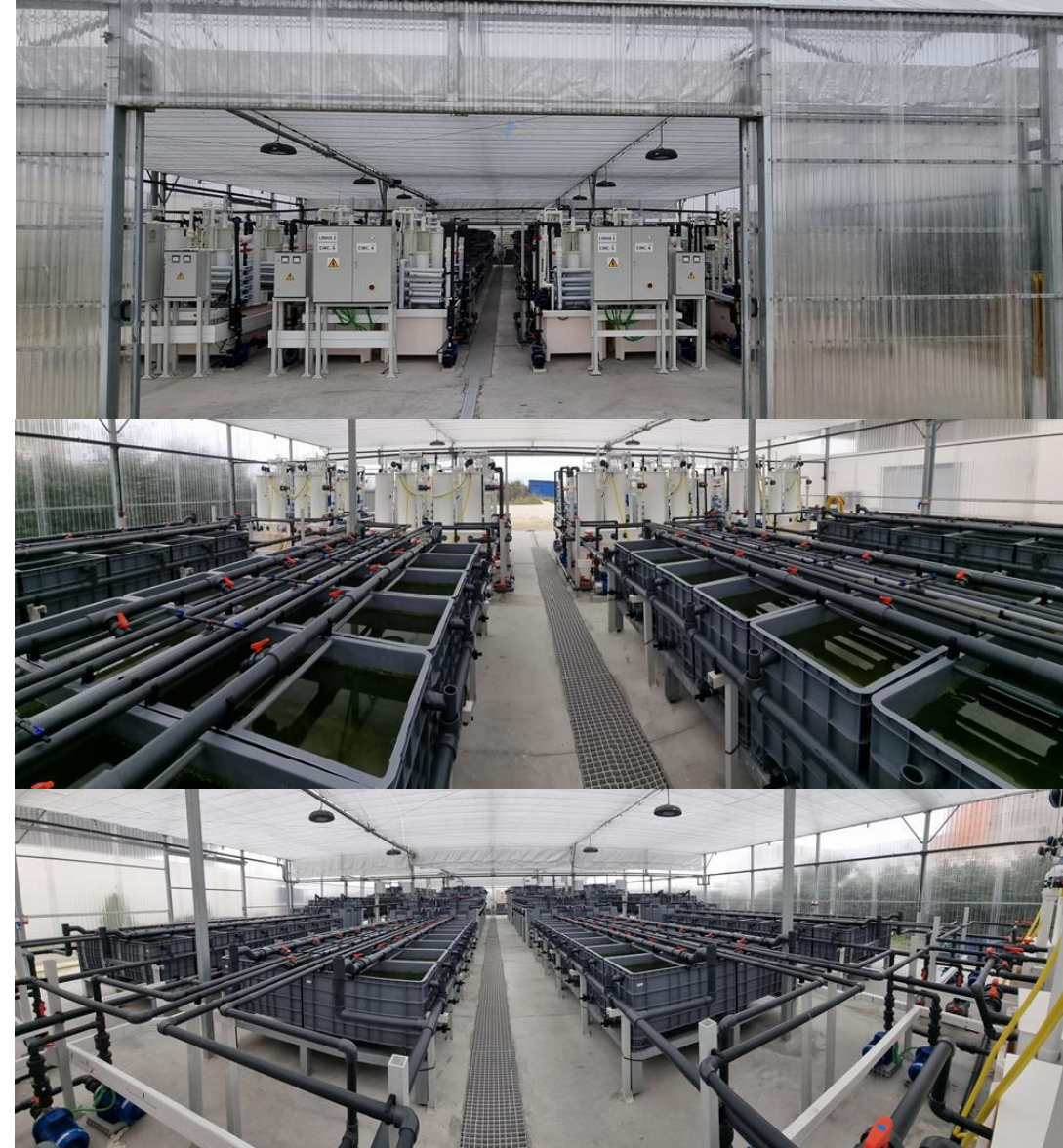


Uso de macrófitas e invertebrados na aquicultura multitrófica integrada

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graus académicos

2020 Habilitation in Biology, University of Aveiro

2005 PhD in Biology, Specialization in Animal Biotechnology by the Faculty of Sciences of the University of Lisbon

1999 5 years degree (Licenciatura) in Biology Applied to Animal Resources – Marine Branch by the Faculty of Sciences of the University of Lisbon with the final classification of 16 (out of 20).

interesses de investigação

Blue BioEconomy
Sustainable Aquaculture
Traceability of Seafood and Live Marine Organisms
Bioprospecting of Marine Natural Products
Marine Lipidomics

publicações

Artigos WoS (208)
Outros Artigos (5)
Livros (4)
Teses (17)

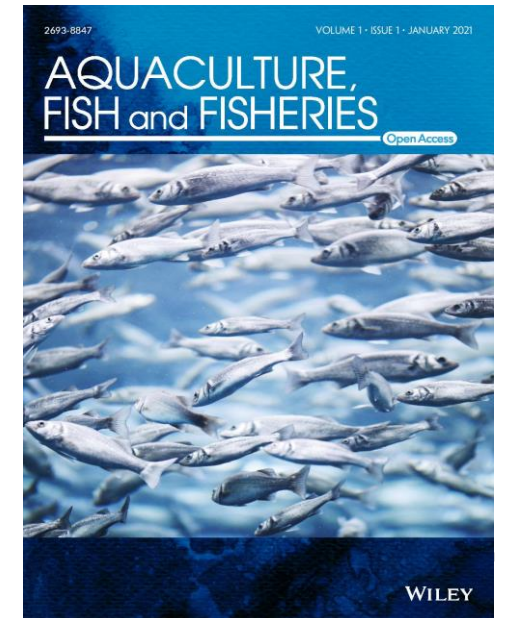


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Calado, Ricardo

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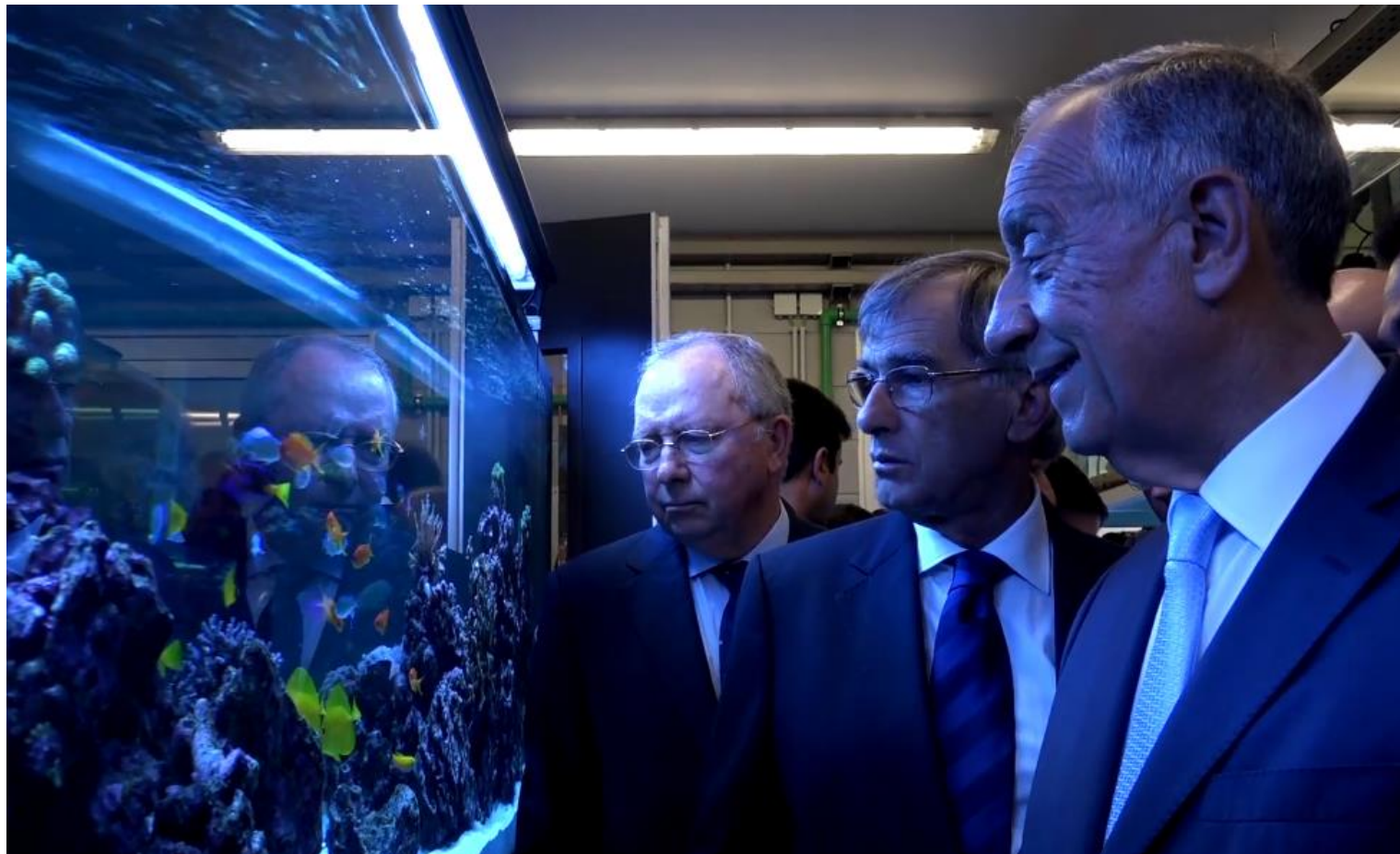
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Marcelo Rebelo de Sousa

Ílhavo, 15 de junho de 2017

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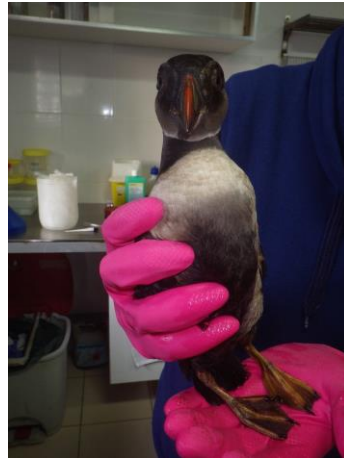
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dos recursos marinhos



**“Just another day
at the office...”**

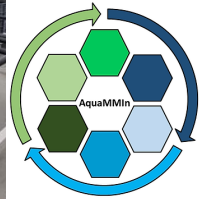
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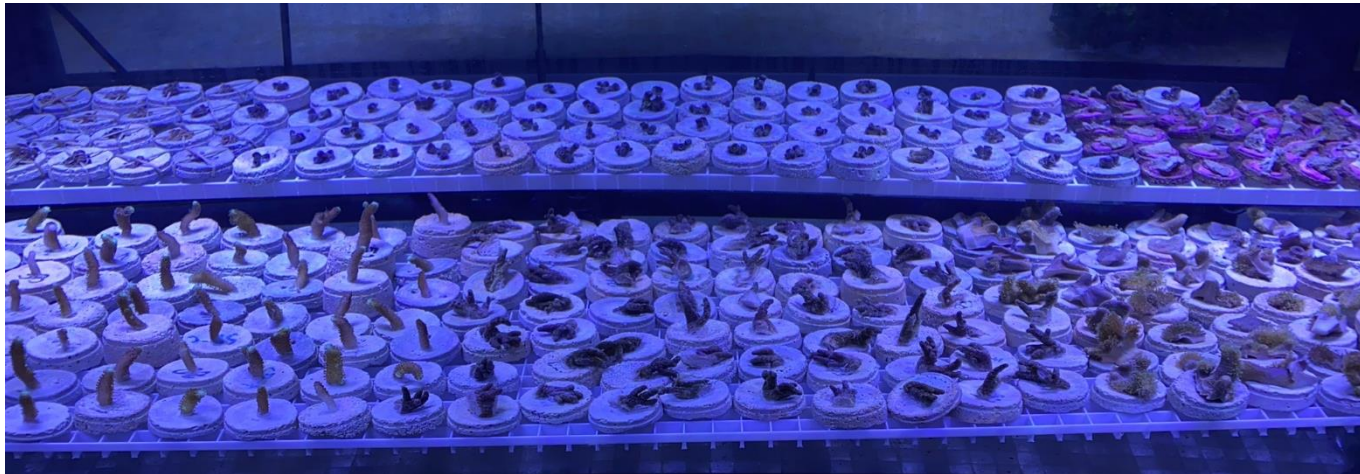
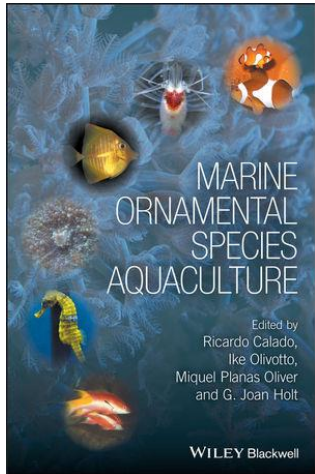
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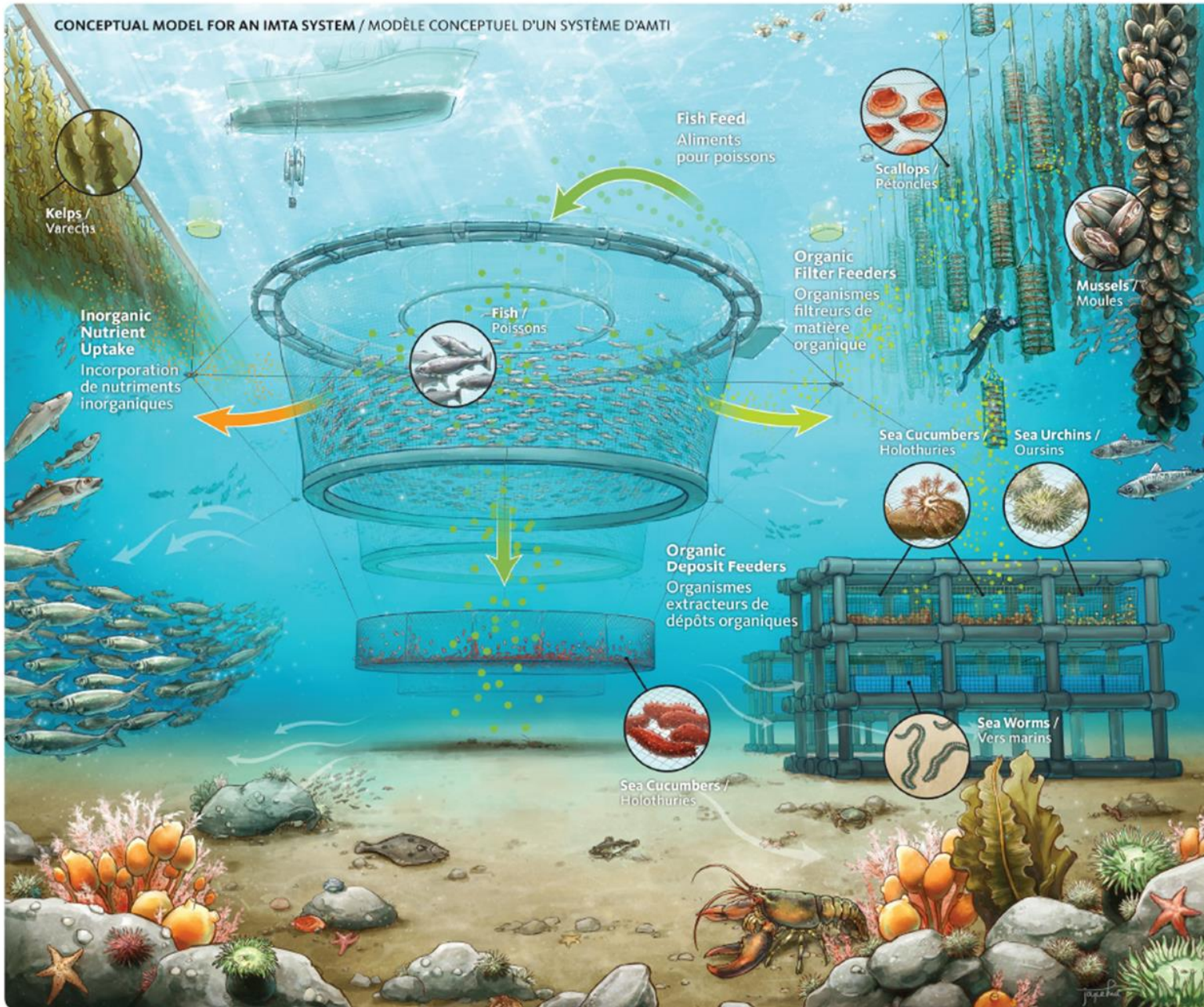


Centro de Extensão e de Pesquisa em Aquacultura e Mar (CEPAM-ECOMARE)



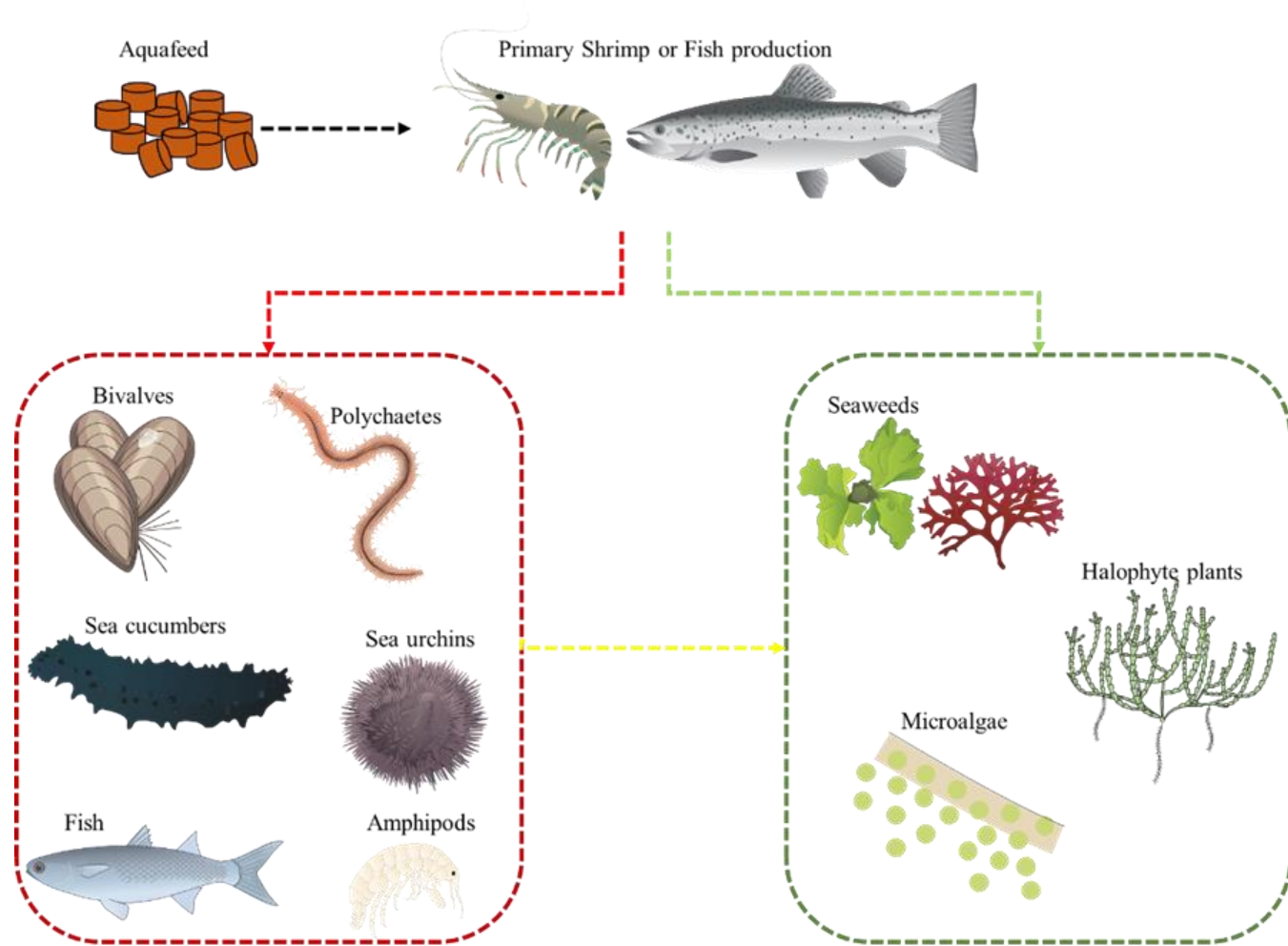
Centro de Extensão e de Pesquisa em Aquacultura e Mar (CEPAM-ECOMARE)





Aquicultura Multitrófica Integrada AMTI

A solução “milagrosa”
para uma aquicultura sustentável...



Num sistema de AMTI espécies aquáticas de diferentes níveis tróficos são cultivadas de forma integrada, de modo a melhorar a eficiência produtiva, reduzir o desperdício de nutrientes e promover serviços de ecossistema, como a biorremediação.



Concetualmente, a AMTI faz todo o sentido, pois a produção de peixe e crustáceos em tanques e jaulas é ainda pouco eficiente no uso integral dos nutrientes fornecidos em rações aquícolas.

No entanto, a AMTI é um modelo de produção complexo cujo desempenho depende de um equilíbrio de interações tróficas difícil de alcançar entre as espécies cultivadas. É improvável que um piscicultor possua o conhecimento necessário para cultivar todas as espécies integradas num modelo de AMTI funcional e rentável.





Por outras palavras, a AMTI pode tornar uma tarefa difícil, como a criação de peixes ou camarões, ainda mais desafiadora ao adicionar camadas de complexidade a sistemas de produção de monocultura já de si complexos...



As “pequenas coisas” sobre AMTI de que ninguém fala:

Os sistemas AMTI são menos flexíveis do que os sistemas de monocultura na resposta ao mercado, pois se ocorrer um aumento na procura (e conseqüentemente do preço) das espécies extrativas (ex., bivalves e/ou algas), não é possível aumentar o fornecimento de nutrientes sem perturbar o equilíbrio necessário para manter um sistema AMTI.

As cadeias de valor das diferentes espécies cultivadas em AMTI são quase sempre distintas e desconexas, o que constitui um desafio para o produtor.

**Muitas vezes os sistemas de AMTI
combinam a Teoria e a Prática:**

Teoria

Alguém sabe tudo, mas nada funciona...

Prática

Tudo funciona, mas ninguém sabe porquê...

Sistemas de AMTI

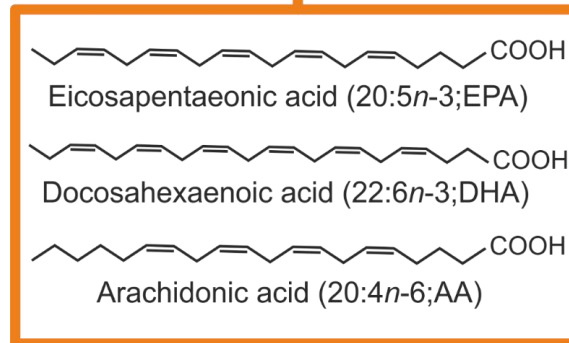
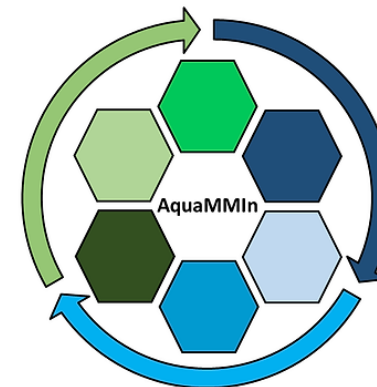
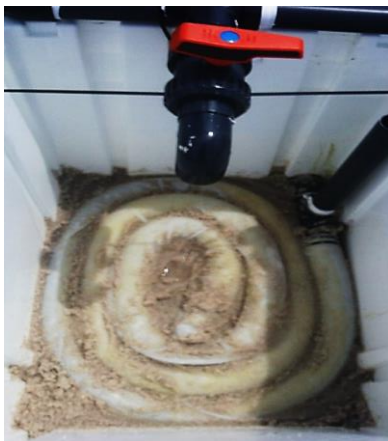
Nada funciona e ninguém sabe porquê...

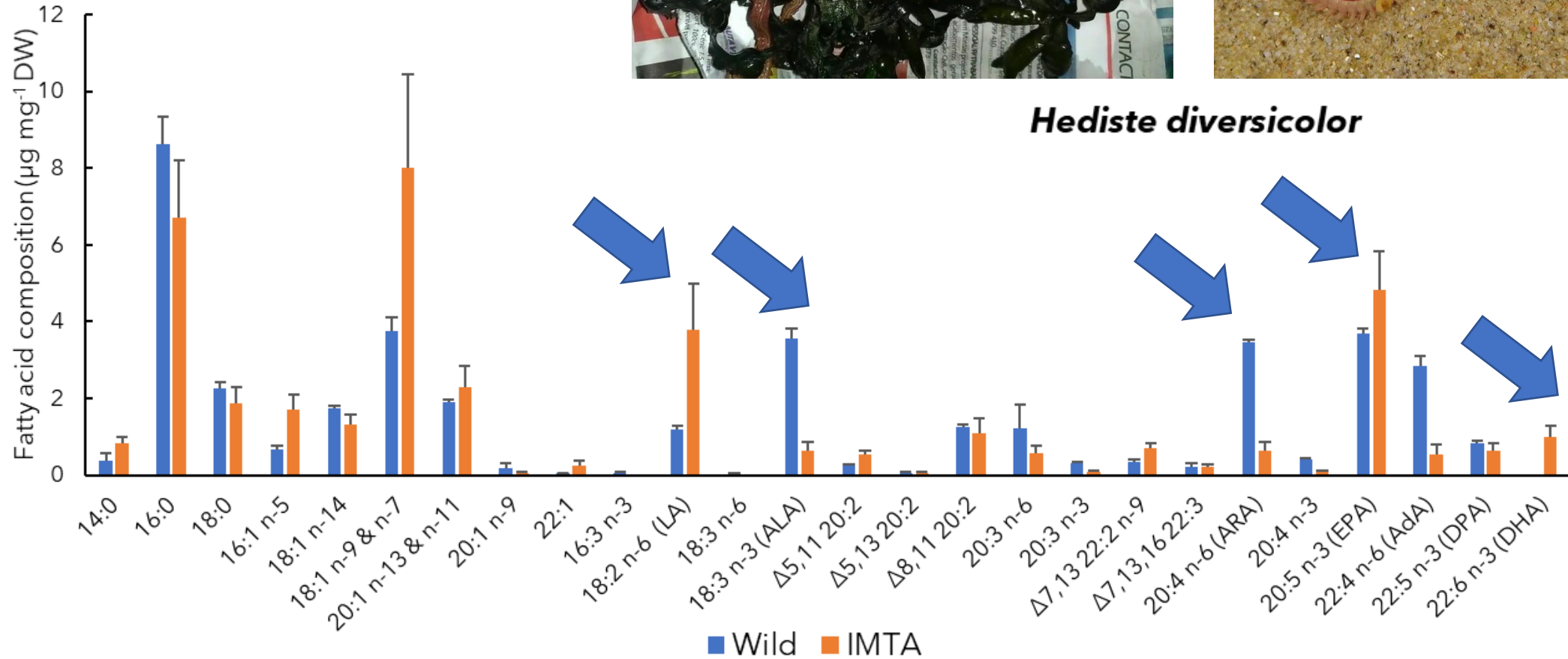


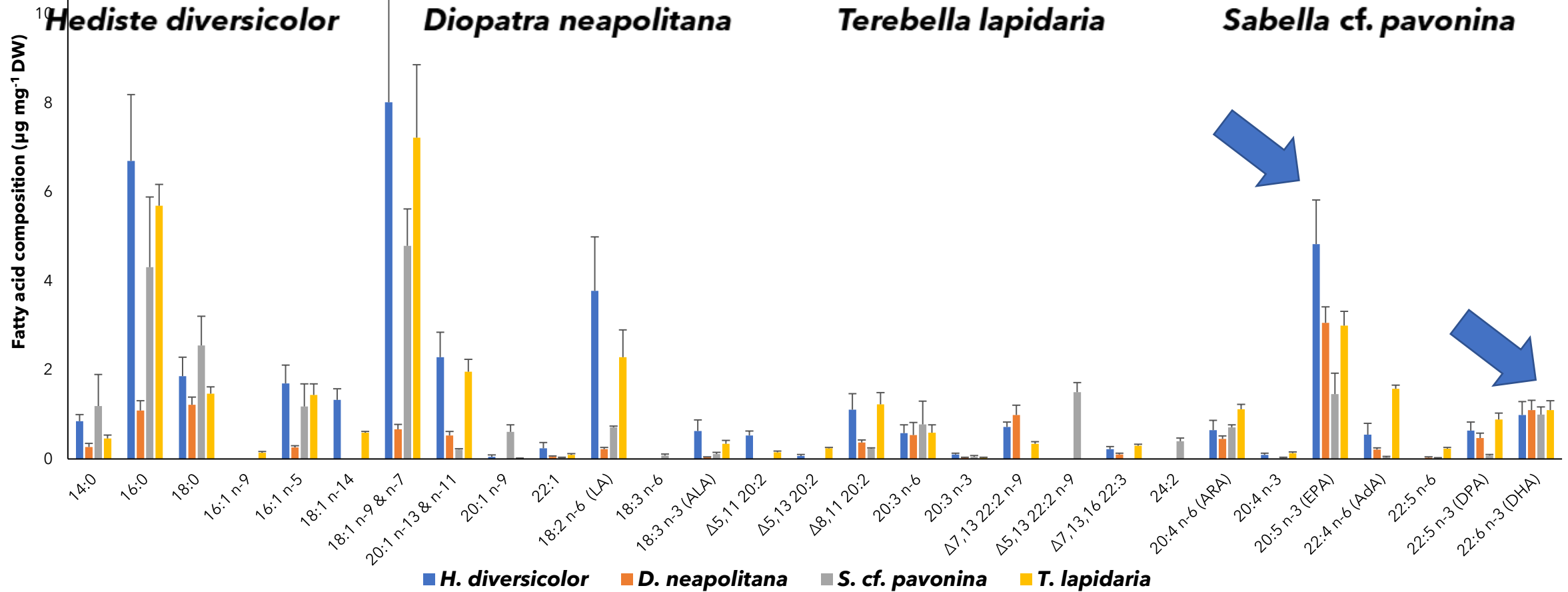


Apesar de todos os desafios, se um produtor ainda assim quiser avançar com a instalação de um sistema de AMTI, o primeiro passo é reutilizar a matéria orgânica particulada existente na água...

Filtros de areia fluidizados por poliquetas (*Hediste diversicolor*)









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Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv



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Aquaculture

journal homepage: www.elsevier.com/locate/aquaculture



Salinity shapes the stress responses and energy reserves of marine polychaetes exposed to warming: From molecular to functional phenotypes



Diana Madeira^{a,b,c,*}, Joana Filipa Fernandes^a, Daniel Jerónimo^a, Patrícia Martins^a, Fernando Ricardo^a, Andreia Santos^a, Maria Rosário Domingues^{d,e}, Mário Sousa Diniz^b, Ricardo Calado^{a,**}



Contents lists available at [ScienceDirect](#)

Environmental Research

journal homepage: www.elsevier.com/locate/envres



Calcium homeostasis and stable fatty acid composition underpin heatwave tolerance of the keystone polychaete *Hediste diversicolor*



Diana Madeira^{a,b,c,*}, Joana Filipa Fernandes^a, Daniel Jerónimo^a, Fernando Ricardo^a, Andreia Santos^a, Maria Rosário Domingues^{d,e}, Ricardo Calado^{a,**}

scientific reports

OPEN Performance of polychaete assisted sand filters under contrasting nutrient loads in an integrated multi-trophic aquaculture (IMTA) system

Daniel Jerónimo^{1,2}, Ana Isabel Lillebo¹, Andreia Santos¹, Javier Cremades² & Ricardo Calado^{1,2}



Modulation of fatty acid profiles by global and local ocean change drivers in the ragworm *Hediste diversicolor*: implications for aquaculture production



Joana Filipa Fernandes^{a,*}, Fernando Ricardo^a, Daniel Jerónimo^a, Andreia Santos^a, Maria Rosário Domingues^{b,c}, Ricardo Calado^a, Diana Madeira^{a,d,*}

frontiers
in Marine Science

ORIGINAL RESEARCH
published: 11 May 2021
doi: 10.3389/fmars.2021.671545

Optimizing the Timeframe to Produce Polychaetes (*Hediste diversicolor*) Enriched With Essential Fatty Acids Under Different Combinations of Temperature and Salinity

OPEN ACCESS

Edited by: Daniel Jerónimo^{1*}, Ana Isabel Lillebo¹, Felisa Rey^{2,3}, Henrique Koga Ili¹, M. Rosário M. Domingues^{2,3} and Ricardo Calado^{1*}

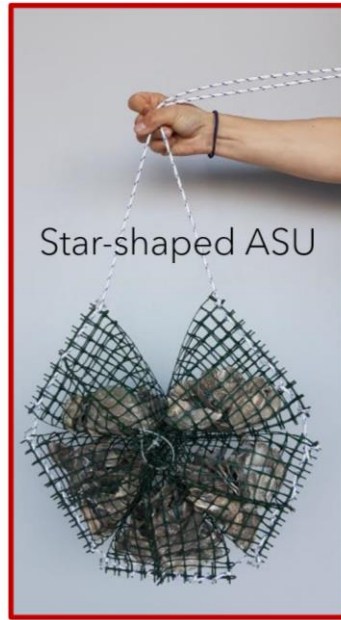
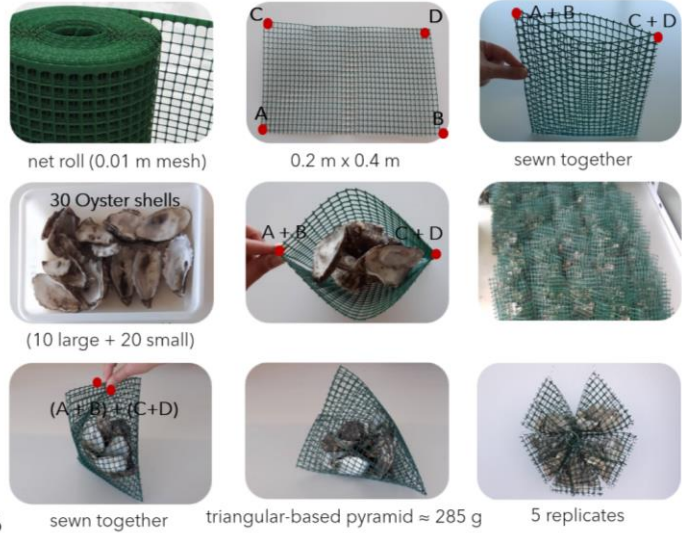
scientific reports

OPEN Unravelling the fatty acid profiles of different polychaete species cultured under integrated multi-trophic aquaculture (IMTA)

Daniel Jerónimo^{1,2}, Ana Isabel Lillebo¹, Elisabete Maciel^{1,3}, M. Rosário M. Domingues^{2,3}, Javier Cremades⁴ & Ricardo Calado^{1,2}



Metodologia - Artificial Substrate Unit (ASU)



Ascidiella aspersa



Ciona intestinalis



Microcosmus sp.



Molgula sp.1



Molgula sp.2



Styela sp.



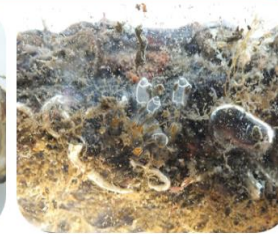
Styela plicata



Botryllus schlosseri



Botrylloides violaceus



Clavelina lepadiformis

As ascídias (tunicados) conseguem filtrar matéria orgânica dissolvida presente na água e a sua biomassa apresenta elevado potencial biotecnológico.



Using Oyster Shells for Customized 3-D Structures for Monitoring Ecosystem Shifts on Ascidians Diversity

Luisa Marques^{*}, Guilherme Teixeira, Ricardo Calado and Ana Isabel Lillebo^{*}






Potential of Ascidians as Extractive Species and Their Added Value in Marine Integrated Multitrophic Aquaculture Systems—From Pests to Valuable Blue Bioresources

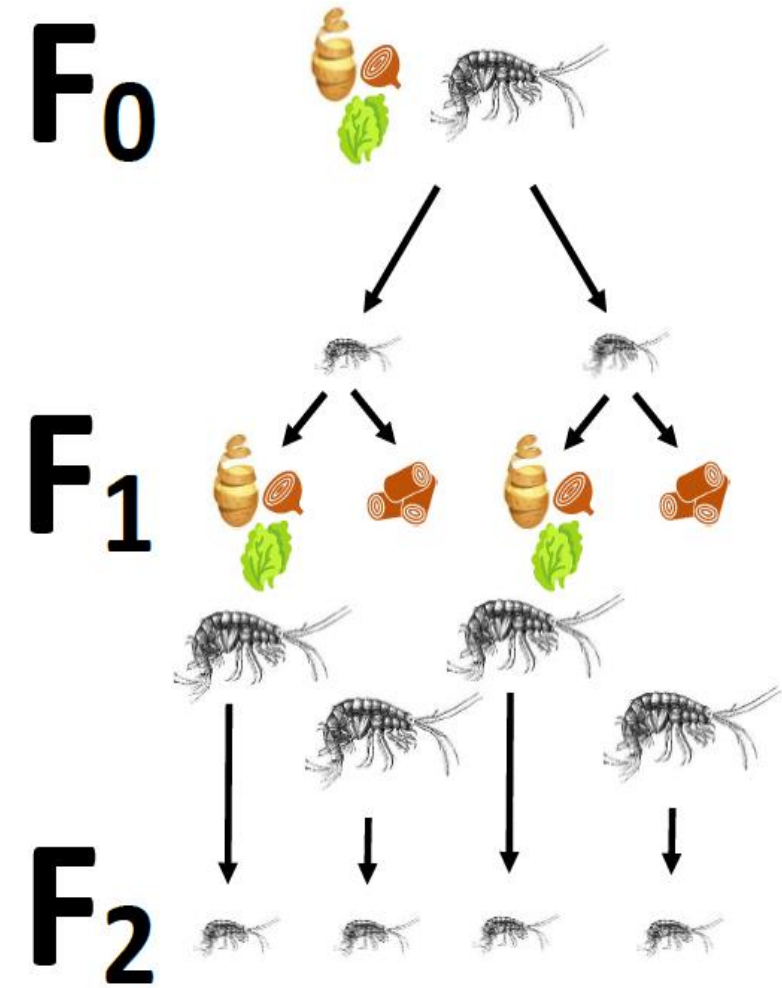
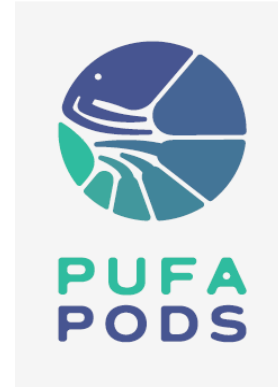
Luisa Marques^{*}, Ricardo Calado and Ana Isabel Lillebo^{*}



Article

Screening for Health-Promoting Fatty Acids in Ascidians and Seaweeds Grown under the Influence of Fish Farming Activities

Luísa Marques^{1,*} , Maria Rosário Domingues^{2,3} , Elisabete da Costa^{2,3} , Maria Helena Abreu⁴, Ana Isabel Lillebo¹  and Ricardo Calado^{1,*} 



Os anfípodes gamarídeos (ex. *Gammarus locusta*) realizam um “upgrade” trófico, sintetizando LC-PUFA a partir de alimento sem estas biomoléculas.



Depois de reutilizar a matéria orgânica particulada existente na água é necessário proceder à reutilização dos nutrientes inorgânicos dissolvidos na água...

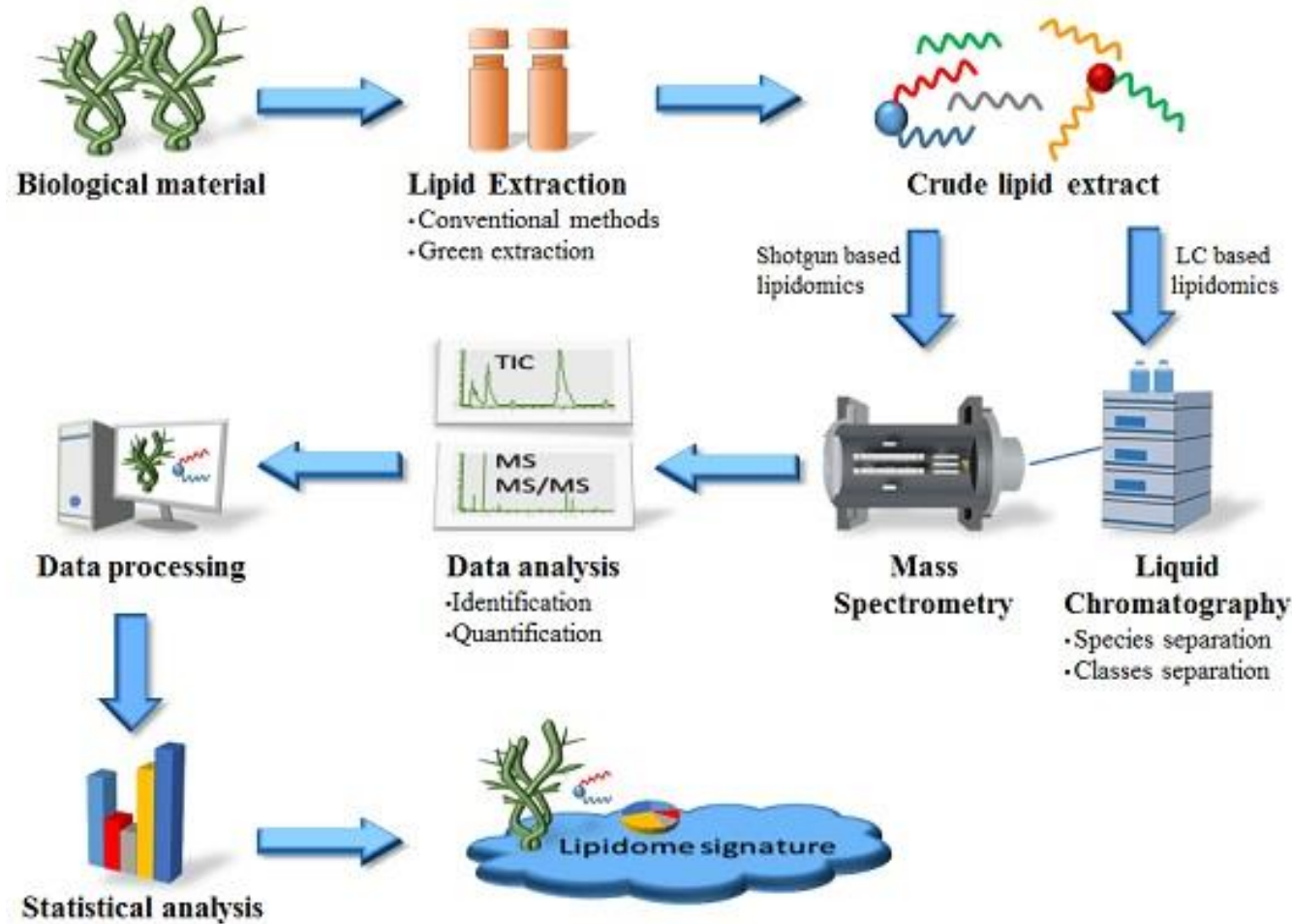




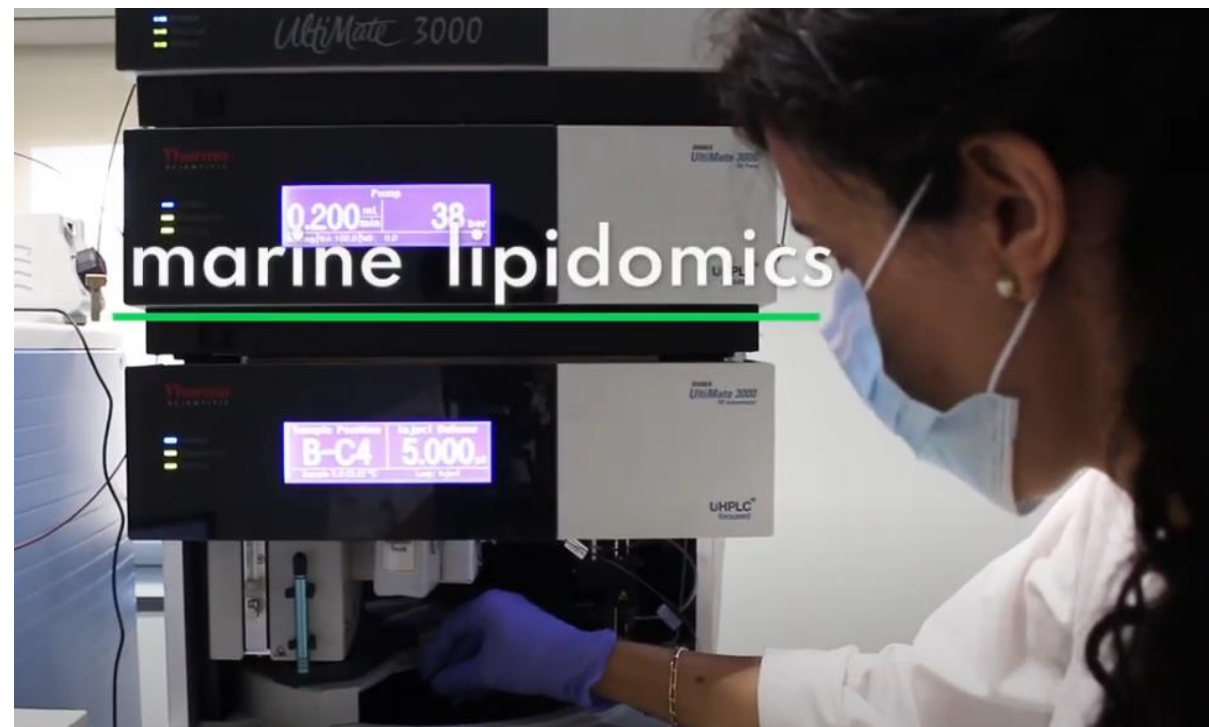
Review

Bioprospecting of Marine Macrophytes Using MS-Based Lipidomics as a New Approach

Elisabete Maciel ^{1,2,*}, Miguel Costa Leal ³, Ana Isabel Lillebø ², Pedro Domingues ¹, Maria Rosário Domingues ¹ and Ricardo Calado ^{2,*}



fatty acid profile

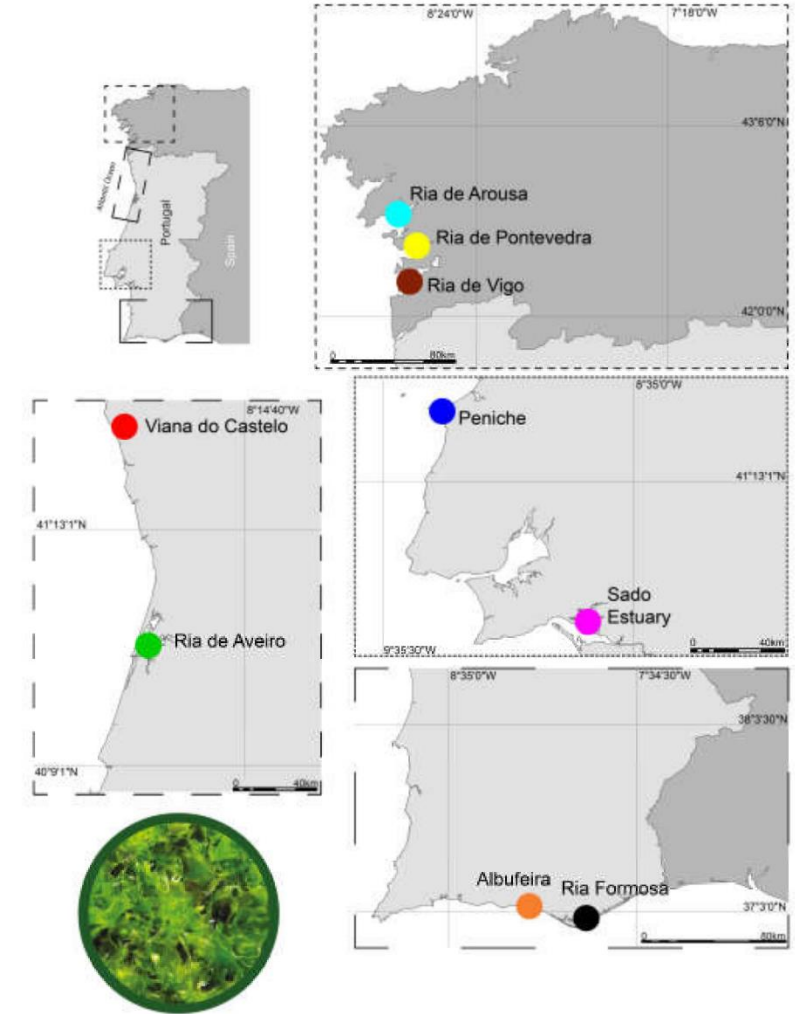
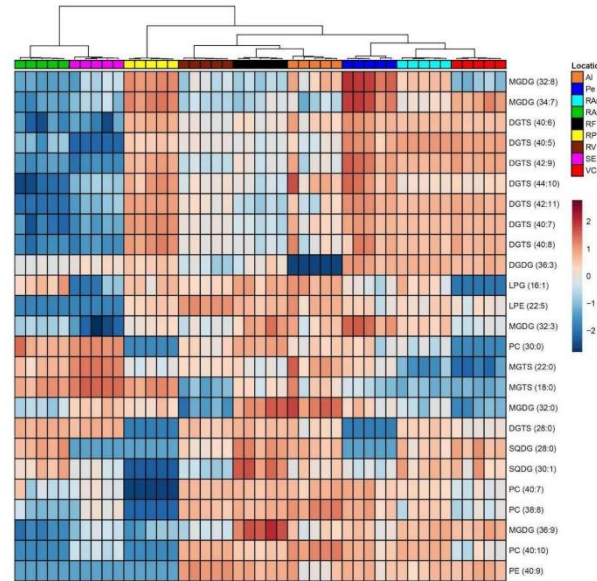
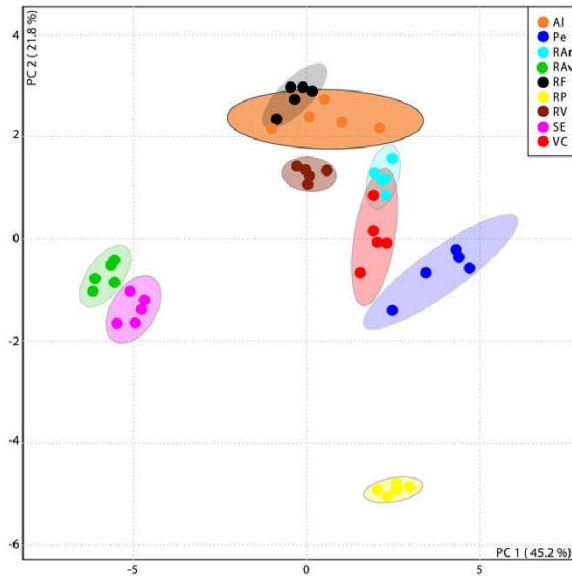


**Laboratório de Lipidómica Marinha @Departamento de Química
Universidade de Aveiro**

Article

Site-Specific Lipidomic Signatures of Sea Lettuce (*Ulva* spp., Chlorophyta) Hold the Potential to Trace Their Geographic Origin

Elisabete da Costa ^{1,2}, Fernando Ricardo ^{1,3}, Tânia Melo ^{1,2}, Renato Mamede ³, Maria H. Abreu ⁴, Pedro Domingues ^{1,2}, M. Rosário Domingues ^{1,2} and Ricardo Calado ^{3,*}





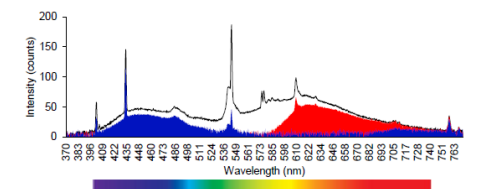
Intensidade



Espectro

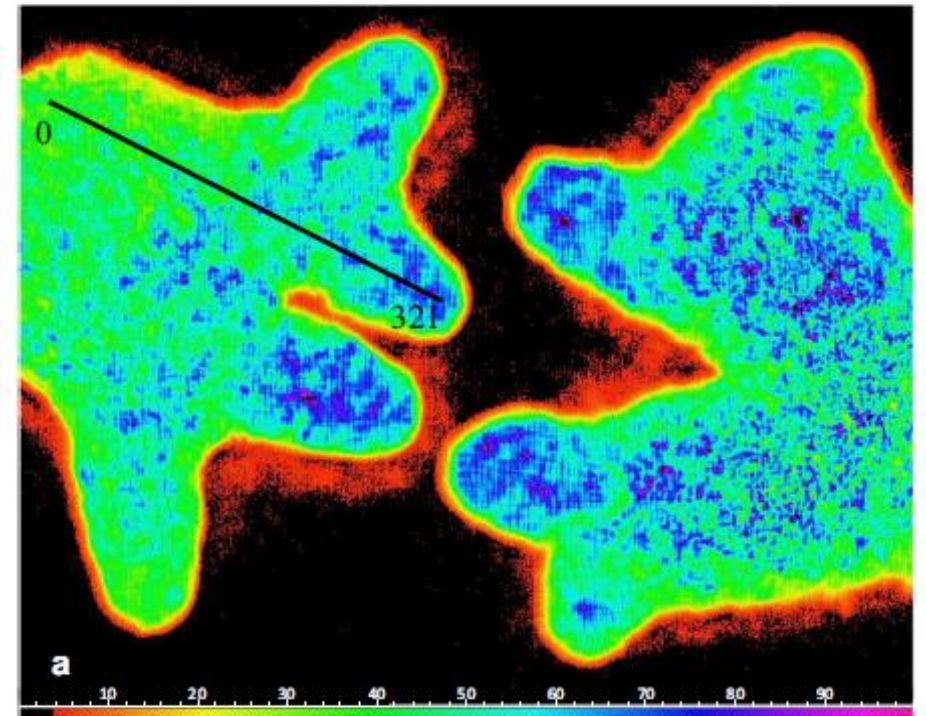
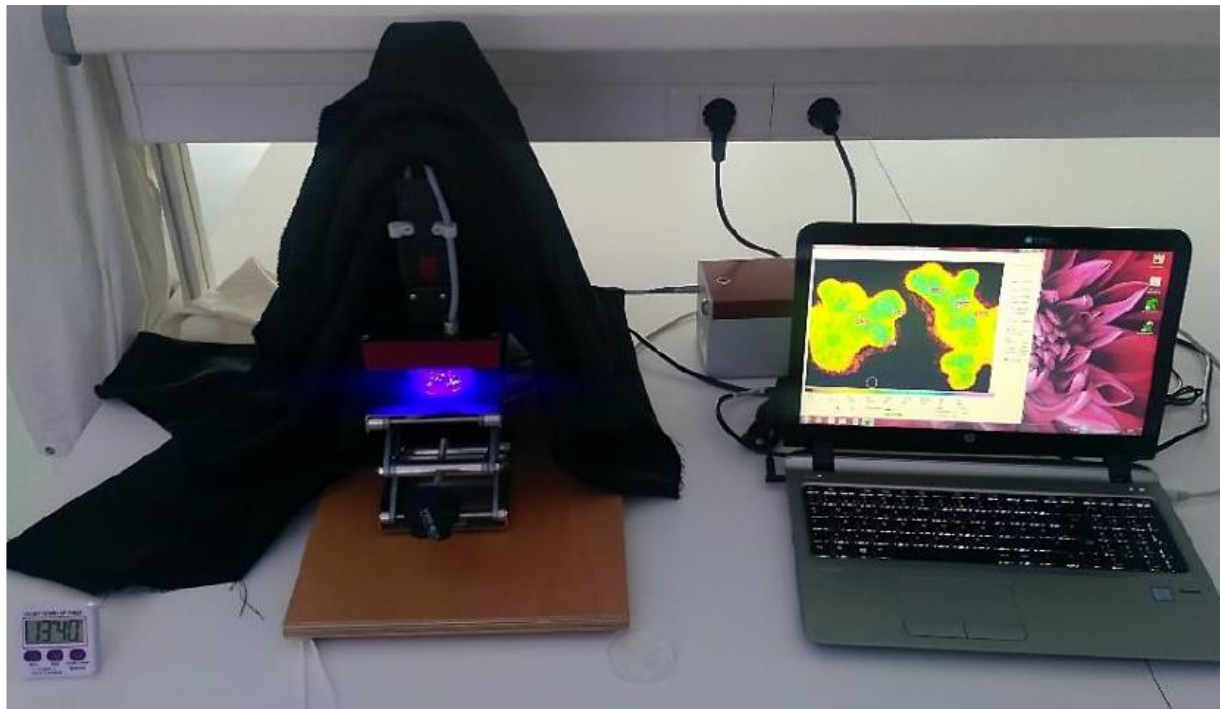


(ainda é grátis)



Manipulando a intensidade e o espectro da luz do sol para otimizar o crescimento/qualidade das algas

Fluorescência da Clorofila a – Metodologias para avaliação da atividade fotossintética, fotoproteção e fotoinibição











Controlling Light to Optimize Growth and Added Value of the Green Macroalga *Codium tomentosum*

Rúben Marques[†], Anthony Moreira, Sónia Cruz, Ricardo Calado and Paulo Cartaxana^{*}



Communication

Photosynthetic Pigment and Carbohydrate Profiling of *Fucus vesiculosus* from an Iberian Coastal Lagoon

Ana C. R. Resende¹ , Rui Pereira² , Cláudia Nunes³ , Sónia Cruz⁴ , Ricardo Calado⁴  and Paulo Cartaxana^{4,*} 



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Algal Research

journal homepage: www.elsevier.com/locate/algal



Spatial variability of elemental fingerprints of sea lettuce (*Ulva* spp.) and its potential use to trace geographic origin

Renato Mamede^{a,*}, Fernando Ricardo^a, Maria Helena Abreu^b, Eduardo Ferreira da Silva^c, Carla Patinha^c, Ricardo Calado^{a,*}



Sarcocornia spp.



Atriplex halimus



Sesuvium portulacastrum



Halimione portulacoides



Salicornia spp.



Aster tripolium



Grafts



Week 1



Week 5

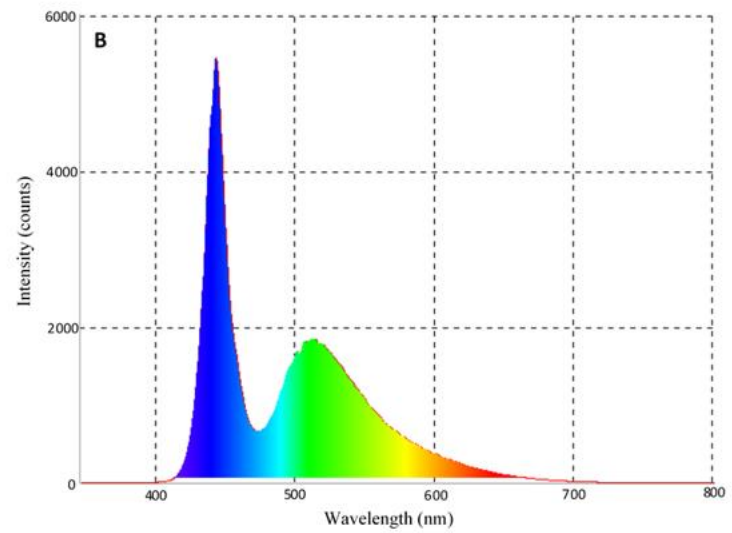
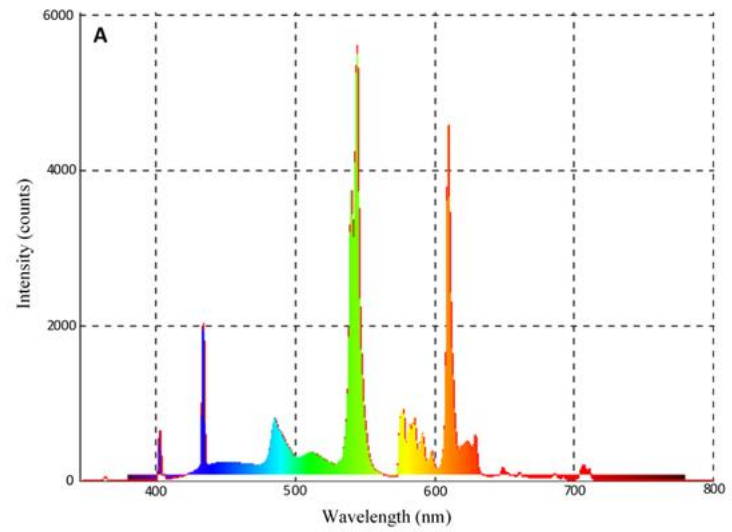


Week 10

	Nitrogen (mg L ⁻¹)	Phosphorous (mg L ⁻¹)
[N,P] _{low}	6	0.8
[N,P] _{med}	20	3.0
[N,P] _{high}	100	6.0
Control	56	15.5

		[N,P] _{low}	[N,P] _{med}	[N,P] _{high}	Control	
Final biomass	Initial biomass	g unit ⁻¹	44.6 ± 6.0	47.4 ± 6.3	49.3 ± 6.2	48.6 ± 2.1
	Total	g unit ⁻¹	195.9 ± 28.7 ^a	245.5 ± 39.7 ^{ab}	257.6 ± 40.8 ^{ab}	279.4 ± 44.7 ^b
	Aboveground	g unit ⁻¹	155.2 ± 16.7 ^a	216.3 ± 36.5 ^b	228.6 ± 35.4 ^b	245.4 ± 40.4 ^b
	Belowground	g unit ⁻¹	40.3 ± 12.9	28.9 ± 4.5	29.0 ± 5.5	32.0 ± 6.7
	Total productivity	g m ⁻² day ⁻¹	48.0 ± 7.9 ^a	62.9 ± 13.7 ^{ab}	66.1 ± 11.2 ^{ab}	73.3 ± 14.5 ^b
	Root: shoot ratio	-	0.26 ± 0.06 ^a	0.13 ± 0.02 ^b	0.13 ± 0.01 ^b	0.13 ± 0.02 ^b
	Leaves count	n unit ⁻¹	1658 ± 167	1879 ± 103	2008 ± 190	1958 ± 277
	Stems length	m unit ⁻¹	1.83 ± 0.12 ^a	2.29 ± 0.26 ^b	2.39 ± 0.22 ^b	2.51 ± 0.32 ^b





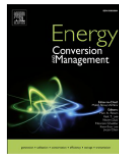




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Energy Conversion and Management

journal homepage: www.elsevier.com/locate/enconman



Halimione portulacoides biomass - a sustainable feedstock for bioenergy production from an integrated water-energy-food system

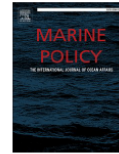
Ricardo N. Coimbra^a, Marco Custódio^b, Eduardo M. Cuerda-Correa^c, Moonis Ali Khan^d, Ricardo Calado^b, Ana I. Lillebø^b, Marta Otero^{a,e,*}



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Marine Policy

journal homepage: www.elsevier.com/locate/marpol



Full length article

Halophytes as novel marine products – A consumers' perspective in Portugal and policy implications

Marco Custódio^{a,b,*}, Ana I. Lillebø^a, Ricardo Calado^a, Sebastián Villasante^{c,d,**}



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Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv



Testing the hydroponic performance of the edible halophyte *Halimione portulacoides*, a potential extractive species for coastal Integrated Multi-Trophic Aquaculture

Marco Custódio^{a,*}, Sebastián Villasante^b, Ricardo Calado^a, Ana I. Lillebø^{a,*}

REVIEWS IN Aquaculture

Reviews in Aquaculture (2020) 12, 392–405

doi: 10.1111/raq.12324

Valuation of Ecosystem Services to promote sustainable aquaculture practices

Marco Custódio^{1,2} , Sebastián Villasante^{2,3} , Ricardo Calado¹ and Ana Isabel Lillebø¹



Article

LED Lighting and High-Density Planting Enhance the Cost-Efficiency of *Halimione portulacoides* Extraction Units for Integrated Aquaculture

Marco Custódio^{1,2,*}, Paulo Cartaxana¹ , Sebastián Villasante^{3,4,5}, Ricardo Calado¹ and Ana Isabel Lillebø^{1,*}

SCIENTIFIC
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nature research

OPEN

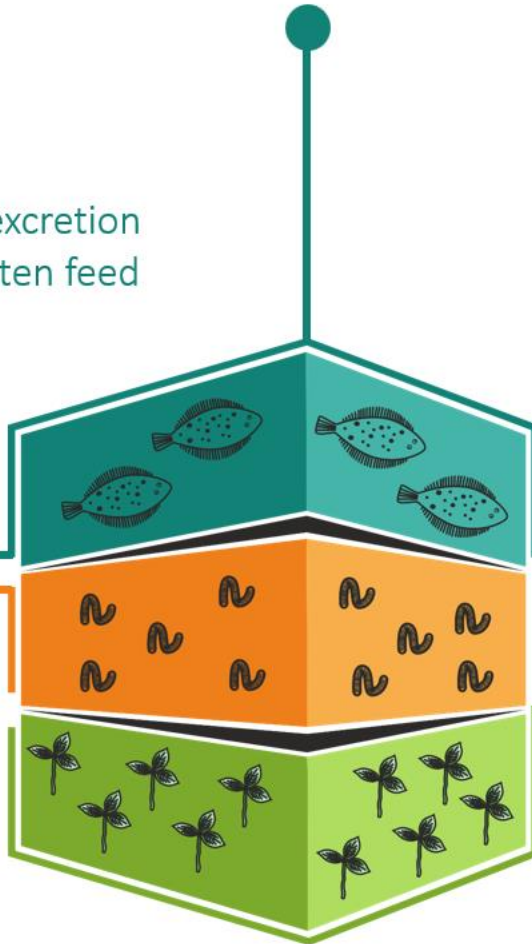
Nutrient availability affects the polar lipidome of *Halimione portulacoides* leaves cultured in hydroponics

Marco Custódio^{1*} , Elisabete Maciel^{1,2,3}, Maria Rosário Domingues^{2,3}, Ana Isabel Lillebø¹ & Ricardo Calado^{1*}

Fish Feed

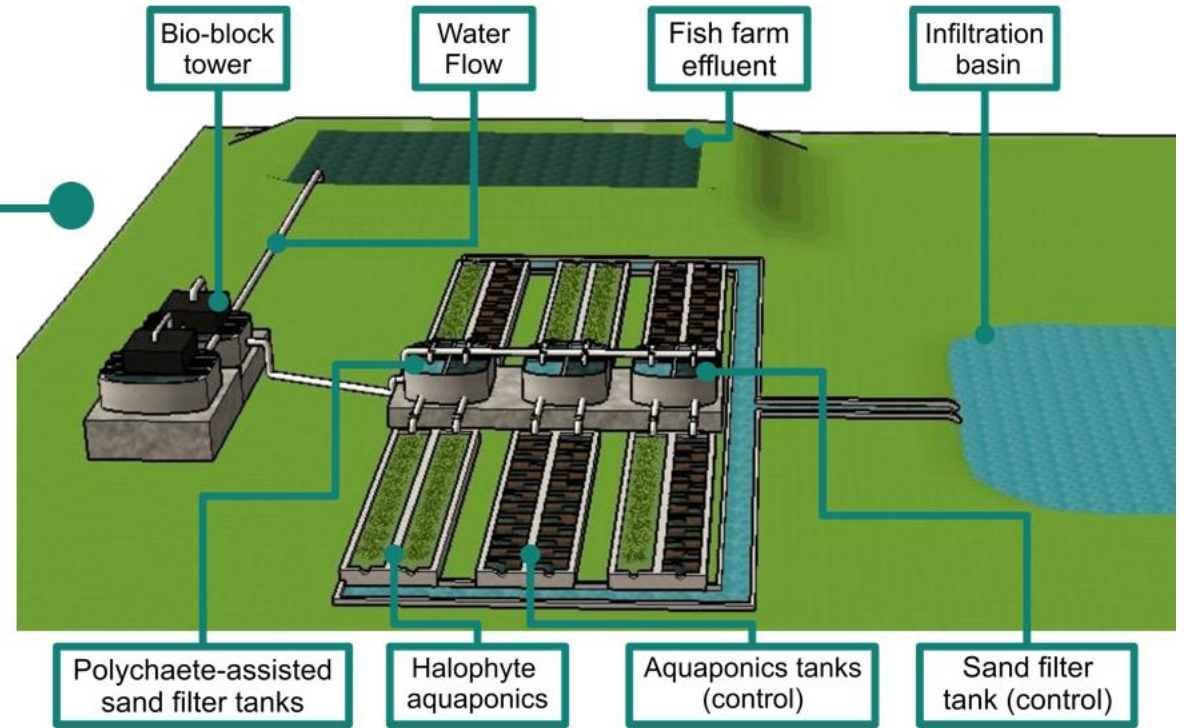
Effluent

- fish excretion
- uneaten feed



Hediste diversicolor

Halimione portulacoides



Project STEP was designed to remove as much particulate organic matter and dissolved nutrients from fish farm effluent water as possible.





New species for the biomitigation of a super-intensive marine fish farm effluent: Combined use of polychaete-assisted sand filters and halophyte aquaponics



Bruna Marques, Ricardo Calado *, Ana I. Lillebø *

FEATURE ARTICLE



Adding value to ragworms (*Hediste diversicolor*) through the bioremediation of a super-intensive marine fish farm

Bruna Marques¹, Ana Isabel Lillebø¹, Fernando Ricardo¹, Cláudia Nunes^{2,3}, Manuel A. Coimbra³, Ricardo Calado^{1,*}

SCIENTIFIC
REPORTS

nature research



OPEN

Aquaponics using a fish farm effluent shifts bacterial communities profile in halophytes rhizosphere and endosphere

Vanessa Oliveira³, Patrícia Martins², Bruna Marques², Daniel F. R. Cleary³, Ana I. Lillebø² & Ricardo Calado²



REVIEW

Unravelling the potential of halophytes for marine integrated multi-trophic aquaculture (IMTA)—a perspective on performance, opportunities and challenges

Marco Custódio^{1,*}, Sebastian Villasante², Javier Cremades³, Ricardo Calado¹, Ana I. Lillebø¹



molecules



Article

Effect of High-Pressure Processing (HPP) on the Fatty Acid Profile of Different Sized Ragworms (*Hediste diversicolor*) Cultured in an Integrated Multi-Trophic Aquaculture (IMTA) System

Bruna Marques¹, Ana Isabel Lillebø^{1,*}, Maria do Rosário M. Domingues², Jorge A. Saraiva³ and Ricardo Calado^{1,*}



applied
sciences



Article

Halophyte Plants Cultured in Aquaponics Hold the Same Potential for Valorization as Wild Conspecifics from Donor Sites

Bruna Marques^{1,*}, Elisabete Maciel², Maria Rosário Domingues^{2,3}, Ricardo Calado¹ and Ana Isabel Lillebø¹

A inspiração para novos modelos de AMTI



Os ecossistemas de recifes de coral são altamente produtivos e biodiversos, embora existam em ambientes oceânicos pobres em nutrientes (oligotróficos); este fenômeno é conhecido como o paradoxo de Darwin.



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MARINE BIOTECHNOLOGY
& AQUACULTURE



**KEEP
CALM
AND
DO YOUR
RESEARCH**





Obrigado!
Gracias!
Thank you!
Merci!
Grazie!
Danke!
Xièxiè!