

COCKLES

Co-Operation for Restoring Cockle Shellfisheries
and its Ecosystem-Services in the Atlantic Area

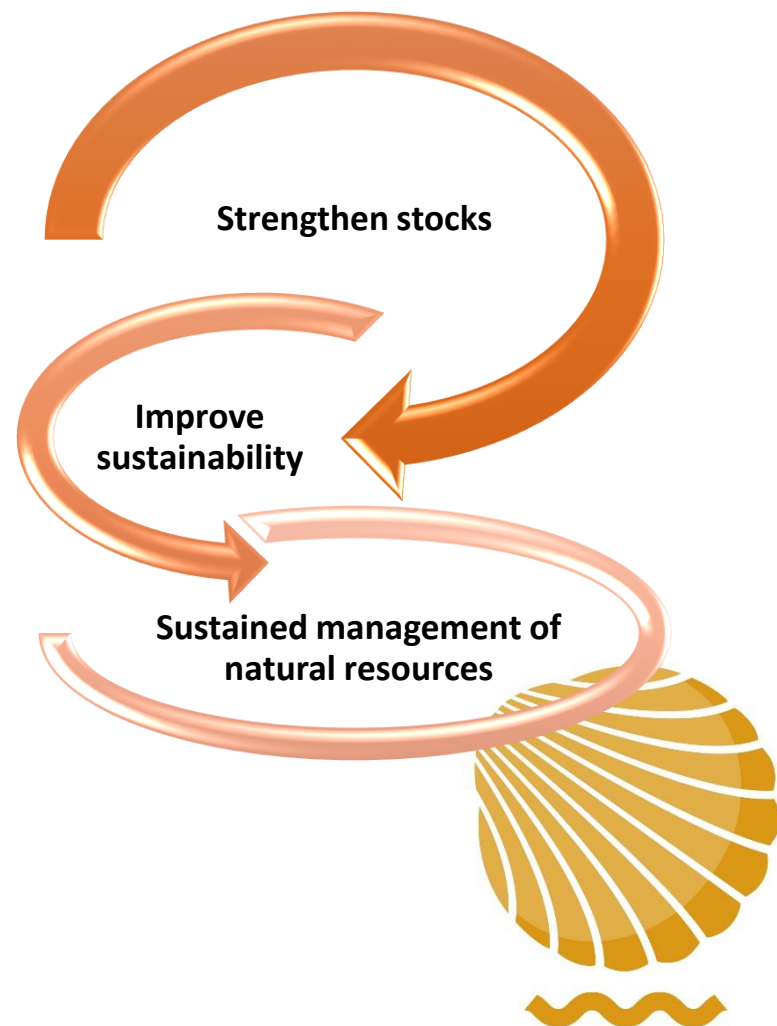
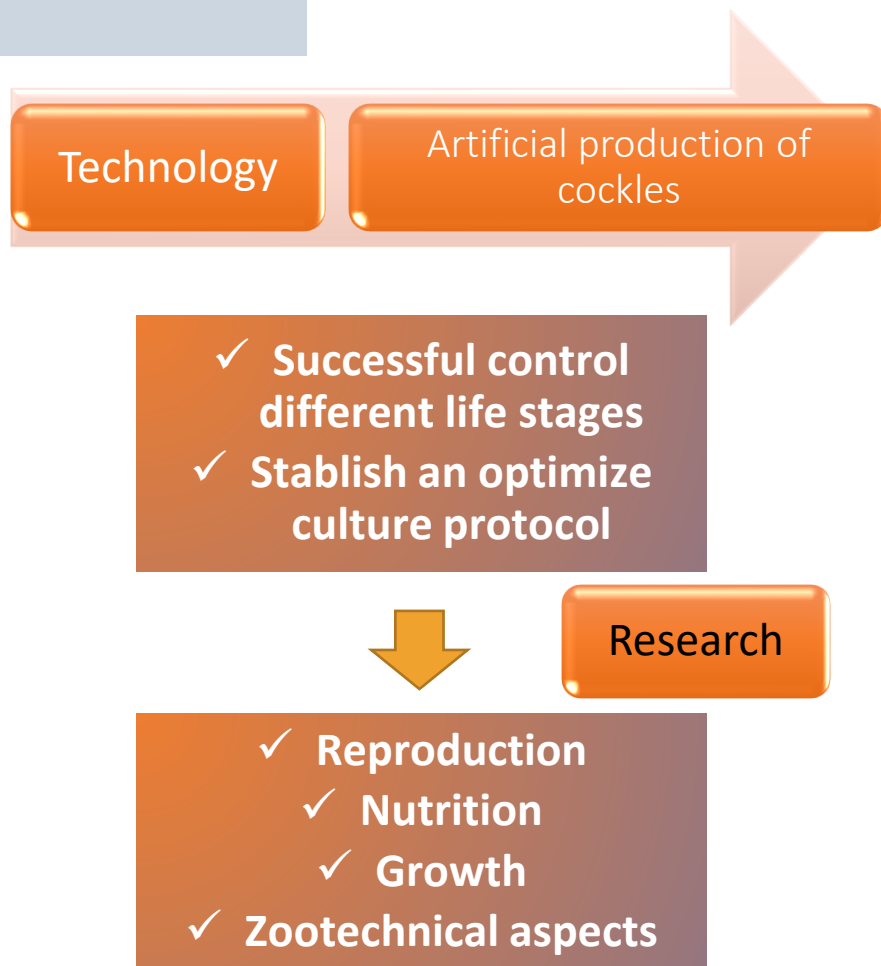
Opportunities from progress in culture techniques

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FINAL VIRTUAL CONFERENCE
March 2021



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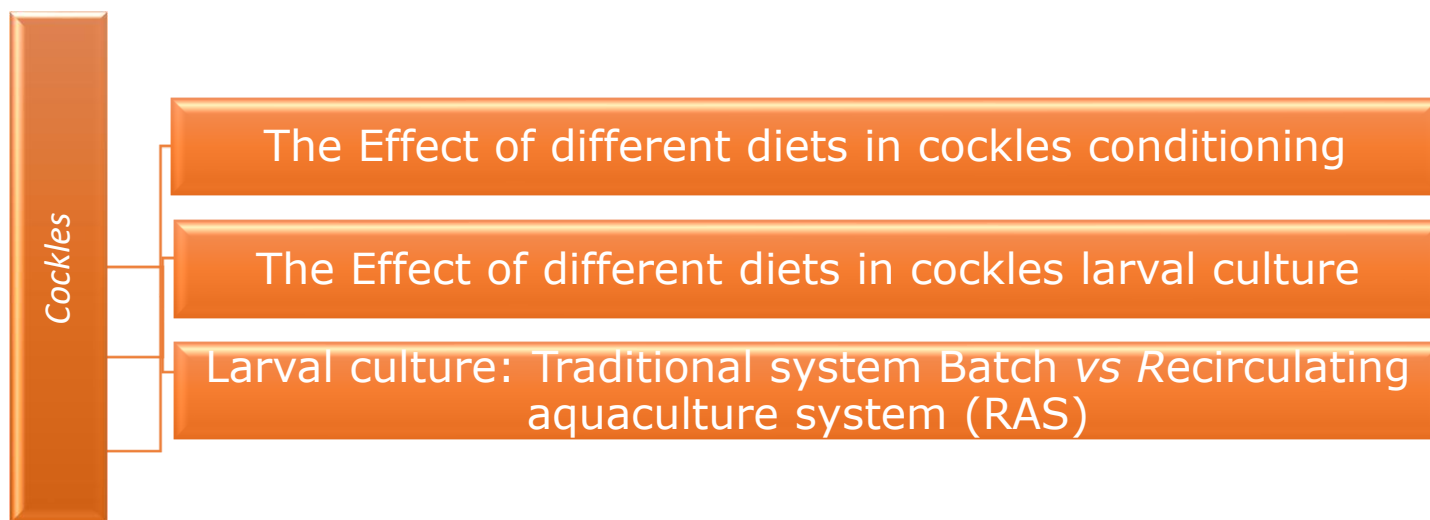
- Objective

Cost-effective procedures will be settled to produce cockle seed in hatchery facilities and to grow outdoor up to market size, minimising the impact on the ecosystem.



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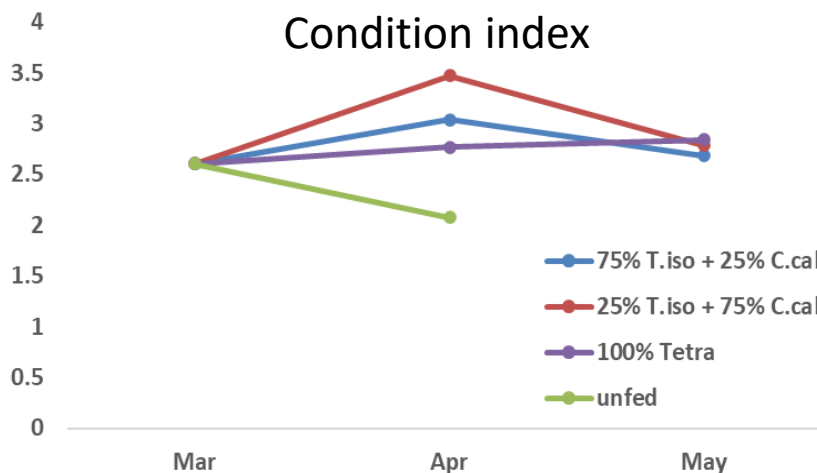
Hatchery



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Conditioning

- **Diet 1** – *Isochrysis aff galbana* (T-iso) 75%+ *Chaetoceros calcitrans* (C.cal) 25%
- **Diet 2** – *Isochrysis aff galbana* (T-iso) 25%+ *Chaetoceros calcitrans* (C.cal) 75%
- **Diet 3** – *Tetraselmis suecica* 100% (Published results)



Best diet

Isochrysis aff galbana (T-iso) 25%+ *Chaetoceros calcitrans* (C.cal) 75%



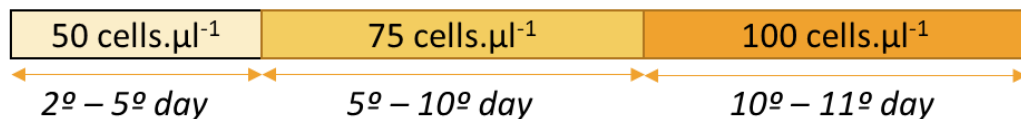
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Larval rearing

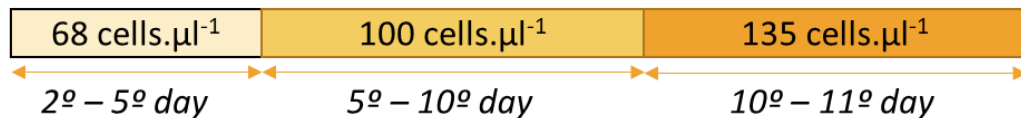
The effect of different diets in larval rearing

Feeding plans

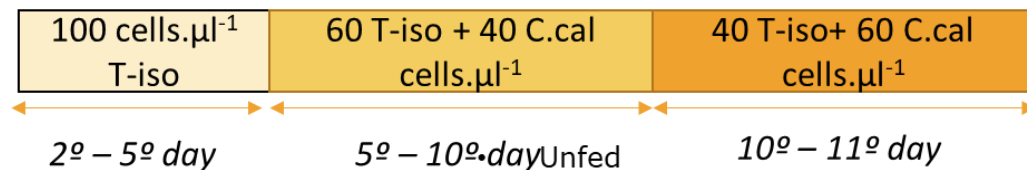
- Diet 1 – *Isochrysis aff galbana* (T-iso)



- Diet 2 – *Chaetoceros calcitrans* (C.cal)



- Diet 3 – *Isochrysis aff galbana* + *Chaetoceros calcitrans* (Tiso+Ccal)



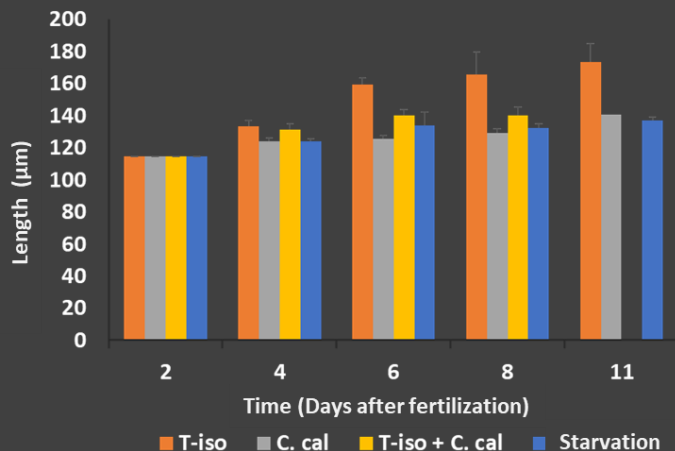
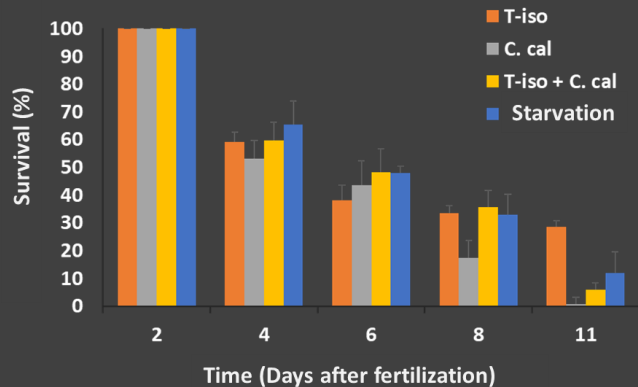
* Larvae were fed daily to provide equal biomass proportions of T-iso and C. cal in a ration cell number



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Larval rearing

The effect of different diets in larval rearing



✓The mono-specific diet T-iso is the most suitable diet for larval rearing;

✓The settlement was initiated at 11th days of culture only with diet 1;

✓Clearly, the diets with C. cal microalgae was not adequate for cockle larval.



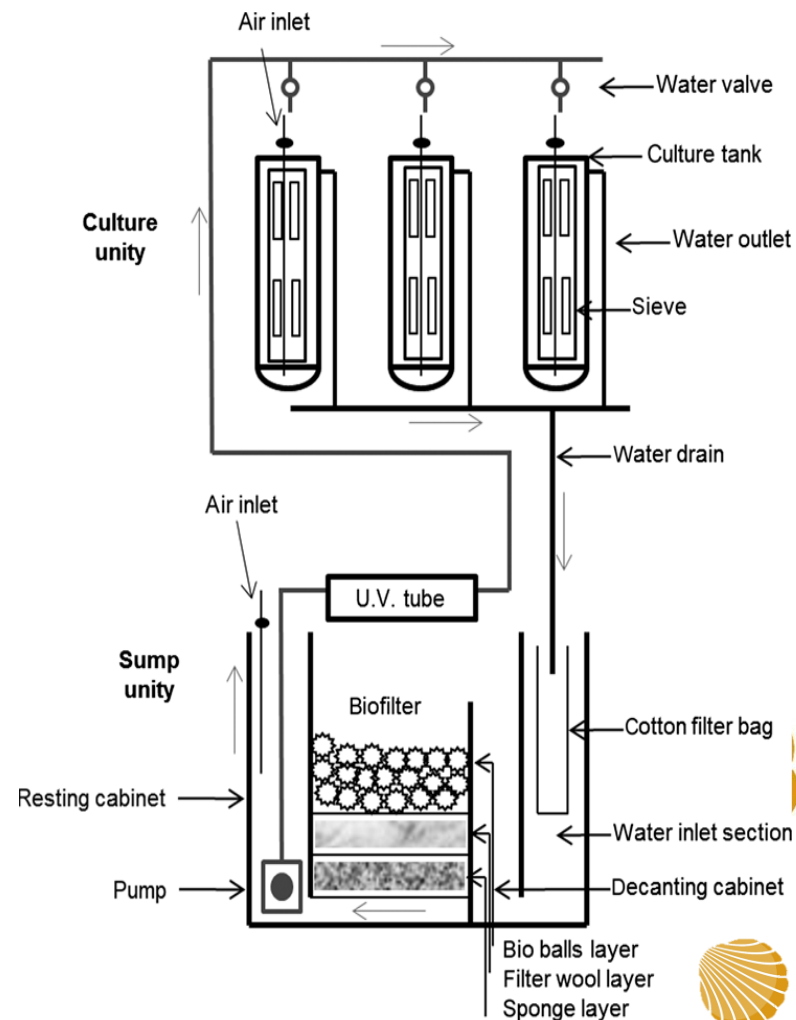
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Larval rearing

Batch vs RAS

Experimental design:

- ✓ Laboratory-scale closed recirculating system – RAS
 - 5-l tanks with natural filtered ($0.45\ \mu\text{m}$) and UV- sterilized seawater
 - 10% of water changed daily
 - Initial Larvae density of 7, 10 and 30 larvae ml^{-1}
 - 4 Replicates
 - Food (T-iso) was added daily to each sump unity
- ✓ Traditional larval rearing system – Batch.
 - 20-l tanks with natural filtered ($0.45\ \mu\text{m}$) and UV- sterilized seawater
 - Water changed every other day
 - Initial Larvae density of 7 larvae ml^{-1}
 - 3 Replicates
 - Food (T-iso) was added daily to each sump unity

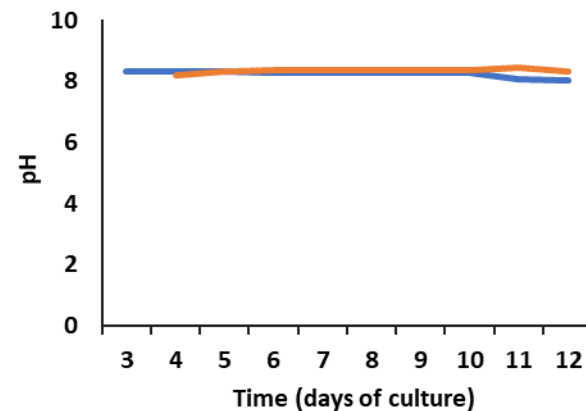
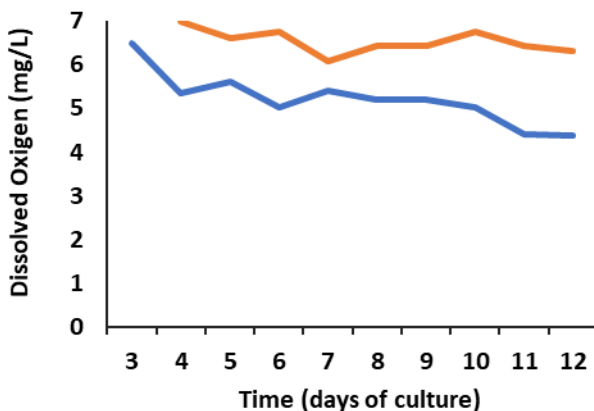
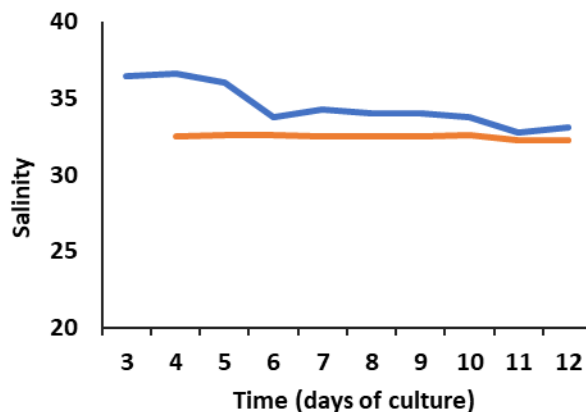
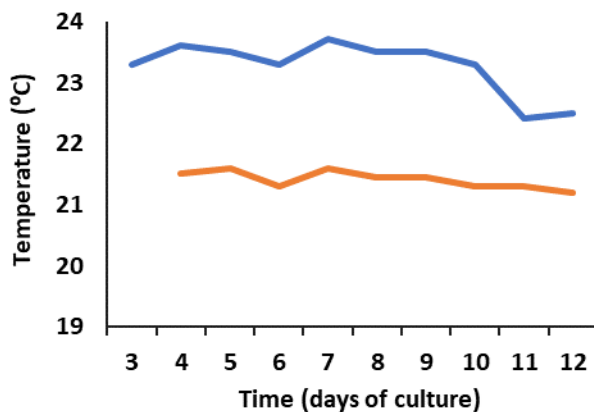


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Larval rearing

Batch vs RAS

Results: Physical parameters of water



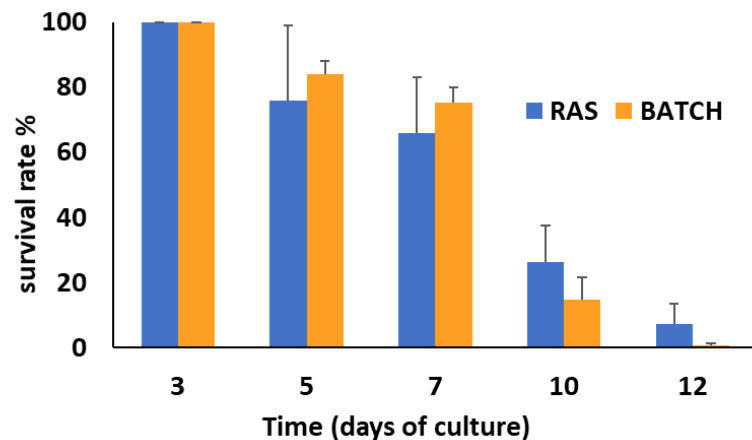
— RAS — Batch



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Larval rearing

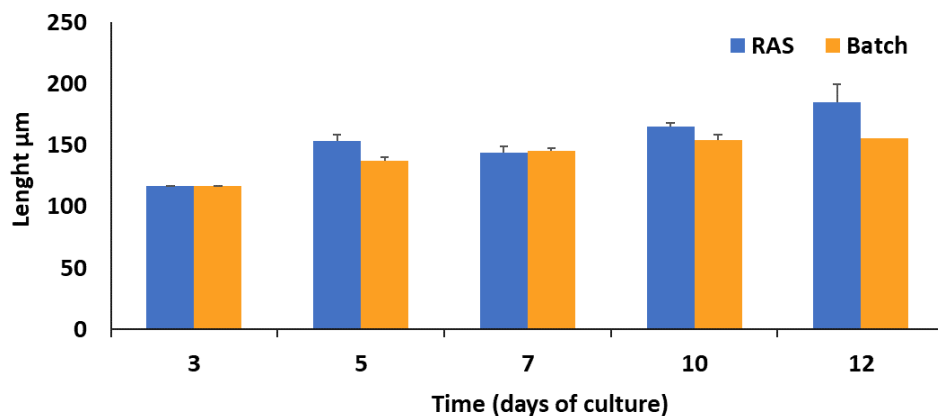
Batch vs RAS



✓ Mortality high in both systems;

✓ Differences in growth only in the last day of culture.

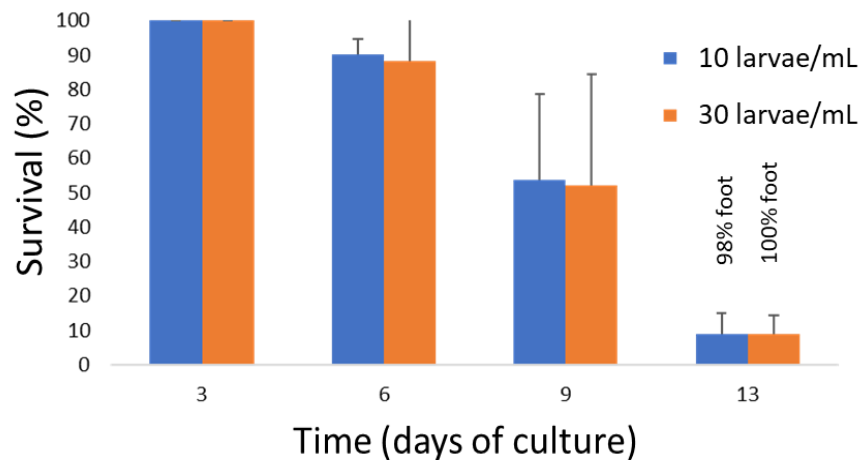
✓ Foot: RAS-70%; Batch-49%



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Larval rearing

Densities in RAS



✓ No differences between densities;

✓ On 13th day of culture, all live larvae were metamorphosed.



but it is not necessary in feeding the larvae



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Hatchery

In summary...

- ✓ Diatoms (*C. cal*) are an important component in adults conditioning, but it is not necessary in larvae feeding.
- ✓ The mono-specific diet T-iso is the most suitable diet for larval rearing;
- ✓ No significant differences were observed between RAS and Batch systems.
- ✓ It is possible to triple the density on larval rearing in RAS.

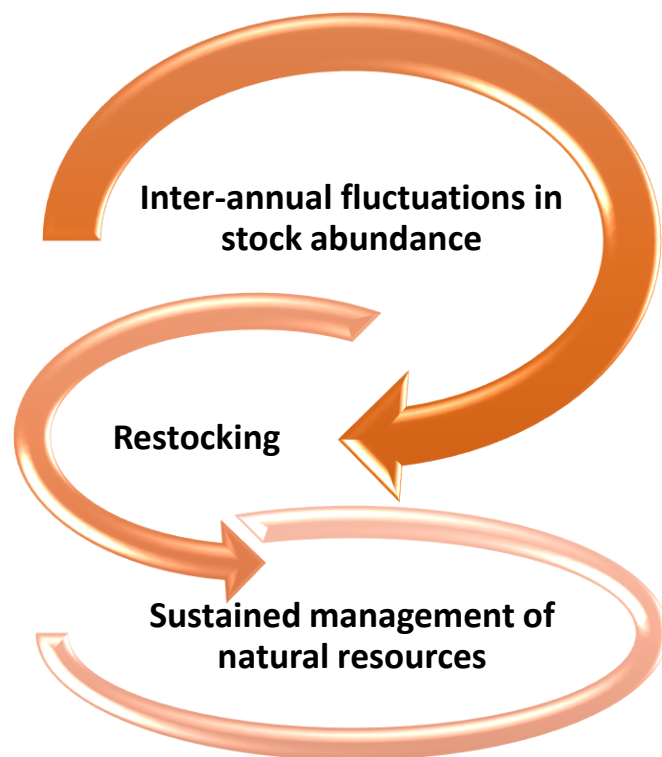


but it is not necessary in feeding the larvae



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Outdoor



Opportunities from progress in culture techniques

Outdoor



Shellfish plot in Ria Formosa


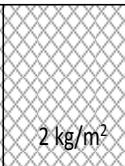
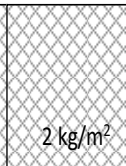

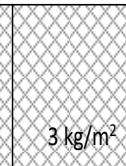
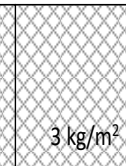
Integrate Multi-trophic Aquaculture System





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Outdoor

Shellfish plot system

1m	 2 kg/m ²	 2 kg/m ²	 2 kg/m ²	 3 kg/m ²	 3 kg/m ²	 3 kg/m ²
	2 kg/m ²	2 kg/m ²	2 kg/m ²	3 kg/m ²	3 kg/m ²	3 kg/m ²
	1m					

-  With protection net
-  Without protection net

Initial length: 19 mm
Initial weight: 2,2g



Opportunities from progress in culture techniques

Outdoor

Shellfish plot system



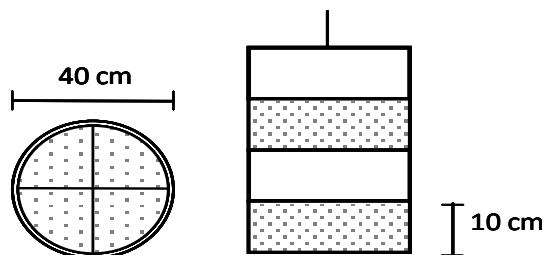
- ✓ Net protection against predators increased survival between 15 and 20% in the first month after restocking;
- ✓ Increase $\approx 60 \mu\text{m/day}$ in 4 autumn/winter months in in both tested densities;
- ✓ Biomass yield $\approx 1400\text{g/m}^2$ in high density.
- ✓ Growth: 26 mm of mean length and 5g of mean fresh weight.



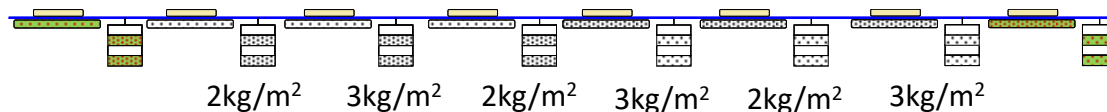
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Outdoor

IMTA system



Oyster basket



Initial length: 19 mm

Initial weight: 2,2g



Opportunities from progress in culture techniques

Outdoor

IMTA system



- ✓ Increase $\approx 85 \mu\text{m/day}$ in 3.8 autumn/winter months in high tested density;
- ✓ Biomass yield $\approx 2500\text{g/m}^2$
- ✓ Growth: 29 mm of mean length and 7,3g of mean fresh weight.
- ✓ Results of growth better than in shellfish plots
- ✓ Shell deformations.



Processing industry



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Conclusions

- ✓ Potential for aquaculture;
- ✓ Short larval period = more possibility of success and decrease production costs;
- ✓ Production in low-cost systems;
- ✓ Possibility of production in IMTA systems
- ✓ Possibility of production in high densities in shellfish plots
- ✓ Sustainable stock management



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Thank you!