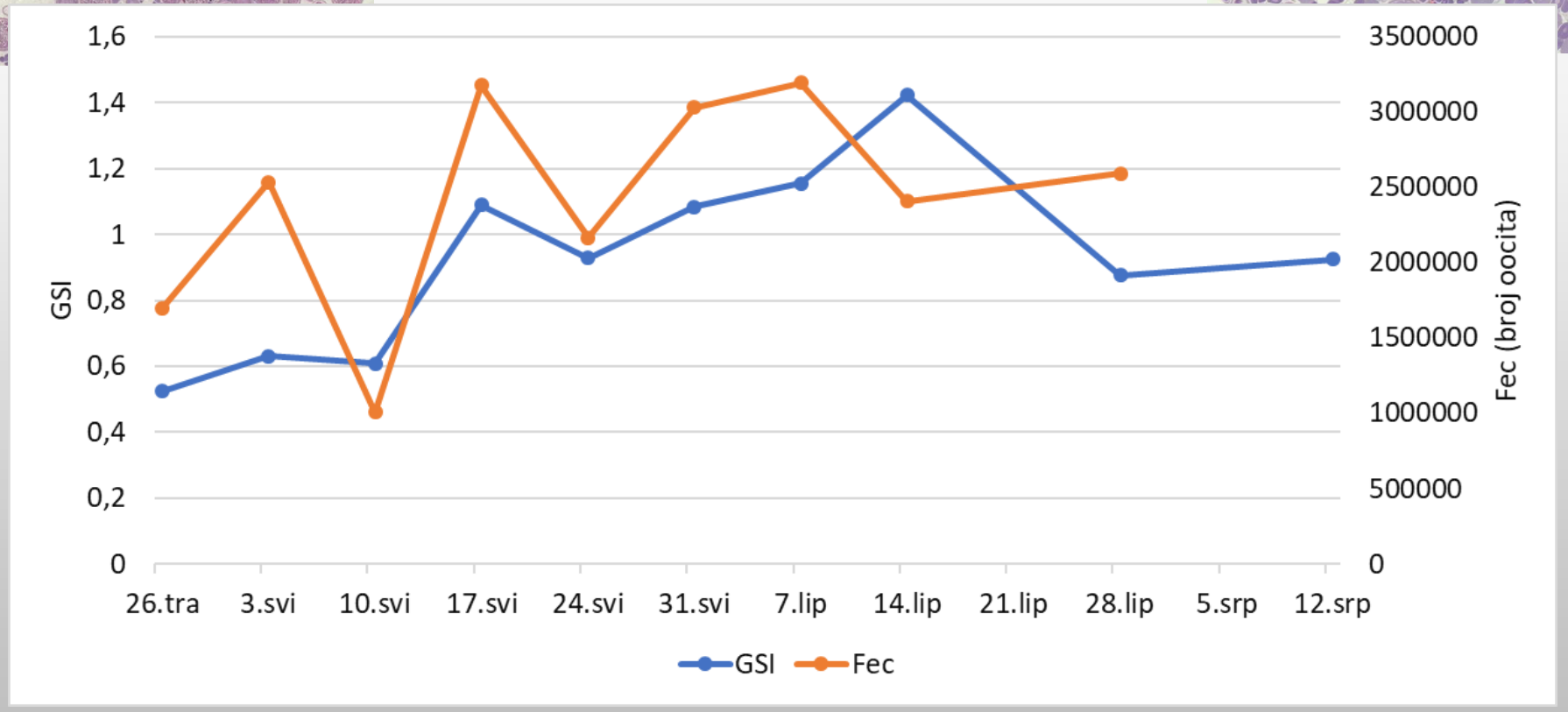




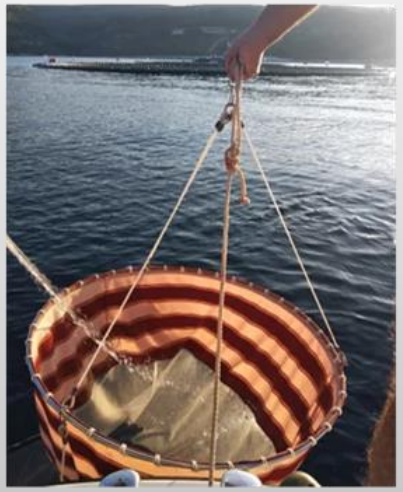
- the highest GSI values were observed during June (up to 1.4) after which the values decreased in July (below 1)
- for both sexes, the significant increase of GSI from April to May indicates that the May is the peak period of maturity for BFT caged in the Adriatic

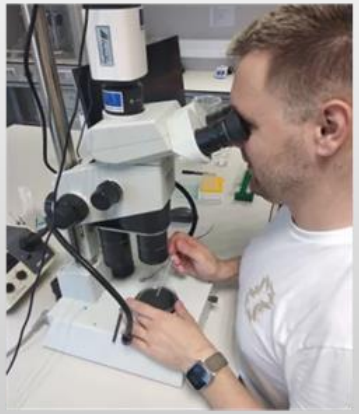


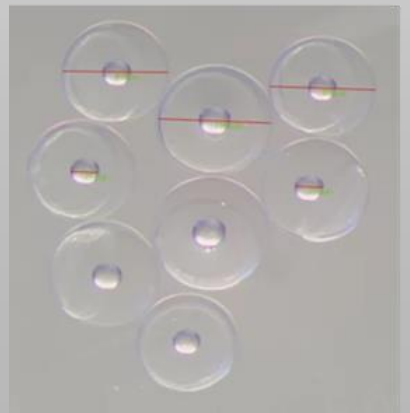


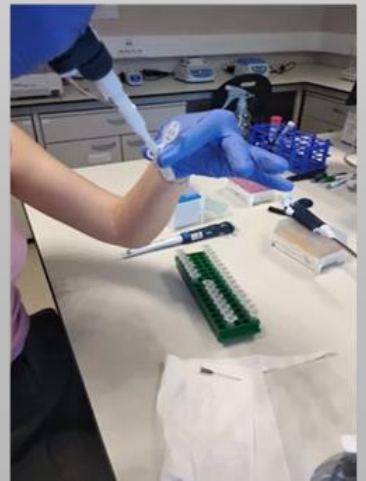


- Gravimetric method (Hunter et al. 1985) for females with late stage migratory nucleus or hydrated oocytes
- The relative batch fecundity ranged from 17 to 44 oocytes per gram of body weight with mean fecundity of 35 oocytes g^{-1}.









Ichthyoplankton Sampling Around Tuna Farms

• **Sampling Period:** Late May–July 2024, coinciding with tuna spawning

• **Methodology:** Plankton net sampling in early morning hours for optimal egg collection

• **Laboratory Analysis:** Egg identification under a magnifying lens; barcoding using the COI and CR regions

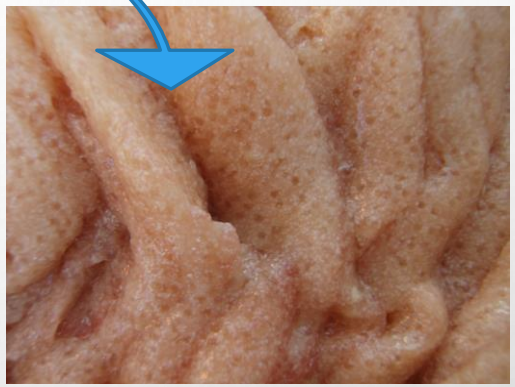
• **Results:** Over 100 tuna eggs successfully identified through molecular analysis

• **Next Steps:** In December, sampling potential parent fish from cages for genetic parentage testing.

• **Goal:** Determine parent-offspring relationships using molecular techniques

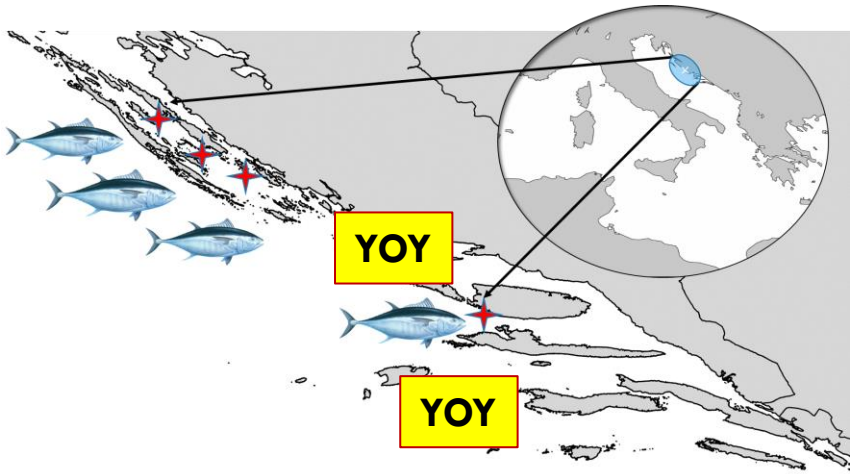
  • SNP genotyping (~8000 markers) for parentage analysis in Atlantic bluefin tuna.

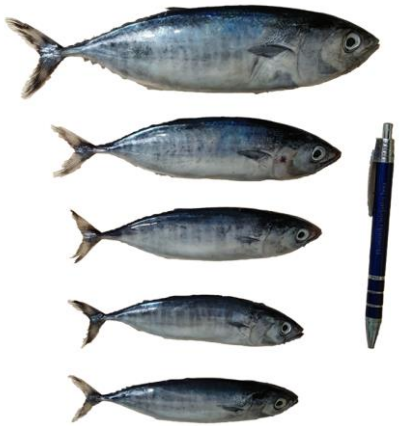
- 30.000 tuna - annual carry over to the next farming year ≈ 15% individuals reach BW of 60 kg in the spawning season ≈ 60% active spawners ≈ 50% females ≈ 1350 females may actively spawn in captivity

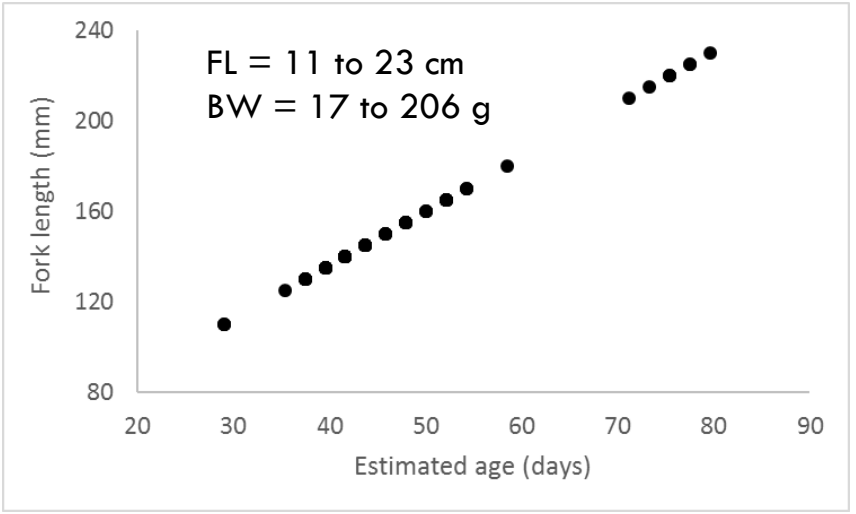


- With average BW of captive tuna (60 kg) and the batch fecundity (35 eggs gr-1), the batch egg production of each captive female can be around **2.1 million eggs** and the potential batch egg production of the whole group close to 2835 million
- If one egg per million produced in sea-cages survives to adulthood, our estimates suggest that **3240 fish per batch** could recruit into wild populations
- significant contribution to stock repopulation

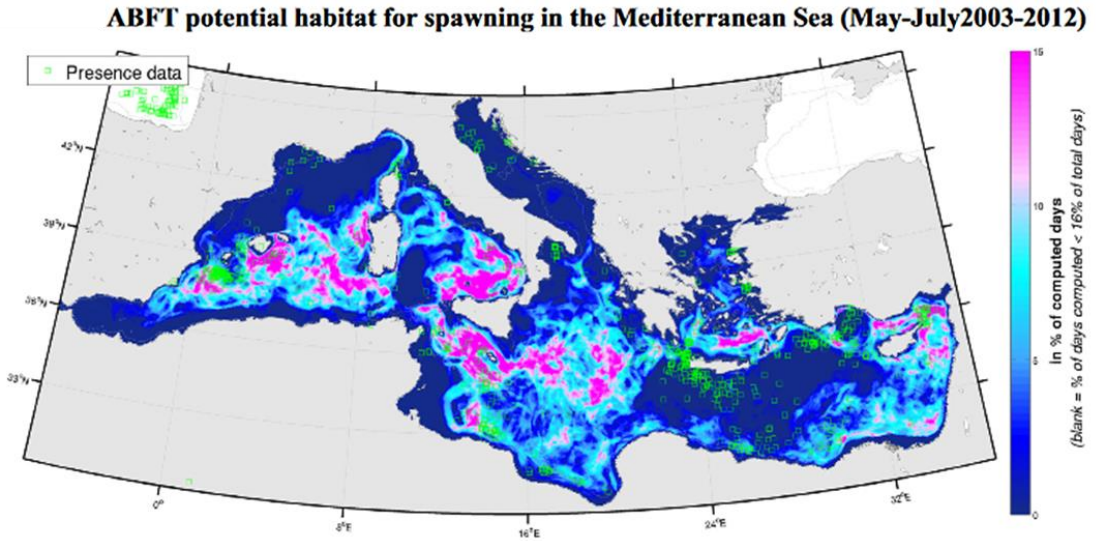
- YOY tuna samples collected during 2th and 3th week of August 2022-2024 in the south and middle part of eastern Adriatic (Mljet and Brač archipelago)







- Growth model from La Mese et al. (2005) - age estimates ranged from 29 days to 80 days with mean ± SD **age of 46 ± 9.8.**
  - '**escape through spawning**' phenomenon could be the vector for juveniles tuna increase in the Adriatic or
  - Adriatic Sea act as a spowning ground ????



OPEN QUESTIONS

- FISH FECUNDITY AT THE DIFFERENT AGE AND WEIGHT
- SURVIVAL OF EARLY DEVELOPMENT STAGES…..

Thank you!