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EPURVAL 2

Integrated Multi-Trophic Co-cultivation of finfish filter & deposit feeders: a promising system for the Greek aquaculture sector

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HCMR

15 et 16 mai 2019

Associer les espèces pour une aquaculture durable : l'aquaculture multi trophique intégrée

Avec la participation de :

Breizh'alg

Background

The Strategy for Sustainable Development of European Aquaculture (CEC, 2002)

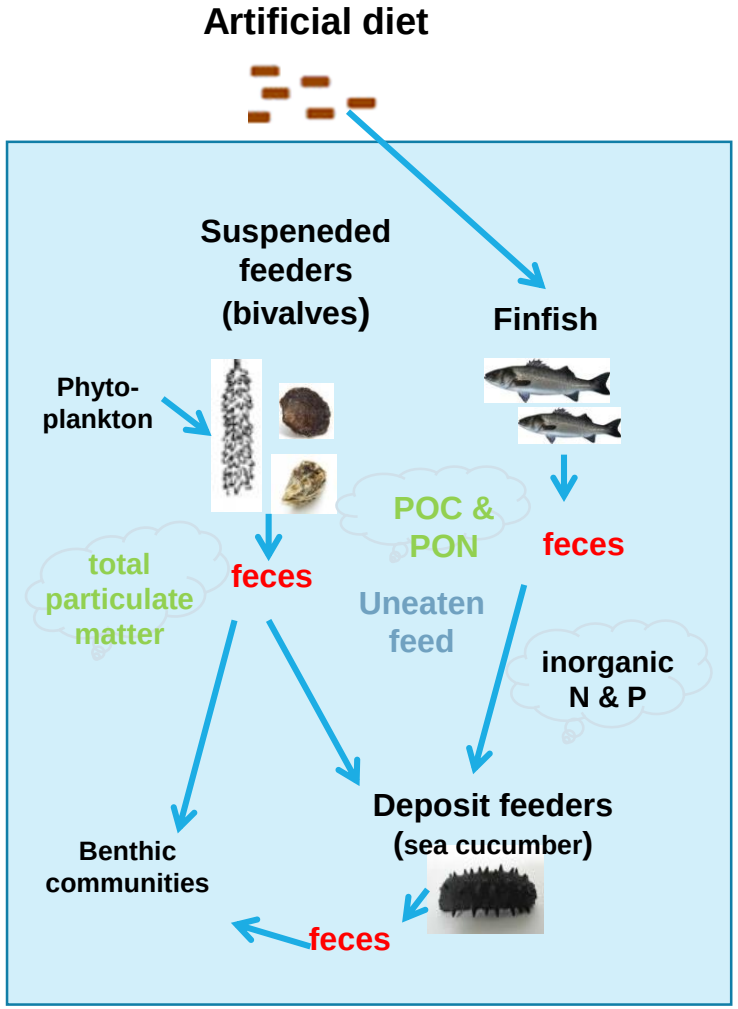
Aims of National fisheries policy for aquaculture sector :

- **to increase the production and the diversification**
- **to increase the product quality**
- **to improve the competitive position of the sector**
- **to promote environmental, economic and social sustainability.**

Despite possessing a large finfish aquaculture network and important finfish production in the Mediterranean area and EU, Greece has not developed any IMTA system near/or at commercial scale yet.

The co-cultivation of the European sea bass, with filter- & deposit – feeders is a case study of the Integrated MultiTrophic Aquaculture for EFFiciency and Environmental ConservaTion (IMTA-EFFECT) project, in the framework of the ERA-NETs, COFASP 2nd call.

Concept


Artificial diet
Suspeneded feeders (bivalves)
Finfish
Phyto-plankton
POC & PON
feces
feces
total particulate matter
Uneaten feed
inorganic N & P
Deposit feeders (sea cucumber)
Benthic communities
feces

Selection of species

Finfish

Dicentrarchous labrax

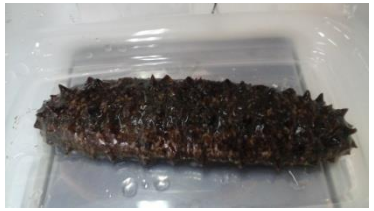
Filter feeders

Mytilus galloprovincialis

Ostrea edulis

Crassostrea gigas

Deposit feeders

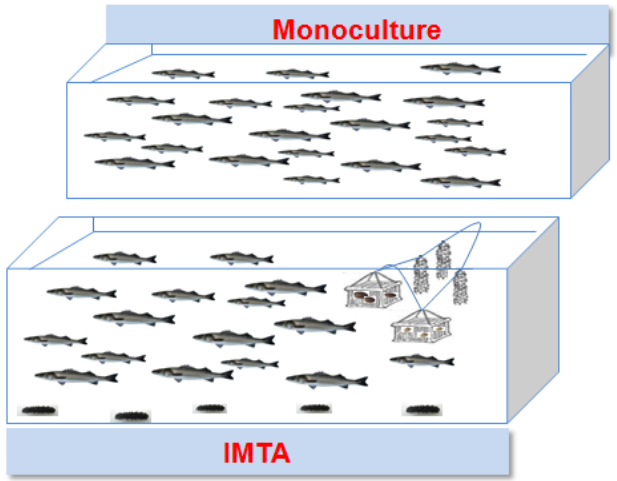


Holothuria poli

Holothuria sanctori

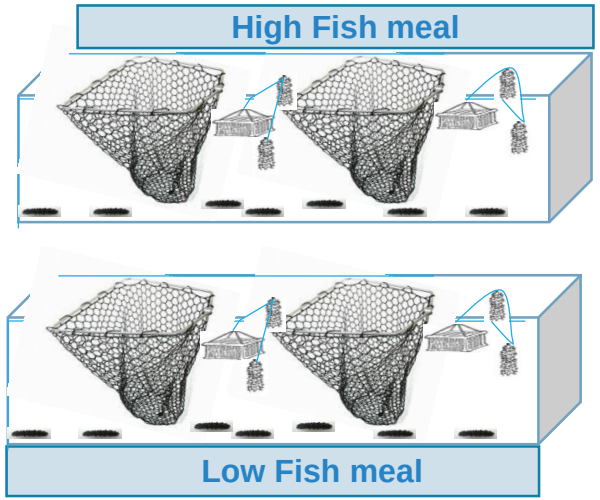
Holothuria tubulosa

Experimental Design



Experiment 1
(spring 17)

2 kg / m³



Experiment 2
(spring 18)

0.5 kg / m³

Duplicate concrete tanks of 15 m³ each with a flow rate of 980-1200 l/h located at the coast

- *Dicentrarchus labrax:*	200 fish/tank (**1**) or 30 fish/net (**2**)
- *Mytilus galloprovincialis:*	300/tank (**1**), or 200/tank (**2**)
- *Crassostrea gigas:*	20/tank (**1**) or 20/tank (**2**)
- *Ostrea edulis*:	20/tank (**1**)
- *Holothuria tubulosa:*	10/tank (**1**) or 5/tank (**2**)
- *Holothuria sanctori or poli:*	10/tank (**1**) or 5/tank (**2**)

Commercial fish feeds

Composition of fish feeds

	H-Fish meal (%)	L-Fish meal (%)
Fish meal	30	20
Fish oil	12	11
Plant meal	45	48
Plant oil	0	6
Gluten	10	5
Hemoglobin	0	5
Mineral/Vit	3	5
	100	100

Growth performance indicators of fish

	Survival (%)	WG (g)	DWG (g/day)	SGR (%/day)	FCR (g/g)
Monoculture	93,35 ± 0,95	54,48 ± 1,81	0,92 ± 0,03	0,53 ± 0,01	1,82 ± 0,10
IMTA	92,65 ± 0,25	56,34 ± 0,42	0,95 ± 0,01	0,55 ± 0,003	1,49 ± 0,03 *
High Fish meal	90,67 ± 0,00	52,66 ± 1,34	0,59 ± 0,01	0,41 ± 0,01	1,85 ± 0,08
Low Fish meal	89,33 ± 8,33	46,34 ± 0,04 *	0,51 ± 0,00 *	0,36 ± 0,00 *	2,33 ± 0,04 *

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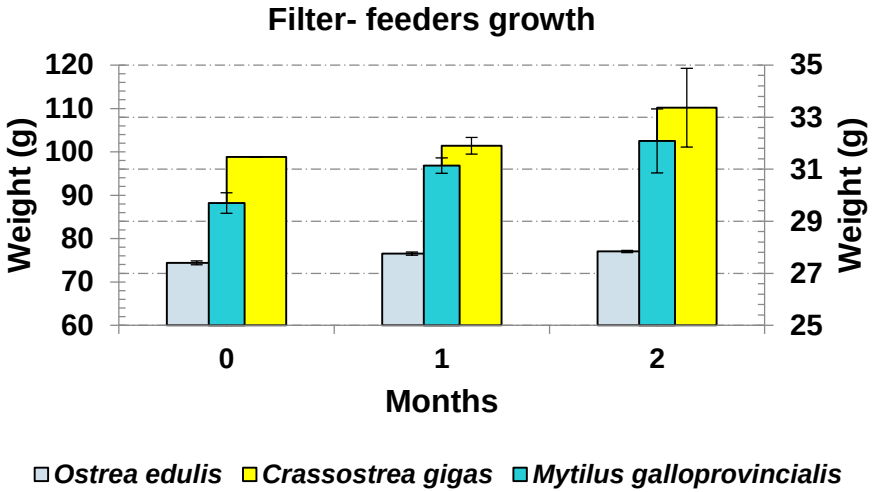
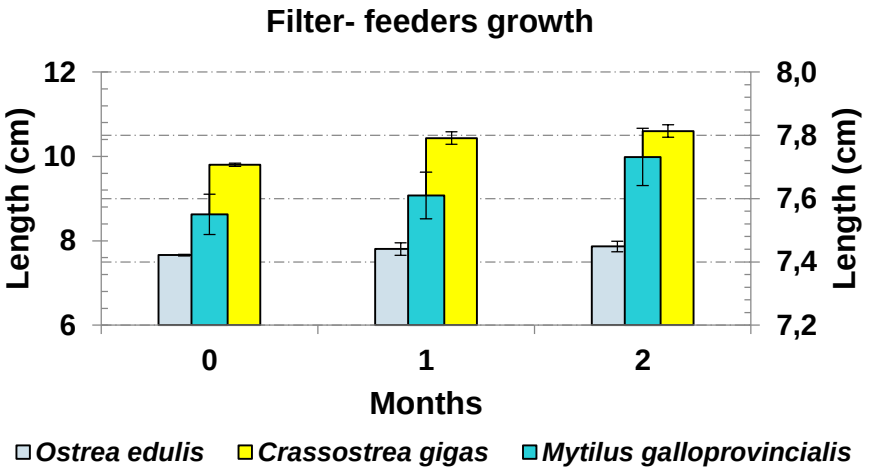
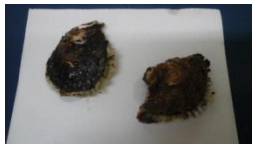
Growth performance indicators of filter feeders







Oysters	High Fish meal		Low Fish meal	
	Initial	Final ↑	Initial	Final ↑
Shell length (cm)	9,9 ± 0,7	11,3 ± 0,9	9,9 ± 0,7	11,4 ± 0,8
Weight (g)	95,3 ± 0,3	96, 5 ± 0,2	96,1 ± 0,1	97,3 ± 0,3
BCI (%)	5,9 ± 0,1	7,4 ± 0,2	5,7 ± 0,4	7,7 ± 0,4
Mussels				
Shell length (cm)	7,6 ± 0,2	7,6 ± 0,4	7,4 ± 0,5	7,4 ± 0,5
Weight (g)	30,9 ± 5,0	34,8 ± 5,1	29,2 ± 6,3	34,5 ± 6,0
BCI (%)	19,2 ± 0,2	25,8 ± 0,4	19,5 ± 0,3	25,5 ± 0,4

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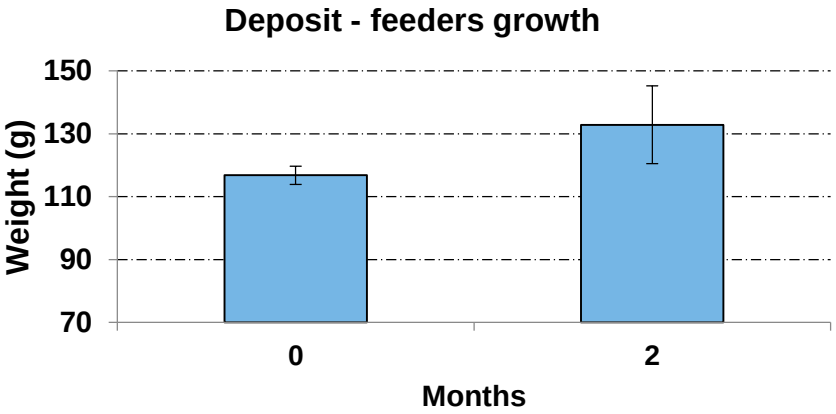
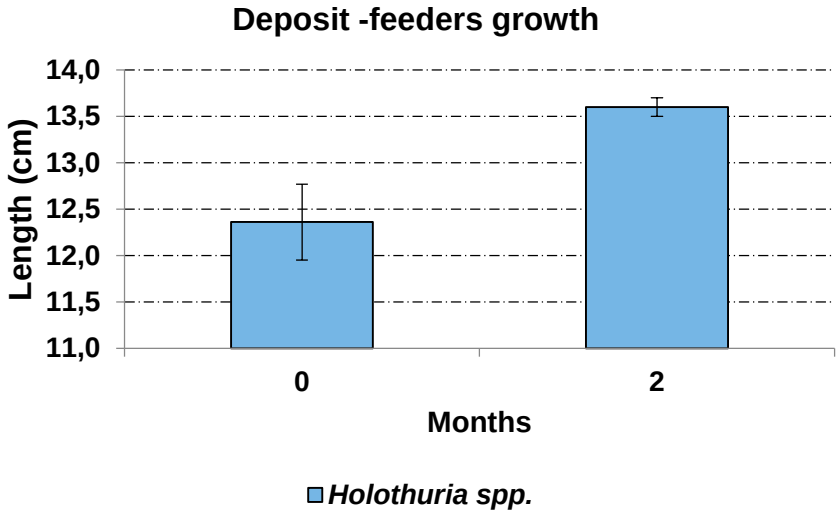
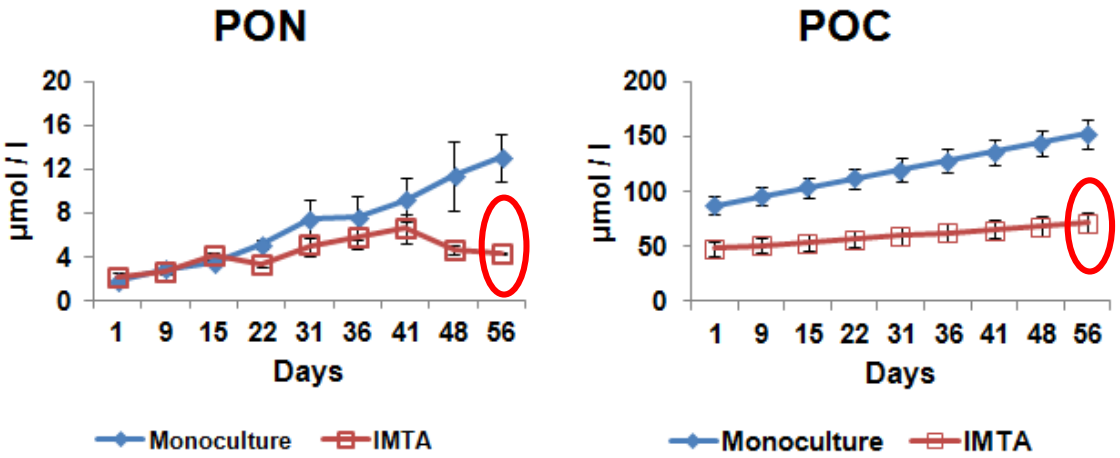
Growth performance indicators of deposit feeders

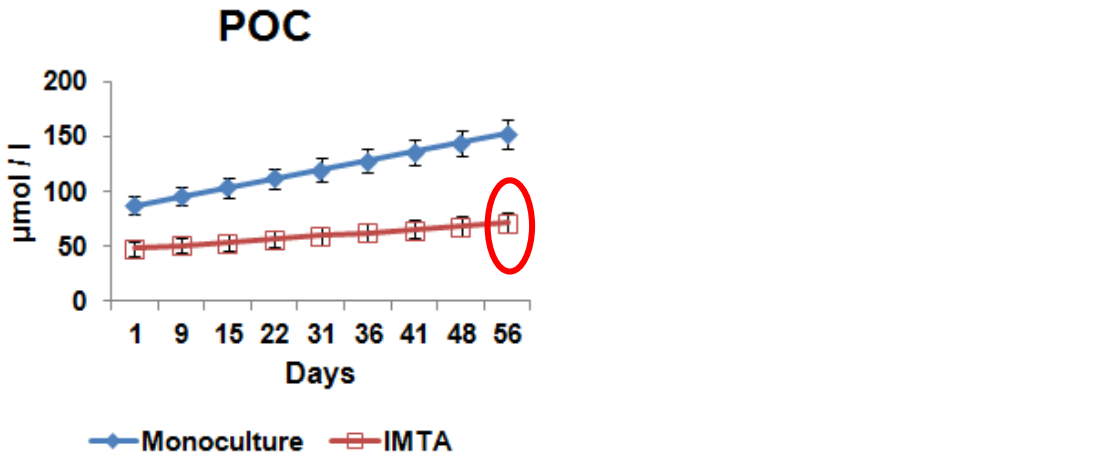


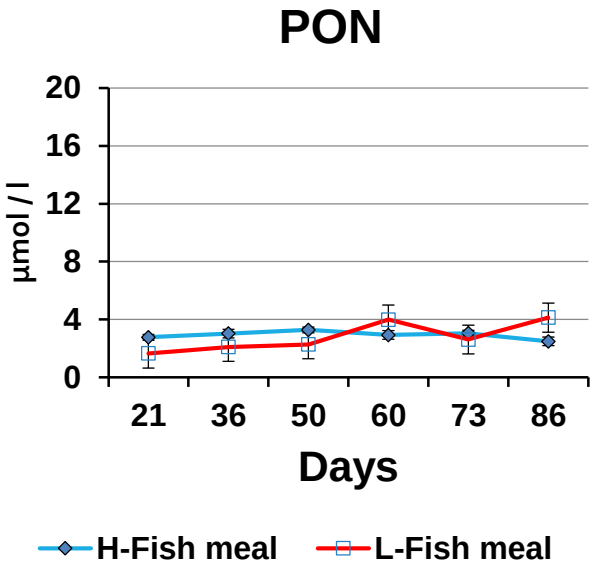


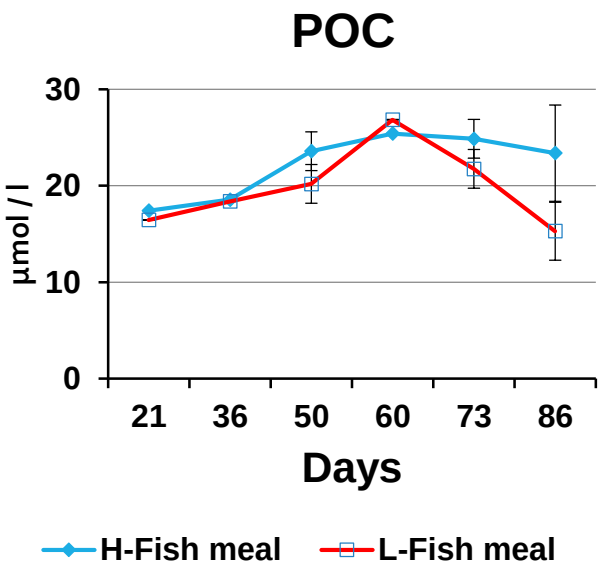
	High Fish meal	Low Fish meal
Holothuria tubulosa		
Initial weight (g)	167,7 ± 13,7	154,0 ± 18,9
Final weight (g)	187,2 ± 45,2	166,75 ± 7,01
WG (g)	19,4	12,7
Holothuria poli		
Initial weight (g)	93,05 ± 12,9	77,8 ± 24,2
Final weight (g)	97,9 ± 10,0	80,9 ± 52,4
WG (g)	4,8	3,2

Environmental parameters

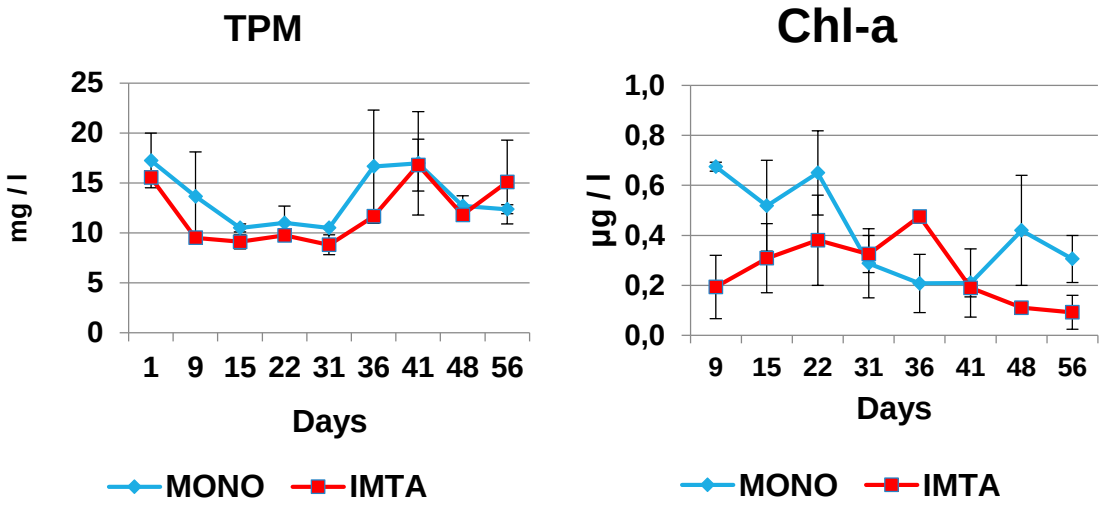


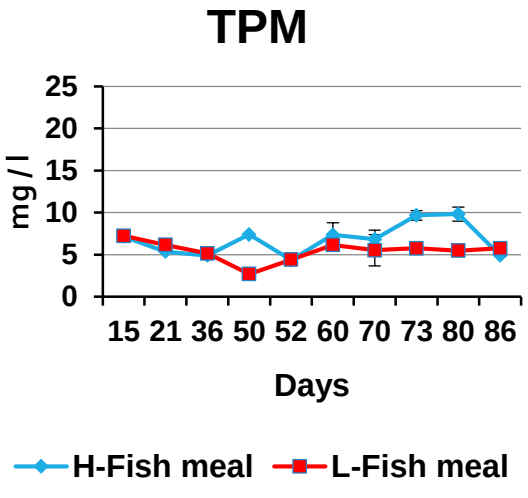


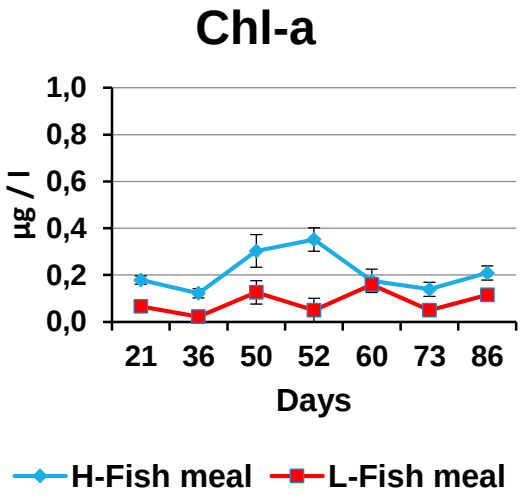




Environmental parameters







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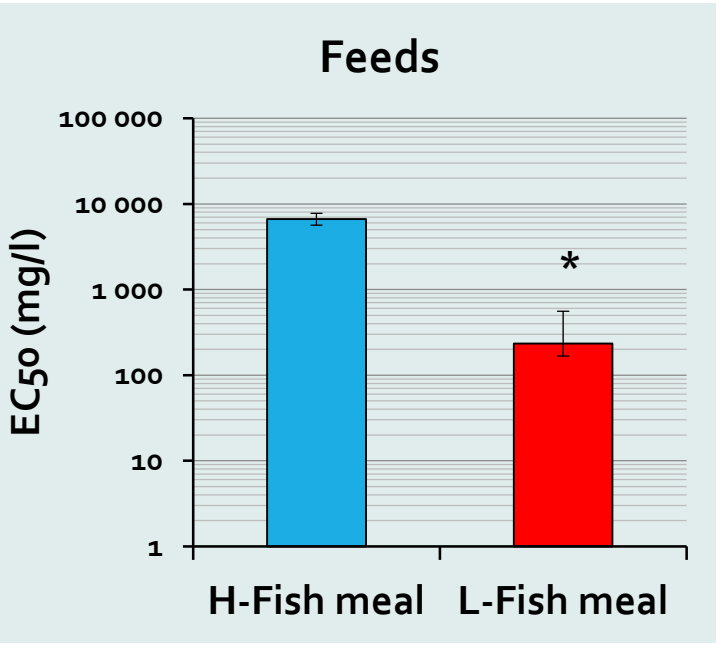
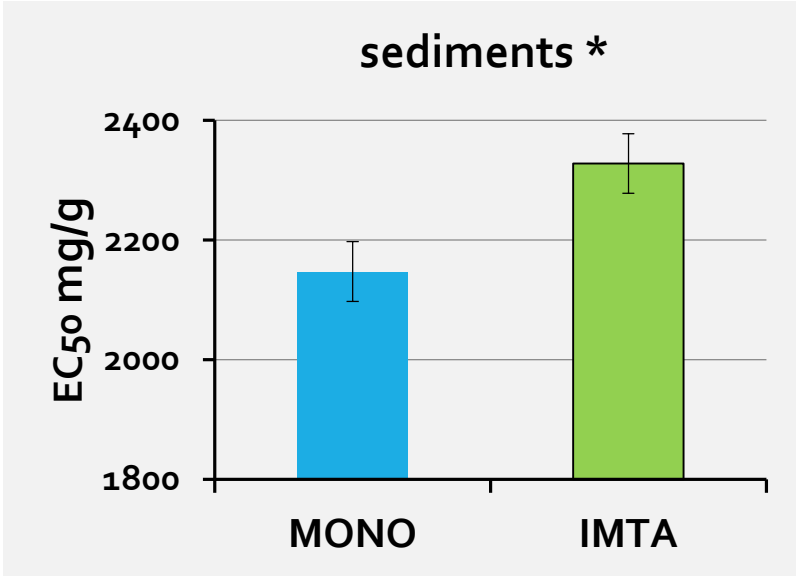
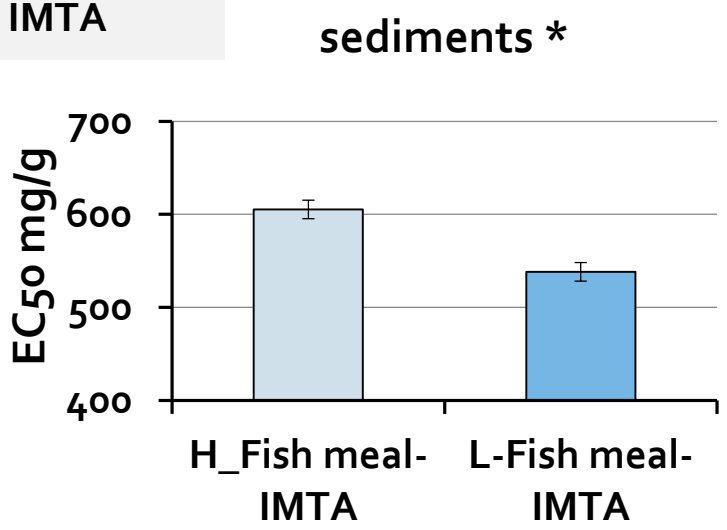
Toxicity in feeds & sediments *







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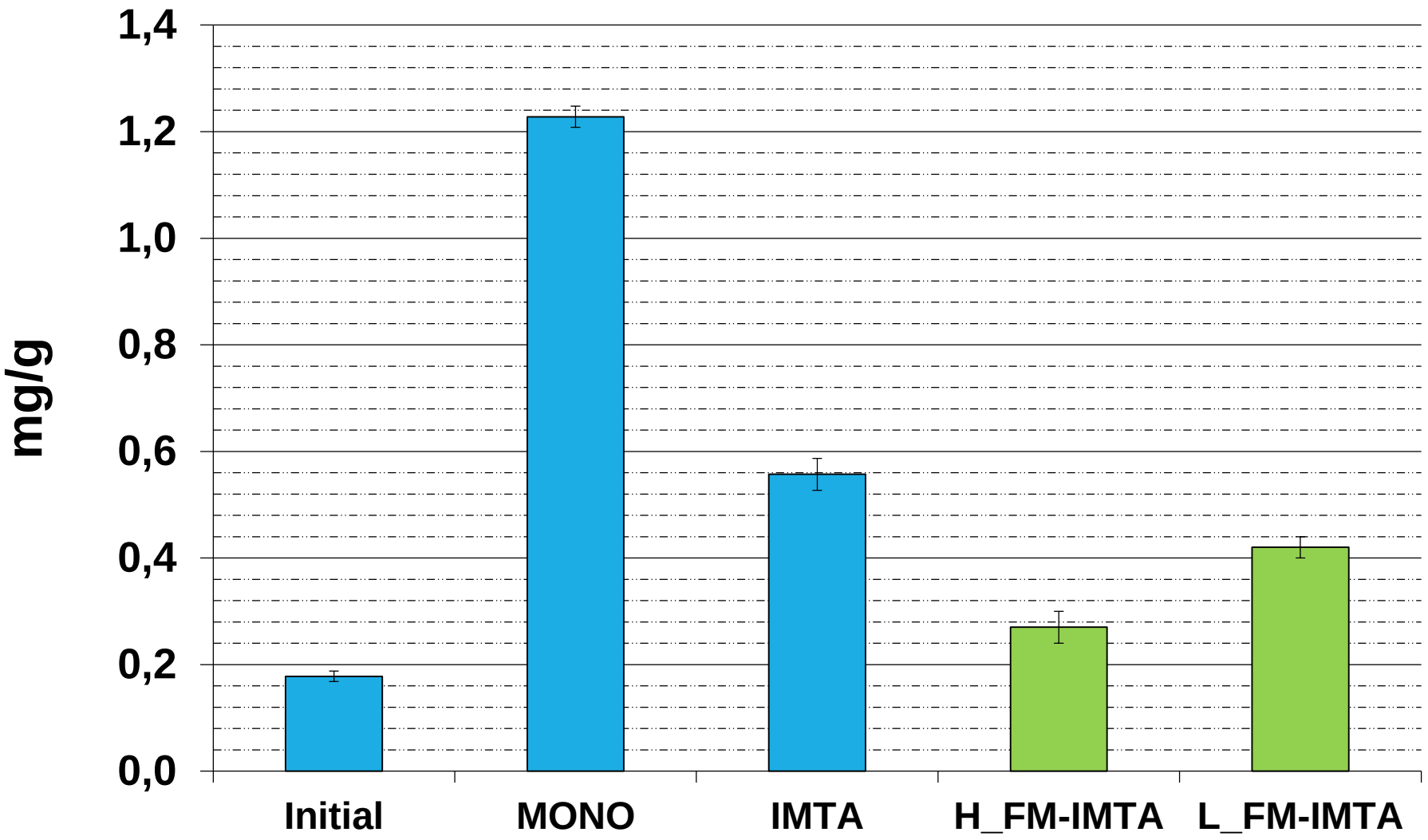
Total lipids in sediments *



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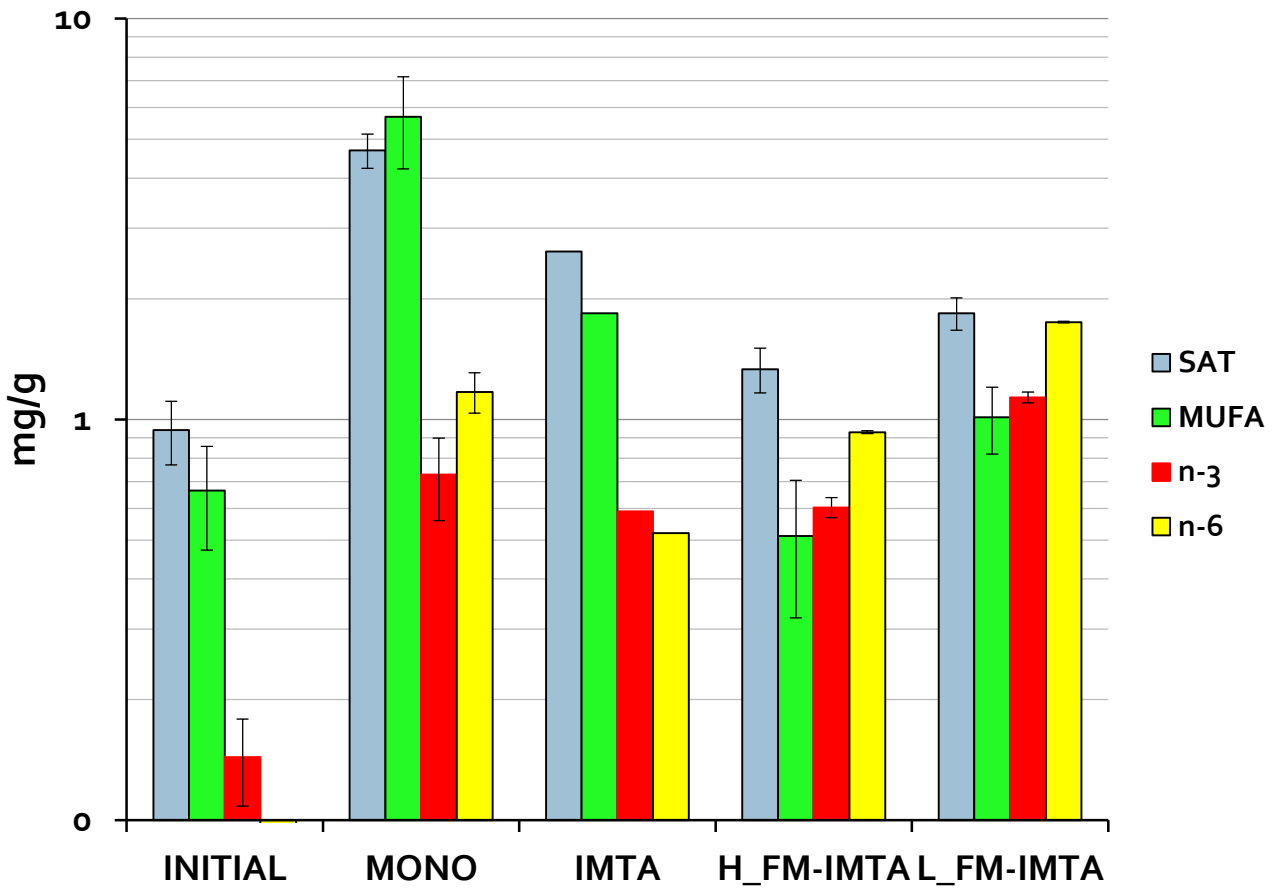
Fatty acids profiles in sediments *

mg/g	INITIAL	MONO	IMTA
SATURATED			
14:0	0,19 ± 0,05	0,69 ± 0,05	0,37 ± 0,10
15:0	0,00 ± 0,00	0,09 ± 0,02	0,06 ± 0,01
16:0	0,60 ± 0,09	2,84 ± 0,31	1,55 ± 0,36
17:0	0,00 ± 0,00	0,05 ± 0,01	0,06 ± 0,03
18:0	0,11 ± 0,03	0,67 ± 0,02	0,36 ± 0,08
20:0	0,00 ± 0,00	0,10 ± 0,02	0,04 ± 0,01
22:0	0,04 ± 0,00	0,12 ± 0,02	0,07 ± 0,01
24:0	0,00 ± 0,00	0,13 ± 0,01	0,09 ± 0,02
Sum SAT	**0,94 ± 0,12 1,2**	**4,69 ± 0,46 1,2**	**2,62 ± 0,60**
MUFA			
16:1n-9	0,07 ± 0,01	0,04 ± 0,02	0,02 ± 0,01
16:1n-7	0,35 ± 0,14	0,78 ± 0,04	0,41 ± 0,05
17:1n-9	0,04 ± 0,02	0,00 ± 0,00	0,00 ± 0,00
18:1n-9	0,10 ± 0,02	2,53 ± 0,58	0,63 ± 0,03
18:1n-7	0,11 ± 0,00	0,91 ± 0,27	0,49 ± 0,11
20:1n-11	0,00 ± 0,00	0,05 ± 0,03	0,04 ± 0,03
20:1n-9	0,00 ± 0,00	0,48 ± 0,17	0,10 ± 0,01
20:1n-7	0,00 ± 0,00	0,03 ± 0,01	0,02 ± 0,00
22:1n-11	0,00 ± 0,00	0,64 ± 0,27	0,10 ± 0,00
22:1n-9	0,00 ± 0,00	0,08 ± 0,05	0,01 ± 0,00
24:1n-9	0,00 ± 0,00	0,14 ± 0,04	0,03 ± 0,00
Sum MUFA	**0,66 ± 0,14 1,2**	**5,69 ± 1,47**	**1,84 ± 0,15 1,3**
n-3			
18:3n-3	0,00 ± 0,00	0,22 ± 0,02	0,21 ± 0,14
18:4n-3	0,00 ± 0,00	0,08 ± 0,03	0,05 ± 0,03
20:5n-3 (EPA)	0,13 ± 0,03	0,27 ± 0,10	0,27 ± 0,17
22:6n-3 (DHA)	0,02 ± 0,00	0,16 ± 0,03	0,06 ± 0,03
Sum n-3	**0,14 ± 0,04 1,2**	**0,73 ± 0,17**	**0,59 ± 0,37**
n-6			
18:2n-6	0,00 ± 0,00	1,06 ± 0,10	0,35 ± 0,06
20:4n-6 (ARA)	0,04 ± 0,01	0,11 ± 0,04	0,17 ± 0,11
Sum n-6	**0,04 ± 0,01 1,2**	**1,17 ± 0,06 2,3**	**0,52 ± 0,17**



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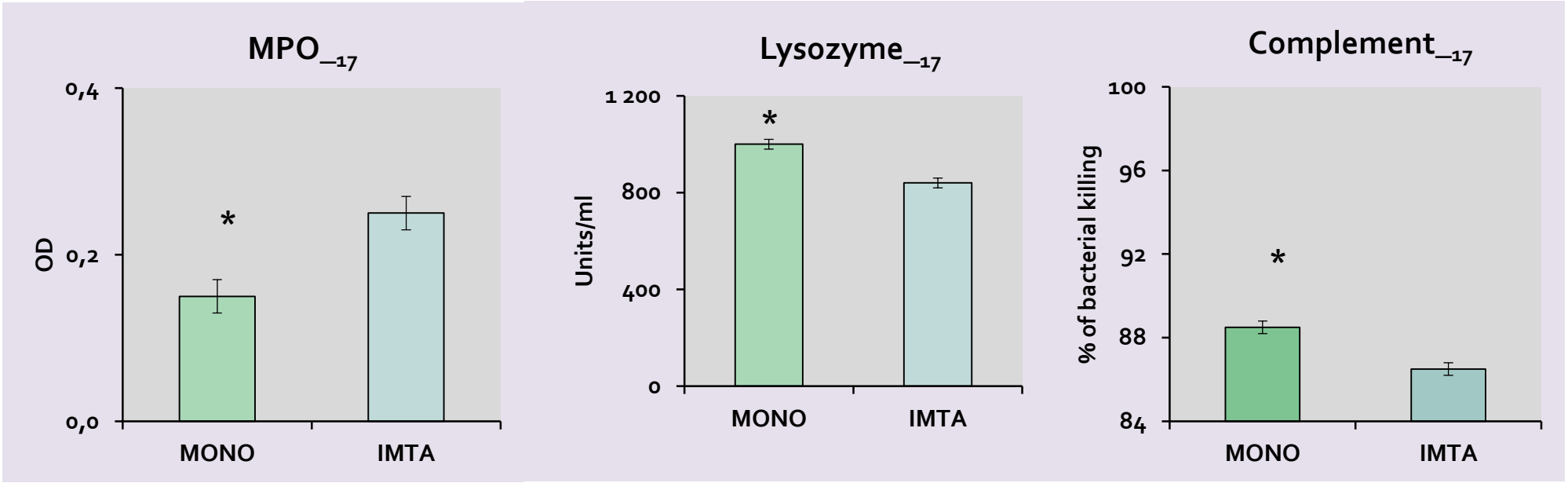
Fish health status



Conclusion

1) **Growth Performance Indicators of finfish such as SGR and FCR**

2) **Growth of filter & deposit feeders**

3) **Environmental variables including PON and POC, total lipids and fatty acids profile in sediment**

are showed to be promising

- to manage culture system by-products,

- to increase feed efficiency that lower the production cost

and achieving economic viability and environmental quality through diversification of different trophic levels.

Thank you for your attention

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