# WWW.ENCONTROMARE.COM

29 e 30 de novembro 2023 Centro de Artes e Espectáculos | Campus UC Figueira da Foz



# Livro de Contribuições























# **ENCONTRO MARE 2023**

# Figueira da Foz 29 e 30 de novembro 2023

# Editado por:

Zara Teixeira Vogal da Direção do MARE Investigadora do MARE-Universidade de Coimbra

Ana Cunha Investigadora do MARE-Universidade de Coimbra

Uma publicação de: MARE-Centro de Ciências do Mar e do Ambiente Portugal

# Ficha técnica

Título: Encontro MARE 2023 - Livro de Contribuições

Editoras: Zara Teixeira, Ana Cunha

1ª edição - novembro 2023

DOI: https://doi.org/10.5281/zenodo.10209472

# Agradecimentos

Os editores e a comissão organizadora agradecem o apoio para a publicação do Livro de Contribuições e à organização do Encontro MARE 2023 às seguintes organizações e individualidades:

- Universidade de Coimbra
- Politécnico de Leiria
- Faculdade de Ciências e Tecnologia da Universidade de Lisboa
- FCiências.ID
- Universidade NOVA de Lisboa
- NOVA.ID.FCT
- ISPA-Instituto Universitário
- Universidade de Évora
- ARDITI, Madeira
- Fundação para a Ciência e a Tecnologia (FCT), Ministério da Educação e Ciência, através do Fundo de Apoio à Comunidade Científica (FACC)
- Câmara Municipal da Figueira da Foz
- Campus UC da Figueira da Foz
- Gabinete de Comunicação do MARE
- Divisão de Comunicação da Universidade de Coimbra
- Investigadores do MAREFOZ que colaboraram com a Comissão Organizadora
- Entidades locais que apoiaram o evento: Centro de Dia do Centro Social Nossa Senhora da Boa Viagem da Cáritas Diocesana de Coimbra (Leirosa), Eurico Gonçalves da ADMS - Associação Desenvolvimento +Surf, Incubadora do Mar & Indústria da Figueira da Foz, Quinta Ciência Viva do Sal, Associação Comercial e Industrial da Figueira da Foz (ACIFF), The Navigator Company, Celbi S.A., Porto da Figueira da Foz
- Todas as pessoas que, direta ou indiretamente, ajudaram na preparação ou durante o evento.

# Comissão Organizadora do Encontro MARE 2023

Presidente | Zara Teixeira (PhD), MARE-UCoimbra Alejandro Bernal (MSc), MARE-Madeira Carla Silva (PhD), MARE-NOVA Carmen Elias (PhD), MARE-PLeiria Célia Teixeira (PhD) ,MARE-ULisboa Esmeralda Pereira (MSc), MARE-UÉvora João Pequeno (PhD), MARE-NOVA Marco Simões (MSc), MARE-PLeiria Priscila Silva (MSc), MARE-ULisboa Raquel Calapez (PhD), MARE-UCoimbra Sara Francisco (PhD), MARE-UCoimbra Sara Veríssimo (MSc), MARE-UCoimbra Sílvia Pedro (PhD), MARE-UÉvora Sónia Costa (PhD), MARE-Madeira

# **Equipa de Apoio Local**

Ana Bóia (MSc), MARE-UCoimbra
Ana Cunha (MSc), MARE-UCoimbra
Bárbara Camarão (MSc), MARE-UCoimbra
Carlos Gonçalves (MSc), MARE-UCoimbra
Cátia Marques (MSc), MARE-UCoimbra
Claúdia Moreira (MSc), MARE-UCoimbra
Daniela Silva (MSc), MARE-UCoimbra
João Fernandes (MSc), MARE-UCoimbra
Luís Resende (MSc), MARE-UCoimbra
Juliana Spitz Felipe (MSc), MARE-UCoimbra
Sarah Freitas (Lic), MARE-UCoimbra

# **Prefácio**

O Encontro MARE é um evento anual de partilha e convívio entre os membros de todas as Unidades Regionais de Investigação do MARE-Centro de Ciências do Mar e do Ambiente. Disponibiliza momentos de discussão e pretende promover uma maior colaboração entre a comunidade MARE, fortalecendo as suas iniciativas de investigação.

O Encontro MARE 2023 teve lugar de 29 a 30 de novembro, no Centro de Artes e Espectáculos (CAE) e Campus UC na Figueira da Foz, Portugal. Serviu para olhar para o passado recente e perspectivar o futuro, no quadro da avaliação das Unidades de Investigação nacionais por parte da Fundação para a Ciência e Tecnologia (FCT).

Este Livro de Contribuições do Encontro MARE 2023 compila os Posters científicos apresentados por investigadores do MARE durante o evento, numa mostra das suas contribuições mais recentes em eventos científicos nacionais e internacionais.

Para o sucesso do evento contribuiu a presença de membros juniores e seniores, docentes e investigadores, técnicos, gestores, bolseiros entre outros. Pela sua dimensão e oferta, cremos que este evento será um marco na história do MARE e esperamos que os participantes sintam que foram criadas as condições para uma proveitosa troca de ideias e momentos únicos de formação.

Zara Teixeira e Ana Cunha

Figueira da Foz, novembro 2023

# Contribuições

1. Almeida, R., Mateus, C.S., Tanner, S.E., Quintella, B.R., 2023. FRESHseaBASS - Divergent sea bass freshwater incursions
2. Amorim, A., David, H., Dias, C., Dâmaso-Rodrigues, M.L., 2023. ALISU Coleção de Cultura de Algas da Universidade de Lisboa
3. Barreto, G., Ferreira, V., 2023. Como Levar Um Ribeiro Para A Sala De Aula Aquário De Fragmentadores – Um Recurso Para Explorar A Ecologia Dos Ribeiros De Floresta
4. Borges, F.O., Sampaio, E., Santos, C.P., Rosa, R.,2023. Cephalopods stand to lose under changing future Ocean conditions
5. Brotas, V., Ferreira, A., Veloso, V., Tracana, A., Ribeiro, L., Guerreiro, C., Tarran, G., Woodward, E. M. S., Netting, J., Clewley, D., Groom, S., 2023. Phytoplankton size structure in the Atlantic Ocean in situ and remote sensing.
6. Cadima, M., Castellanos, P., Dias, J., Olmedo, E., Campos, E.J.D., 2023. Surface salinity maximum in the North Brazil Current A 3-dimensional view6
7. Carvalho, R.F., 2023. Detalhes de escoamentos usando modelos físicos e simulações numéricas em OPENFOAM®7
8. Dias, M., Antunes, J., Sobral, P., Branco, V., Carvalho, C., Martins, M., Figueiredo, N., 2023. PlasticHg project coexistence of MPs and Hg in Tagus estuary8
9. Fernandes, J.N., Jacinto, D., Penteado, N., Sousa, A., Mateus, D., Seabra, M.I., Silva, T., Castro, J.J., Cruz, T., 2023. Ten years of monitoring recruitment of the stalked barnacle Pollicipes pollicipes linking with environmental variability9
10. Ferreira, A., Abreu, J., Araújo, P.M., Bastos, L., Brito, A.C., Brotas, V., Carmo, D., Cerveira, L.R., Fragão, J., Santos, C.F., Guímaro, H., Guerreiro, C.V., Guerreiro, M., Nunes, G.S., Queirós, J., Quitério, M., Rosa, R., Santos, C.P., Santos, D.A., Santos, S., Seco, J., Xavier, J., 2023. MARE's Role in Polar Science.
11. Ferreira, V., 2023. How to take the most from scientific evidence Systematic review and meta-analysis11
12. Ferreira, M.A., Andrade, F., 2023. Early 21st century morphodynamics of the NW section of the Tróia peninsula (SW coast of Portugal) - 2004 to 202212
13. Jacinto, D., Mateus, D., Fernandes, J.N., Seabra, M.I., Silva, T., Castro, J.J., Cruz, T., 2023. Estimating abundance of the stalked barnacle Pollicipes pollicipes photo-quadrats vs drone imagery
14. Mancini, C., Ramalhosa, P., Ferrario, J., Parretti, P., 2023. Spatio-temporal variability of NIS in the marinas of Madeira Archipelago14
15. Marques, J.P., Reis-Santos, P., Tanner, S., Alexandre, C., Almeida, A.R., Alves, M.J., Amorim, C., Costa, J.L., Domingos, I., Fonseca, P., Jorge, A., Lança, M.J., Mateus, C.S., Prista, N., Silva, M., Stratoudakis, Y., Vieira, M., Almeida, P.R., Quintella, B.R., 2023. Integrated approach to study the movement dynamics of the meagre
16. Matos, B., Diniz, M., Branco, V., Martins, M., 2023. Induction of CYP1A1 by Benzo[a]pyrene and Phenanthrene in zebrafish hepatocytes

17. Matos, D.M., Ramos, J.A., Bessa, F., Silva, V., Rodrigues, I., Antunes, S., dos Santos, I., Coentro, J., Brandão, A.L.C., Batista de Carvalho, L.A.E., Marques, M.P.M., Santos, S., Paiva, V.H., 2023. Anthropogenic Debris in a Tropical Seabird Community Insights from Taxonomy and Foraging Distribution
18. Moreira, C., Rocha, A.C.S., Campos, C., Marques, J.C., Verdelhos, T., 2023. Acclimation period for Mytilus spp. prior to laboratory experiments preliminary results
19. Moutinho, A.B., Monteiro, H.R., Damasceno, J.M., David, H., Amorim, A., Novais, C.S., Lemos, M.F.L., Simões, T., 2023. Toxicity of Ostreopsis cf. siamensis and Prorocentrum lima effects in the coastal amphipod Echinogammarus marinus
20. Neves, F., Simões, B., Correia, I., Rolim, M., Jacinto, D., Silva, T., Sequeira, M., Cruz, T., Castro, J. J., 2023. The establishment of a regional stranding network on the southwest coast of mainland Portugal (Alentejo) first results and challenges
21. Neves, F., Sousa, A., Jacinto, D., Maia, S., Penteado, N., Silva, T., Leandro, S.M., Mateus, D., Castro, J. J., Cruz, T., 2023. Temporal and spatial variation in abundance and size of the stalked barnacle <i>Pollicipes pollicipes</i> at Berlengas Nature Reserve (Portugal)
22. Oliveira, I.C., Almeida, P.R., Salzburger, W., Mateus, C.S., 2023. Sea lamprey adaptation in a climate change scenario from genes to sustainable fisheries
23. Pereira, E., Quintella, B., Lança, M.J., Mateus, C., Almeida, P.R., 2023. Study of fish migrations and life-story strategies - Migratory dynamic of catadromous thinlipgrey mullet 23
24. Rato, A.S., Alexandre, C.M., Lima, I.P., Almeida, P.R., 2023. Gestão e conservação de espécies potamódromas dinâmica de movimentos, fidelidade espacial e migrações parciais 24
25. Reis, B., Neves, F., Silva, T., Crus, T., Castro, J.J., Jacinto, D., 2023. Installation of a passive acoustic monitoring network (F-PODs) to detect toothed cetaceans (odontocete) on the Alentejo coast preliminary results
26. Rodrigues, F., Feio, M.J., Calapez, A.R., Simões, N., Pereira, A.M.P.T., Silva, L.J.G., Freitas, A., Durães, L., 2023. Novel photocatalysts for pharmaceuticals removal from wastewater a literature survey and a perspective for healthy freshwater ecosystems
27. Santos, C.J., Ferreira, J.C., Beck, M.W., 2023. Nature-based Solutions and Coastal Resilience How can nature protect us from nature
28. Santos, D., Rosa, R., Badhe, R., Ehler, C.L., Grant, S.M., Hughes, K.A., Van de Putte, A.P., Xavier, J.C., Santos, C.F., 2023. Promoting sustainable marine planning in the arctic and Antarctic.
29. Seabra, M.I., Santos, M., Jacinto, D., Mateus, D., Fernandes, J.N., Pombo, A., Silva, T., Castro, J.J., Cruz, T., 2023. Effects of hydrodynamic condi2ons and feeding period on size, growth and cirral behavior of the stalked-barnacle Pollicipes pollicipes
30. Sent, G., Spyrakos, E., Brito, A., Jackson, T., Brotas, V., Nwokocha, E., Atwood, E., Groom, S., 2023. Assessing the impact of tidal aliasing on remote sensing observations of transitional waters a Case study of the Tagus estuary using Sentinel-2 MSI data
31. Silva, A.F., Castro, J.J., Pereira, E., Marques, J.P., Pinto, B., Silva, T., Lino, P.G., Candeias-Mendes, A., Pousão-Ferreira, P., Costa, J.L., Almeida, P.R., Quintella, B.R., 2023. In-situ cage conditioning promotes the establishment of released hatchery-reared dusky groupers in the
wild



# FRESHseaBASS – DIVERGENT SEA BASS FRESHWATER INCURSIONS

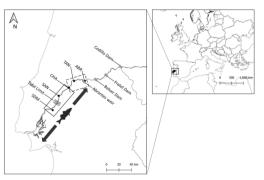


Almeida R.<sup>1,2</sup>, Mateus C. S.<sup>1,3</sup>, Tanner S. E.<sup>1,2</sup>, & Quintella B. R.<sup>1,2</sup> arpalmeida@ciencias.fc.ul.pt

# INTRODUCTION

European Sea Bass (Dicentrarchus labrax L.):

- Relevant for fisheries and aquaculture
- · Marine migrant and euryhaline
- Partial migrations described in coastal areas
- Occurrence of adults in freshwater environments was recently identified in Tagus River





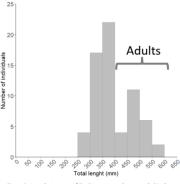
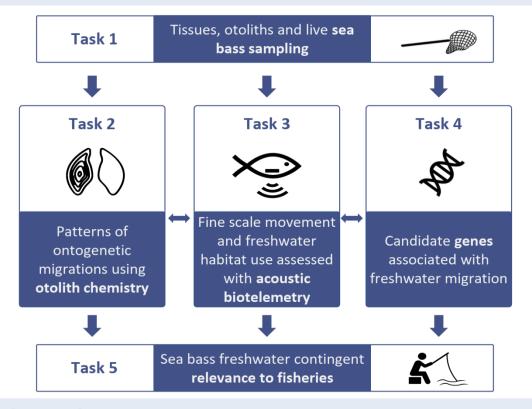


Figure 2 : Length structure of the European sea bass sampled in the freshwater stretch of Tagus River

Unravel the divergent sea bass migrations to freshwater:

- What are the spatial and temporal patterns of sea bass freshwater habitat use?
- Can we identify the genetic drivers influencing migratory behaviour?
- · What is the relevance of the sea bass freshwater contingent for continental waters fisheries?

# **WORK PLAN**



# **ACKNOWLEDGMENTS**











Study supported by Fundação para a Ciência e a Tecnologia (FCT) through the strategic project UIDB/04292/2020 awarded to MARE and through project LA/P/0669/2020 granted to the Associate Laboratory ARNET. A PhD grant was attributed by FCT to Rita Almeida (2022.10942.BD). Catarina S. Mateus was funded by FCT within the project "EVOLAMP - Genomic footprints of the evolution of alternative life histories in lampreys" (PTC/gIA-EVL/30695/2017) and Susanne E. Tanner was funded by FCT Scientific Employment Stimulus Programme (2021.02710.CEECIND). This study also received support from CoastNet Research Infrastructure (PINFRA/22128/2016; http://coastnet.pt) funded by Fundação para a Ciência e a Tecnologia (FCT) and the European Regional Development Fund (FEDER).





# The Algae Culture Collection at University of Lisboa MARE - Phytoplankton and Remote Sensing Lab



Ana Amorim, Helena David, Carla Dias, M. Luísa Dâmaso-Rodrigues

MARE – Centro de Ciências do Mar e do Ambiente

CONTACT: aaferreira@ciencias.ulisboa.pt

The Algae Culture Collection at the University of Lisbon is dedicated to marine phytoplankton from Portuguese coastal waters, with emphasis on Harmful Algae (HABs) and species with potential biotechnological interest.



# Ocean literacy

# Cyanobacteriota

# Chlorophyta

# Arthrospira maxima



Botryococcus braunii Chloromonas augustae Coccomyxa sp. Dunaliella tertiolecta Haematococcus rubens Parietochloris bilobata Scenedesmus rubescens

# Haptophyta

Coccolithus pelagicus subsp. braarudii Diacronema viridis Emiliania huxleyi Tisochrysis lutea





# Culture List

# Heterokontophyta

# Bacillariophyceae

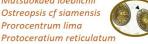
Chaetoceros protuberans Pseudo-nitzschia australis Pseudo-nitzschia fraudulenta Skeletonema marinoi Thalassiosira cf. eccentrica

## Eustigmatophyceae Nannochloropsis oculata

# Raphidophyceae Heterosigma akashiwo

# Dinoflagellata

Amphidinium carterae
Gymnodinium catenatum
Heterocapsa sp.
Lingulodinium polyedra
Matsuokaea loeblichii
Ostreopsis cf siamensis

















# Como Levar Um Ribeiro Para A Sala De Aula





# Aquário De Fragmentadores – Um Recurso Para **Explorar A Ecologia Dos Ribeiros De Floresta**

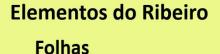


Guilherme Barreto, Verónica Ferreira

MARE – Centro de Ciências do Mar e do Ambiente, ARNET – Rede de Investigação Aquática, Departamento de Ciências da Vida, Universidade de Coimbra, Coimbra, Portugal

# Introdução

Nos ribeiros de floresta, os detritos vegetais suportam grande parte da vida aquática. Os invertebrados fragmentadores têm um papel fundamental na decomposição destes detritos, no ciclo de nutrientes, e servem como ligação a outros níveis da cadeia alimentar. Estes fragmentadores são muito frequentemente larvas de insetos da ordem Trichoptera ('tricópteros'). Estes organismos são insetos aquáticos cuja fase larvar constrói casulos minerais ou orgânicos. As larvas alimentam-se de detritos vegetais e são fáceis de manter em aquário. Propomos a montagem de um aquário com tricópteros, de modo a permitir explorar o seu papel no processo de decomposição de detritos vegetais, algumas fases do seu ciclo de vida, a sua morfologia e taxonomia.





**Sedimentos** 



Larvas de tricóptero



# Oportunidades de Observação

# Lixiviação



# Decomposição foliar



Ciclo de vida



Artigo completo:

# Conclusão

A sala de aula é um local privilegiado para realizar atividades que visem aumentar a literacia sobre o mundo natural, e o aquário de fragmentadores pode ser usado como recurso educativo para abordar temáticas que estão ainda pouco presentes nos exemplos curriculares em biologia, e.g., os ecossistemas ribeirinhos.



**SCAN ME** 





Catarina P. Santos<sup>1,5,6</sup> Rui Rosa<sup>1,7</sup>

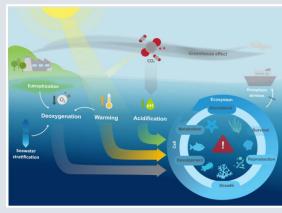




5 Environmental Economics Knowledge Center, Nova School of Business and Economics, New University of Lisbon, Carcavelos, Portugal

\*Corresponding author: fdborges@fc.ul.pt

- 1.MARE Marine and Environmental Sciences Centre/ARNET Aquatic Research Network, Laboratório Marítimo da Guia, Faculdade de Ciências, Universidade de Lisboa, Cascais, Portugal
- 2. Department of Collective Behaviour, Max Planck Institute of Animal Behavior, Universitatsstrasse 10. Konstanz 78464 Germany.
- Atmospheric carbon dioxide (CO2) concentration is at its highest in almost 1 million years1, due to increasing greenhouse gas emissions (GGE) since the Industrial Revolution<sup>2</sup>.
- The 'deadly trio' of marine climate change impact drivers (Figure 1) ocean warming (OW), acidification (OA), and deoxygenation (OD) - are poised to induce severe and negative impacts to marine biodiversity worldwide, from the cellular to the ecosystem level3, across all major taxa4.
- Some groups of organisms have stood out as being potentially more resilient to changing environmental conditions, in particular Class Cephalopoda (i.e., octopuses, squids, cuttlefishes, and nautiluses). Cephalopod's high phenotypic flexibility and environmental plasticity, together with their cognitive and behavioural prowess, and the remarkable ability of some to undergo RNA-editing<sup>5,6</sup> suggest an innate ability to quickly acclimate to novel conditions. At the same time, decreased competition and predation from other species either over explored by fisheries or impacted by climate change - could lead to increased abundance of cephalopod species over time7.
- Notwithstanding, growing evidence suggests deleterious impacts of marine climate change even on these remarkable organisms, hinting at a greater susceptibility to future climate change than previously expected<sup>8,9</sup>.



e 1. Conceptual schematics of the influence of the three main climate change impact drivers (ocean warming, acidification, and deoxygenation) on marine ecosystems. Retrieved from Borges et al.10

The present work consisted of a meta-analysis on the impacts of marine climate change (OW, OA, and their interaction) on Class Cephalopoda, utilizing the available scientific literature on experimental exposure to these drivers. Scan the QR code for a summary of the Methodology!





🚫 The following results are SUBMITTED and currently undergoing peer-review, so we kindly ask you NOT to publicly share them! 🚫

# **RESULTS**

Table 1. Results of the meta-analyses [Acidification (OA), Warming (OW), and their interaction (OWA)]. (\*) Significant effects. (=) - Absence of effects. (↑) - stimulation. (↓) - inhibition.

STAGE	MODERATOR	LEVEL / RESPONSE	ACIDIFICATION	WARMING	INTERACTION
Global	TREATMENT	Overall	*	*	*
	SUPER ORDER	Decapodiformes	*	•	•
		Myopsida	=	*	=
	ORDER	Octopoda		*	
	ONDER	Sepiida	*	•	•
		Sepiolida	=		
Attribute		Egg / Embryo	=	*	*
	LIFE STAGE	Paralarvae	*	*	
	LII E STAGE	Juvenile		•	
		Adult	=	=	
	HABITAT	Temperate	*	*	*
	HABITAT	Tropical	=		
		Survival	=	*↓	*↓
		Development	=	*↓	*↓
		Behaviour	=		
		Growth	=	=	=
		Calcification	=	=	=
Biological	TREATMENT	Feeding		=	
Category		Aerobic metabolism	*↓	*↑	*↓
		Anaerobic metabolism		=	
		Thermal tolerance	=	*↑	*↑
		Cell stress		*↑	
		Body composition		=	
		Oxygen related		=	
		Foraging	=		
		Lipid reserves		=	
		Aminoacid/protein reserves		=	
		Calcification: cuttlebone	=	=	
		Calcification: statolith	=	*↑	
		Survival	=	*↓	*↓
Biological		Routine metabolism	=	*↑	*↓
Sub-	TREATMENT	Active metabolism		=	
category		Cell damage		=	
		Antioxidative response		=	
		Development time	=	*↓	=
		Trace element accumulation	=		
		Abnormal development/Premature hatching	=	=	*↑
		Length	=	=	
		Weight	*↓	=	=

### References:

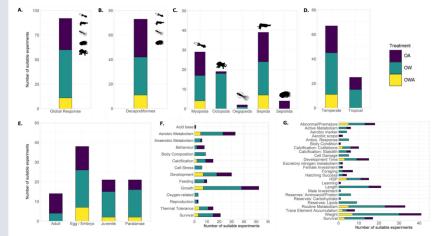


Figure 2. Number of suitable experiments (n = 47 articles) for acidification/hypercapnia (OA), warming/temperature (OW), and their interaction (OWA) in each stage of the analysis. (A) global response; (B) Superorder (only Decapodiformes is presented, since Octopodiformes only featured order Octopoda); (C) Order (Myopsida - squids, Octopoda - octopuses, Oegopsida - pelagic squids, Sepiida - cuttlefish, or Sepiolida - bobtail squid); (D) temperate and tropical climate; (E) egg/embryo, paralarvae, juvenile, and adult life stages; (F) biological category; and (G)

- OW is shown to induce a wide array of deleterious impacts across phylogeny, ontogeny, and biological categories. OA with less pervasive effects but limited to well-studied Sepiids (mostly paralarvae and adult stages of temperate climates). OWA severely underrepresented, limited to embryonic studies but showing synergistic effects of OA and OW.
- Pervasive lack of standardized balanced research between drivers. There is the urgent need to strengthen research surrounding the impacts of climate change in cephalopods, namely regarding OD and OA as well as multi-stressor and multigenerational approaches, to gain a more complete and accurate understanding of the potential impacts and the species which may present the greater susceptibility.
- Cephalopods occupy key positions in marine food-webs, both as predators and prey, and are set to be on the losing side in the Ocean of tomorrow. Fishery- and habitat-management and conservation measures must consider the increasingly conspicuous vulnerability of this incredible group, ensuring that adequate conservation actions prevent the collapse of natural populations and the consequent cascading ecosystem-level impacts worldwide.

Portuguese Foundation for Science and Technology (FCT) PhD fellowship awarded to FOB (SFRH/BD/147294/2019).

PEG centre of Excellence 2117 "Centre for the Advanced Study of Collective Behaviour" (Ib: 422037984) and the Max Planck Society FCT project OCEANIPLAN (PTD/CICTA-AMB/30226/2017), financed through FCEIncist Collective Behaviour" (Ib: 422037984) and the Max Planck Society FCT project OCEANIPLAN (PTD/CICTA-AMB/30226/2017), financed through FCEIncist Collective Behaviour (Ib: 422037984) and the Max Planck Society FCT project OCEANIPLAN (PTD/CICTA-AMB/30226/2017), financed through FCEIncist (PTD/CICTA-AMB/30226/2017), financed through (PTD/CICTA-AMB/30226/2017), finance

Strategic project UIDB/04292/2020 awarded to MARE and the project LA/P/0069/2020 granted to the Associate Laboratory ARNET funded by the FCT/Ministério da Ciência, Tecnologia e Ensino Superior (MCTES).

# and remote sensing

Vanda Brotas, Afonso Ferreira, Vera Veloso, Andreia Tracana, Lourenço Ribeiro, Catarina. Guerreiro, Glen Tarran, E. M. S. Woodward, Jane Netting, Daniel Clewley, Steve Groom

# MARE - FCUL, ARNET, Lisbon, Portugal

Encontro MARE 2023 - 29 e 30 Novembro 2023

DISCOVERY

AMT28



Figure 3 - The spatial distribution of the different

and AMT29 presents the same general pattern with high abundance of Diatoms and Dinoflagellates in

over 40% from 20°N to 40°S on both cruises. Also, in both cruises, a clear increase in Chla was

noticeable in the region around the Equator (where

Size Classes Fraction (%) in carbon Micro-Nano-Pico 44-17-29

37-18-45 40-9-49 41-10-51

nutrient concentrations increase within the photic

zone, and above the nutricline). A bloom of the

Median values of TCarbon, in mg m-3, and fraction of

AMT29. SATL was subdivided in two sub-regions. NS:

not sampled. The overall median for both cruises gave

biogeographic oceanic province, for AMT28 and

micro- nano- and pico-plankton for each

the same result:17 mgCarbon m-3.

observed at #1 of AMT28. Atlantic Longhurst Regions

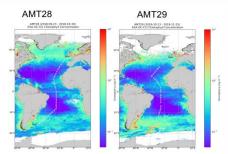
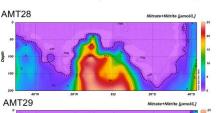


Figure 1 - Composite images of Chla mg m-3. showing cruise track for AMT28 (23 Sept to 30 Oct 2018 and AMT29 (13 Oct to 25 Nov 2019)



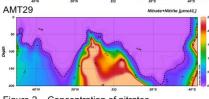
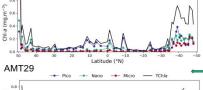


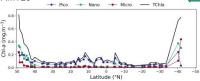
Figure 2 - Concentration of nitrates with the isoline of 1 µmol L-1 NOx, showing the strong trophic gradient which characterizes the Atlantic. Phosphates and Silicates followed the same spatial pattern.

X - in situ	Y - satellite	RMSE	r <sup>2</sup>	p-value
Micro Carbon	Micro Sat	2.93	0.56	<0.001
Nano Carbon	Nano Sat	1.80	0.47	<0.001
Pico Carbon	Pico Sat	2.20	0.15	<0.05
Diatoms carbon	Diatoms Sat	1.84	0.50	<0.001
Dinoflagellates Carbon	Dinoflagellates Sat	3.54	0.41	<0.001

Regression analysis were performed between in situ data of Carbon of size classes, and the size class Chla from satellite following Brewin et al., (2017). Within the microplankton, the partition between of Diatoms and Dinoflagellates, also determined by the satellite model, gave significant correlation values.

# AMT28





References
Brotas, V., Tarran, G., Veloso, V., Brewin, R.J.W., Woodward, E.M.S., Airs, R., et al. (2022). Complementary approaches to assess phytoplankton groups and size classes on a long transect in the Atlantic Ocean. Front. Mar. Sci., 11, 8. DOI:10.3389/fmars.2021.682621.
Brewin, R. J. W., Clavatta, S., Sathyendranth, S., Jackson, T., Tilstone, G., Curran, K., Airs, R. L., Currmings, D., Brotas, V., Organelli, E., Dall'Olmo, G., Raitoso, D. E. (2017a). Uncertainty in ocean-colour estimates of chlorophyll for phytoplankton groups. Front. Mar. Sci. 4:104. doi: 10.3389/fmars.2017.00104
Ultz, J., Clauster, H., Morel, A. and Hooker, S. B. (2006). Vertical distribution of phytoplankton communities in open ocean: An assessment based on surface chlorophyll. Journal of Geophysical Research, 111, CO8005. Doi: 10.1029/2005jc003207.

# Layout of the work

Samples taken in the Atlantic Meridional Transect (AMT) programme in 2018 and 2019

Nutrients concentration from surface to 200m depth.

- Cell number measured by Flow Cytometer for:
- Prochlorococcus, Synecoccocus, Picoeukaryotes (PEUK), Cryptophytes, Coccolithophores, Nanoeukaryotes (NEUK)
- Species identification and abundance by Microscopy for Diatoms, Dinoflagellates (both Autotrophic and Heterotrophic species) Filamentous Cyanobacteria.
- Cell numbers of each taxon were converted into carbon (Brotas et al. 2022)
- Photosynthetic pigments concentration determined by chromatography (HPLC)
- Size classes Micro- Nano and Picoplankton abundances were estimated from in situ pigments data according to Uitz et al. (2006), with the adaptations of Brewin et al. (2017).

### Satellite Data

Satellite data was obtained from the ESA ocean colour climate change initiative (OC-CCI) for TotalChla, and Chla attributed to the three size classes (Brewin et al., 2017)

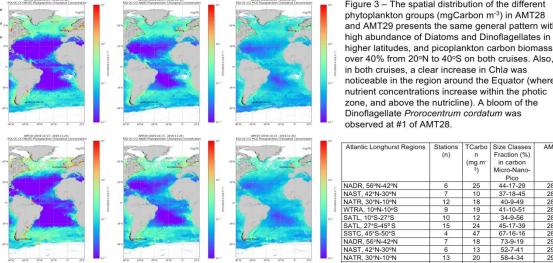


Figure 4 - Composite image of Chla (mg m-3) for each size classe, for AMT28 (top) and AMT29 (bottom). The nutrient gradient affects all three size classes, as all classes present higher abundance in high latitude regions, and lower in oligotrophic gyres. However, the response of cells to nutrient enrichment scales up according to cell size. Picoplankton is present throughout all latitudinal regions, becoming dominant in low-nutrient gyres, where micro- and nanoplankton attain minimum values. Nanoplankton taxa biomass increase in tropical Atlantic and higher latitudes, whereas Microplankton fraction presents high values only in high northern and southern latitudes. This pattern is also clear in Figure 5

Figure 5 - Distribution of TChla (mg m-3) and Chla for each size class: pico-, nanoand microplankton determined by in situ pigment's concentration.

This work is a short version of Brotas V, Ferreira A, Veloso V, Tracana A, Guerreiro C, Tarran G, Woodward EMS, Ribeiro L, Netting J, wley D and Groom S (2023) Assessing ytoplankton community composition in the Atlantic Ocean from in situ and satellite observa Front. Mar. Sci. 10:1229692.doi: ars.2023.1229692

Phytoplankton community size structure showed a consistence spatial pattern, responding to environmental factors, common to both AMT cruises. Nevertheless, interannual differences were found in the relative abundance of Diatoms (more abundant in AMT28) and Dinoflagellates (more abundant in AMT29)

The satellite data products: Chla from micro-, nano, picoplankton, Diatoms and Dinoflagellates were compared, for the first time, in our knowledge, to in situ observations of carbon relative abundance, giving good results.

The collection of in situ data regarding phytoplankton taxa identification and abundance is essential to complement the pigment's size class approach, and hence the link with Satellite observation.

This work received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 810139 Project Portugal Twinning for Innovation and Excellence in Marine Science and Earth Observation – PORTWIMS\*, and Interreg project Innovation



Acknowledgments
The Altantic Meridional Transect is funded by the UK Natural Environment Research Council through its National Capability Long-term Single Centre Science Programme, Climate Linked Altantic Sector Science (grant number NE/R015953/1). This study contributes to the international IMBerR project and is contribution number 393 of the AMT programme.

We thank the officers and crew of the British Antarctic Survey vessel RRS James Clark Ross and RRS Discovery. We are indebted to NEODAAS for processing the satellite imagery. We thank Carolina Sá and Giulia Sent for their help in AMT29.















PORTWIMS

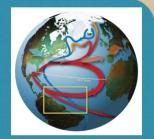
# SURFACE SALINITY MAXIMUM IN THE NORTH BRAZIL **CURRENT: A 3-DIMENSIONAL VIEW**

# Maria Cadima<sup>1</sup>, Paola Castellanos<sup>1,3</sup>, Joaquim Dias<sup>1,2</sup>, Estrella Olmedo<sup>4</sup>, Edmo J.D. Campos<sup>5</sup>

- 1 Marine and Environmental Sciences Centre (MARE), Aquatic Research Network (ARNET), Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal 2 Departamento de Engenharia Geográfica, Geofísica e Energia (DEGGE), Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal 3 Instituto Português do Mar e da Atmosfera (IPMA), Av. Alfredo Magalhães Ramalho, 6 1495-165, Algés, Portugal 4 Barcelona Expert Center (BEC) and Institute of Marine Sciences (ICM), CSIC, P. Marítim de la Barcelonata, 37-49, 08003 Barcelona, Spain 5 Instituto Oceanográfico, Universidade de São Paulo, Brazil

# Introduction

The Atlantic Meridional Overturning Circulation (AMOC) connects the ocean surface and deep waters. The heat transport of the AMOC is a complex system involving exchanges with the atmosphere, which maintain a milder winter climate in Europe. The North Brazil Current (NBC) is a fundamental part of AMOC, transporting heat and salt northward across the Equator. Salinity may have an indirect impact on ocean circulation by changing sea water density and pressure. Changes in the interhemispheric transports of heat and salt may disturb the AMOC, with possibly important consequences for the global climate (e.g. Buckley and Marshall, 2016).

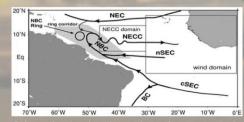


A simplified schematic of the AMOC (Srokosz and Bryden, 2015). The NBC's region is highlighted.







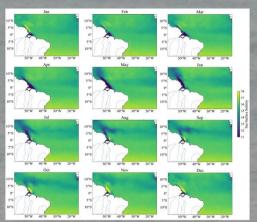


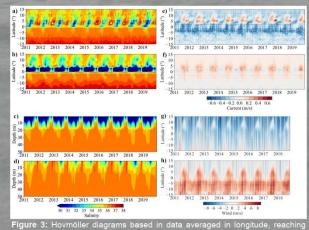
Schematic showing the main surface currents the Tropical Atlantic Ocean. The shaded area represents the NBC. (Fonseca et al, 2004)

# Data

In this study several data sets were used: (1) images of Sea Surface Salinity (SSS) from the SMOS satellite; (2) in situ data from the "Camadas Finas III" cruise in the region of the NBC; (3) reanalysis from 2 different products of Copernicus Marine Service (CORA and GLORYS12).

# Results





- 30 km from the coast:
  Surface Salinity (latitude vs. time) from (a) SMOS and (b) CORA;
  Salinity (depth vs. time) from CORA at (c) 2° N and (d) 4,5° N;
  Surface current (latitude vs. time) from GLORYS12: (e) east-west (E positive)

- and (f) north-south (N positive);
  Wind (latitude vs. time): (g) east-west (E positive) and (h) north-south (N

# 160.4 140.7 120.9 101.1 81.3 61.5 41.8 22.0 Depth (m) 100 200 300 400 500 600

polated transects from Camadas Finas III cruise (8 OCT - 1 NOV 2012). ransect 1 (stns. 1-10); (b) Transect 2 (stns. 10, 11, 14, 15); (c) Transect 3 (stns.

- Temperature: (d) Transect 1; (e) Transect 2; (f) Transect 3.

  Maximum salinity value in each station (g); depth of maximum salinity (h).

  Lines of constant sigma-theta (density, in kg m³) are also represented (a to f).

# Summary

Results reveal the presence of an unexpected salinity maximum in the NBC region, located in the upper layer, close to the Amazon river

mouth. This maximum was first seen in "Camadas Finas III" cruise, represented by orange-red tones (S > 36.5) in Figs. 2b and c. In SMOS satellite data (Fig. 1) the maximum appears as a tongue of high salinity next to the coast. It is a seasonal feature in the period 2011-2019 with largest area from October to December (Figs. 1 and 3a). In the CORA product at 4.5 °N, the maximum also appears every year but for a shorter time (Figs. 3b and d). The annual cycle of the maximum suggests that the physical processes behind it have a similar seasonality. Annual variations in the NBC's transport (Johns et al, 1998) may be related to changes in salinity. It is also worth noting that the maximum's peak coincides with the annual minimum of Amazon river discharge. Further studies are needed to clarify questions: How does climate change impact salinity in the NBC region? Does it affect salinity transports to the North Atlantic Ocean?

Acknowledgments:
This work had the support of national funds through Fundação para a Ciência e Tecnologia, I. P (FCT), under the projects UIDB/04292/2020, UIDP/04292/2020, granted to MARE, and LA/P/0069/2020, granted to the Associate Laboratory ARNET.



# DETALHES DE ESCOAMENTOS USANDO MODELOS FÍSICOS E SIMULAÇÕES NUMÉRICAS EM OPENFOAM®

MARE AR

DETAILS OF THE FLOW USING PHYSICAL MODELS AND NUMERICAL SIMULATIONS WITHIN OPENFOAM®

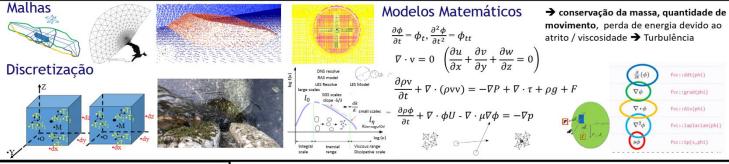
# Rita F. Carvalho

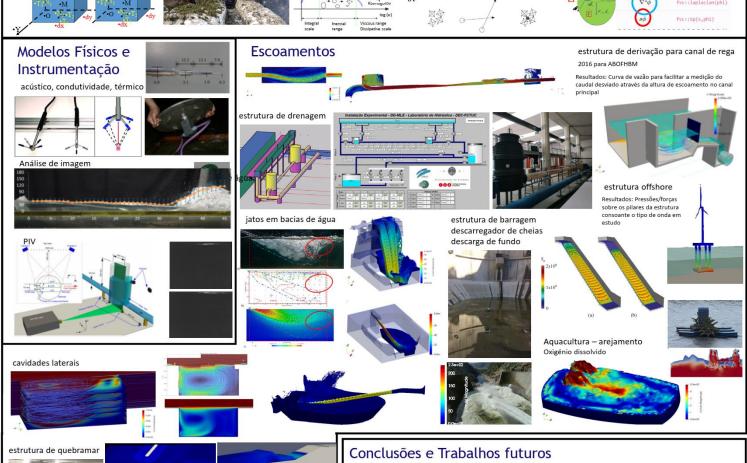
University of Coimbra, Department of Civil Engineering, MARE-ARNET, Coimbra, Portugal.

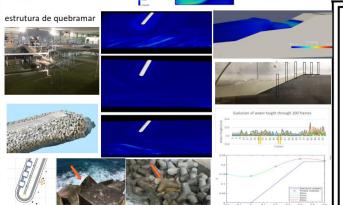
ENCONTRO MARE 2023 29 - 30 November 2023 Figueira da Foz, Portugal

- A hidráulica em engenharia civil abrange matérias que envolvem água, suas propriedades físicas, químicas e mecânicas, sua constituição e movimento, bem como outros componentes que esta pode transportar.
- a quantidade e qualidade em <u>situações gerais de usos comuns, e</u> excecionais, como por exemplo de escassez e de excesso.
- Precipitação, distribuição, transporte e descarga de água, em sistemas naturais ou construídos: aproveitamentos hidroelétricos estruturas hidráulicas;, sistemas de abastecimento, de drenagem públicos, sistemas fluviais, sistemas costeiros e marítimos,

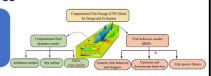
# resistive gauges conductive gauges conductive gauges conductive gauges conductive gauges conductive gauges acoustic velocimenty images acoustic velocimenty images aboundary pressure field all concentration to the concentration of the concen







 É possível a análise detalhada do campo de velocidades e de várias variáveis do escoamento através de Instrumentação avançada e CFD,



- → espera-se quer um impacto em termos de aumento da frequência de eventos extremos, de vento e de tempestades com implicações para a operação de obras hidráulicas, nomeadamente estruturas de descarga e medidas de controle de inundações e descargas → efeitos em cascata desses fenómenos que causam danos ainda mais significativos ao meio ambiente e que podem ser irreversíveis
- → Espera-se aumento do nível do mar com implicações nos fenómenos de transformação de ondas estabilidade dos quebra-mares e demais obras de proteção pelo aumento da agitação marítima e no nível do mar que provoca ângulos de diferentes incidências
- → espera-se poder analisar com mais detalhe os escoamento e os seus impactos





# PlasticHg project: coexistence of MPs and Hg in Tagus estuary

Marta Dias<sup>1</sup>, Joana Antunes<sup>1</sup>, Paula Sobral<sup>1</sup>, Vasco Branco<sup>2,3</sup>, Cristina Carvalho<sup>2</sup>, Marta Martins<sup>1</sup>, and Neusa Figueiredo<sup>1</sup>

1MARE—Marine and Environmental Sciences Centre, Departamento de Ciências e Engenharia do Ambiente, NOVA School of Science and Technology (FCT NOVA), 2829-516 Almada, Portugal.

Research Institute for Medicines (iMed.ULisboa), Faculty of Pharmacy, Universidade de Lisboa, 1649-003 Lisboa, Portugal;

Centro de Investigação Interdisciplinar Egas Moniz (CiiEM), Instituto Universitário Egas Moniz (IUEM), Quinta da Granja, Monte de Caparica, 2829-511 Caparica, Portugal.

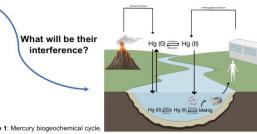
Microplastics (MPs) and mercury (Hg) are ubiquitous in marine ecosystems 1.2. Introduction

These plastic particles 0.1 mm  $< \emptyset < 5$  mm, can be ingested by marine organisms and are uptake by marine biota, bioaccumulated and bioamplified, causing oxidative stress, neurotoxicity, genotoxicity, and inflammation in marine organisms2,4



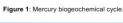
Mercury is present in the marine ecosystems representing an environmental and human health problem, due to the formation of the neurotoxic methylmercury with its subsequent bioaccumulation and biomagnification in the marine food chain5.

Microorganisms can also take an important role on the Hg-biotransformations.





Aim: To investigate the the Hg biogeochemical cycle and study the microorganism's community resistant to Hg in Tagus



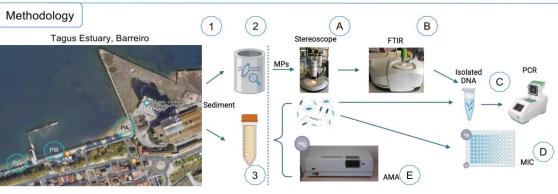


Figure 2: Field sampling location in Barreiro, Tagus estuary (1) with 3 different locations (PA, PB and PC). Sampling of sediment was done for microplastics (metal can) (2) and for bacterial community and mercury (falcon tube) (3)

Microplastics were separated from the sediment using NaCl solution ( $\rho$  =1.2 g.cm<sup>-3</sup>) and then characterized physically surguou ( $\rho$  =1.2 g.cm<sup>-3</sup>) and then characterized physically using binocular microscope ( $\bf A$ ) and chemically using FTIR equipment ( $\bf B$ ).

The microbial community was isolated from the sediment as well as from de microplastics for the isolation of DNA followed by the technique of PCR (C) to amplify the genes of bacteria (16SV1V3primersF28: 16SV3V5primersF), fungi (1TS1ITS4primersF) and Archaea (Arch349F). Also, to test the response of the community to the presence of mercury it was determined the minimal concentration inhibitory (MIC) of mercury (D)

Using a mercury analyzer (E), it was measured the total concentration of Hg in the sediment samples for each point location.

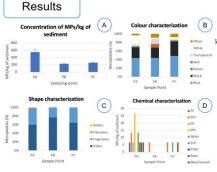


Figure 3: Results of physical and chemical characterization of MPs. A: Concentration of MPs/kg of sediment for each point location (no significative differences between the 3 points (Kruskal-Wallis test, p > 0.05, 0.202). B and C: Percentage of MPs/kg in the sediment regarding the colour and shape characterization, for each point location with no sediment regarding the colour and shape cnaracterization, for each point location with no significative differences between the 3 points (Kruskal-Wallis test, p > 0.05, 0.413 for **B** and p > 0.05, 0.650 for **C**). **D**: Concentration of MPs/kg of sediment for each point location regarding the polymer determined with significative differences between the 3 points (Kruskal-Wallis test, p > 0.05, 0.005), where PA is different from PB and PC. **E**: At the left a FTIR graphic from a sample of polystyrene and at the right some photos of MPs found, from left to right up and down: blue fragment, a Styrofoam sphere, a pink fiber and a pellet.

Bigger concentration of microplastics in sampled area PA

Table 1: Results of mercury concentration in ppm and MIC for each

5	ample location	I.
Sampled Area	[Hg] ppm	MIC ([Hg] ppm)
PA	3.1 ± 9.3	25 ± 0
PB	0.6 ± 1.1	12.5 ± 0
PC	0.4 ± 1.0	6.25 ± 5.6

Bigger concentration of Hg in sampled area PA.

[DNA MPs] =  $14.9 \pm 3.9 \text{ ng/}\mu\text{L}$  (Min:  $11.1 \text{ ng/}\mu\text{L}$ ; Max:  $18.9 \text{ ng/}\mu\text{L}$ ) (n = 9

[DNA Sed] =  $22.3 \pm 0.9 \text{ ng/}\mu\text{L}$ Bigger concentration of DNA in the sediment

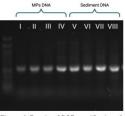


Figure 4: Results of PCR amplification of Figure 4: Results of PCR amplification o the genes amplificated of the DNA isolated from microplastics (I, II, III and IV) and sediments (V, VI, VII and VIII), respectively for bacteria, fungi and archaea.

Hg, MPs and microbial community are present in Tagus estuary, but what will be the result of the interaction of Hg on the surface of MPs in Hg biogeochemical cycle and toxicity?

# Remarks

The results showed that:

- (i) Microplastics were found in every sample location, being the most common type the fibers and fragments with black and blue
- (ii) Regarding chemical composition of the microplastics, expanded polystyrene and polyester were the most abundant.
- (iii) MPs in this system is colonized by bacteria, fungi and archaea:
- (iv) Sampled area PA shows a mercury concentration above Effects Range Medium (0.71 μg/g, dry wt)6, which is selecting for Hgresistant microbial communities, as it was the sampled area with higher microplastics concentration.

Work funded by FCT:

MARE: UIDP/04292/2020

PlasticHg project: 2022.04580.PTDC

ARNET: LA/P/0069/2020

iMed.Ulisboa: UIDB/04138/2020

and UIDP/04138/ 2020.









# Ten years of monitoring recruitment of the stalked barnacle *Pollicipes* pollicipes: linking with environmental variability

J. N. Fernandes<sup>1</sup>, D. Jacinto<sup>1</sup>, N. Penteado<sup>1</sup>, A. Sousa<sup>1</sup>, D. Mateus<sup>1</sup>, M. I. Seabra<sup>1</sup>, T. Silva<sup>1</sup>, J. J. Castro<sup>1,2</sup> and T. Cruz<sup>1,2</sup>

1 MARE – Marine and Environmental Sciences Centre, Laboratório de Ciências do Mar, Universidade de Évora, Apartado 190, 7521-903 Sines, Portugal. Email: jfer@uevora.pt

<sup>2</sup> Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Portugal.

### Introduction

Temporal fluctuations in recruitment can have direct consequences on the population dynamics of a species, changing its abundance and distribution patterns. The edible stalked barnacle *Pollicipes pollicipes* (Figure 1) is a sessile marine invertebrate with a planktonic larval phase that occurs from Brittany to Senegal, in highly exposed rocky shores along the shallow subtidal and intertidal levels. It can be considered the most economically important intertidal resource of the Iberian Peninsula, where it is intensively harvested.

Cyprid larvae of *P. pollicipes* settle heavily on conspecifics and thus the number of cyprids and juveniles per adult individual has been used as a recruitment index for this species (Cruz *et al.*, 2010).

Here we present a long-term study of *P. pollicipes* recruitment over a ten-year period and its relation with environmental variables.





Figure 1 – Adult individual of *Pollicipes* pollicipes and several juveniles (left); details of peduncle of an adult individual with several cyprids and recruits (RC < 0.1 mm) in yellow quadrats (above).

Environmental Variables	r	р
Air temperature	0.3835	< 0.001**
Wind stress (along-shore)	0.0048	n.s.
Wind stress (cross-shore)	0.0533	n.s.
Upwelling Index	0.0043	n.s.
Water temperature	0.3847	<0.001**
Wave height	-0.2297	0.022*
Wave period	-0.1677	n.s.

Table 1 – Pearson correlation coefficients (r) between recruitment of P. pollicipes (IR1) and environmental variables during recruitment season, from 2007 to 2016 (n= 99). \*\* - p< 0.01; \* - p< 0.05; n.s. – non-significant.

# Methods

This study was carried out at the Cape of Sines (SW Portugal), a very exposed headland, where P. pollicipes is abundant. From July 2007 to December 2016, approximately 50 adults with rostro-carinal distance (RC) > 12.5 mm, were randomly sampled fortnightly or whenever there were favourable sea conditions. The number of cyprids and juveniles with RC < 1 mm attached to each adult barnacle (IR1) were counted on each sampling date. IR1 reflects recruitment that occurred mainly during the last month before sampling. The main annual recruitment season of P. pollicipes is defined when IR1 > 3 (Cruz et al., 2010)

Environmental data were obtained from a weather station - air temperature; wind speed and direction - and from an oceanographic buoy - sea surface temperature, wave height and wave period - both located near the Cape of Sines. An upwelling index for Sines region was obtained Español de Oceanografía Instituto (www.indicedeafloramiento.ieo.es). Alongshore and crossshore components of wind stress were calculated and daily mean values were computed for all physical variables. For each physical variable, mean values over 30 days were backwards calculated from each recruitment date. Pearson correlation coefficients between IR1 and physical variables during the main annual recruitment season, were quantified for the whole ten-year period.

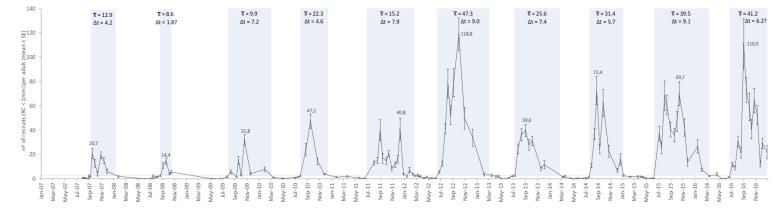


Figure 2 — Mean ( $\pm$ SE) number of recruits per adult individual of P. pollicipes (IR1) from 2007 to 2016 (n~50). Blue rectangle — main recruitment season;  $\bar{x}$  — mean IR1 in each recruitment season;  $\Delta t$  — length of recruitment season in months; peak label — maximum mean IR1 in each recruitment season; "?" - the end of recruitment season was not defined in 2008 due to low frequency of sampling, and in 2016 data is still not available.

### Results and Discussion

Correlations between recruitment and environmental variables were significant for air temperature, water temperature (both positive correlations) and wave height (negative correlation) (Table 1). During the main recruitment season and for the tenyear period, mean air temperature varied between 10.4 and 20.7 °C and mean water temperature varied between 13.7 and 20.1 °C. Mean wave height varied between 0.8 and 2.9m. Periods of warmer surface waters and calm seas are usually associated with the stratification of the water-column. This stratification may be responsible for the accumulation of cyprid larvae in the water and consequent settlement to the shore.

Inter-annual variability in timing, length and intensity of recruitment was considerable (Figure 2). Main recruitment season of *P. pollicipes* started between June and September and ended between December and March. Total duration varied between 4.2 months (2007) and 9.1 months (2016). Maximum values of mean IR1 varied between 14 recruits/adult in 2008 and 119 recruits/adult in 2012.

# Acknowledgements

This study is an output of the project: "Aquapollis + - Aquaculture of the stalked barnacle Pollicipes pollicipes" (ALT20-03-0145-FEDER-000003).

In general, from 2007 to 2016, the length of the main recruitment season increased in more recent years, starting earlier and ending later. In recent years, there was also a tendency to a higher intensity of recruitment than in earlier years.

In a study of recruitment of P. pollicipes in the 1990s for the same area, Cruz et al. (2010) have found that mean IR1 had a maximum value of  $\sim$ 20 recruits/adult, which is similar to our results for 2007 and 2008 recruitment season but considerably lower than our results in recent years. Also in that study, the main recruitment season started in July or September and ended in October or December.

A changing in timing and duration of recruitment season periods and in the intensity of recruitment in more recent years related with climate change is thus a possibility that needs further investigation.

### References

Cruz, T., Castro, J. J., & Hawkins, S. J., 2010. Recruitment, growth and population size structure of *Pollicipes pollicipes* in SW Portugal. *Journal of Experimental Marine Biology and Ecology*, 392 (1-2): 200–209.













# MARE'S ROLE IN POLAR SCIENCE





Ferreira, A.<sup>C</sup>, Abreu, J.<sup>A</sup>, Araújo, P.M.<sup>B</sup>, Bastos, L.<sup>A</sup>, Brito, A.C.<sup>C</sup>, Brotas, V.<sup>C</sup>, Carmo, D.<sup>A</sup>, Cerveira, L.R.<sup>B</sup>, Fragão, J.<sup>A</sup>, Frazão Santos, C.<sup>D</sup>, Guímaro, H.<sup>A</sup>, Guerreiro, C.V.<sup>C</sup>, Guerreiro, M.<sup>D</sup>, Nunes, G.S.<sup>C</sup>, Queirós, J.<sup>A</sup>, Quitério, M.<sup>A</sup>, Rosa, R.<sup>D</sup>, Santos, C.P.<sup>D</sup>, Santos, D.A.<sup>D</sup>, Santos, S.<sup>A</sup>, Seco, J.<sup>A</sup>, Xavier, J.<sup>A</sup>

# **MARE-UCoimbra**

Group: ECOTOP-POLAR

 Marine Food Web Ecology related to environmental and human threats



Climate change and anthropogenic impacts on Arctic shorebirds' migration



# MARE-ULisboa

Group: Phytoplankton Ecology and Remote Sensing

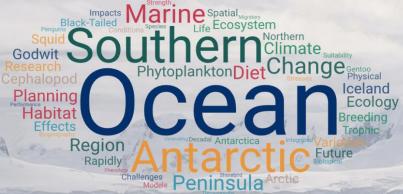
· Marine phytoplankton ecology in Antarctic Peninsula



Group: Integrative Marine Ecology & Ocean Governance and Sustainability

- · Marine Spatial Planning in Polar Regions
- Impacts of climate change on the distribution of pelagic squids in the Southern Ocean





# **ARCTIC**



# **ANTARCTICA**



# Acknowledgements

The research presented in this poster had the support of FCT through the strategic project UIDB/04292/2020 awarded to MARE and through project LA/P/0069/2020 granted to the Associate Laboratory ARNET. We would also like to acknowledge support from the FCT via the Portuguese Polar Program (PROPOLAR), which contributed to countless projects and helped further the Portuguese polar science. This research is also framed within the College on Polar and Extreme Environments (Polar2E) of the University of Lisbon.



# How to take the most from scientific evidence? Systematic review and meta-analysis



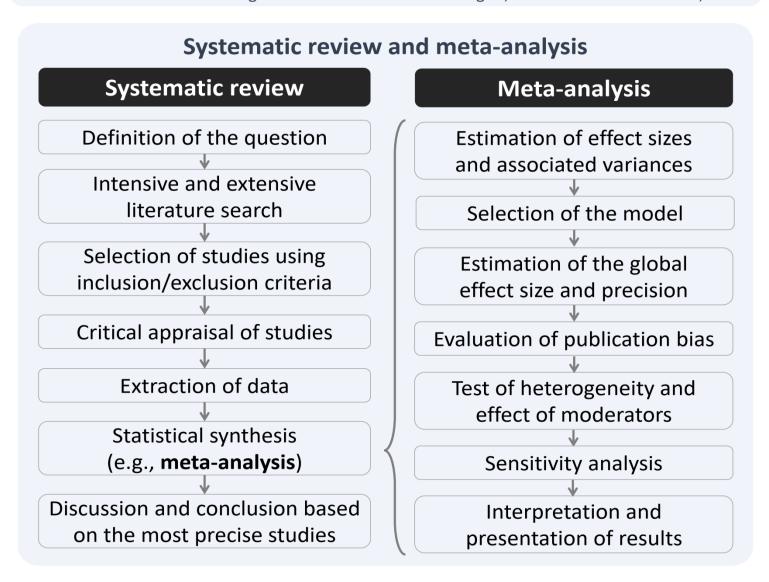
Verónica Ferreira

MARE – Universidade de Coimbra

veronica@ci.uc.pt



Scientific production has been accumulating at high rates, making reviews necessary. To be considered of high quality and have a great impact, these **reviews must be carried out systematically**, following protocols established *a priori* and that guarantee the objectivity and reproducibility of the review. When a systematic review focuses on study results (which often vary due to differences in study characteristics such as different experimental conditions, methods, species, dosages, sample sizes, etc.), these can be combined and analyzed by meta-analysis. **Meta-analysis is a robust statistical tool** to combine the results of studies on the same topic, considering study precision, to allow general conclusions, assessment of the consistency of results across studies, and identification of knowledge gaps. **Meta-analysis can be used for multiple purposes** including to test (new!) hypotheses, assess the impact of environmental drivers, test the effects of covariates that are difficult to test in a single study, assess the effectiveness of management and conservation strategies, combine multi-site results, etc.



# Course offer on demand:

- 1-day workshop on Meta-analysis
   1-week course on Meta-analysis
  - 2-weeks course on Systematic reviews and Meta-analysis



Tróia peninsula - a 16 km long sand spit c. 30 km SW of Lisbon, between the Sado estuary and the Atlantic ocean



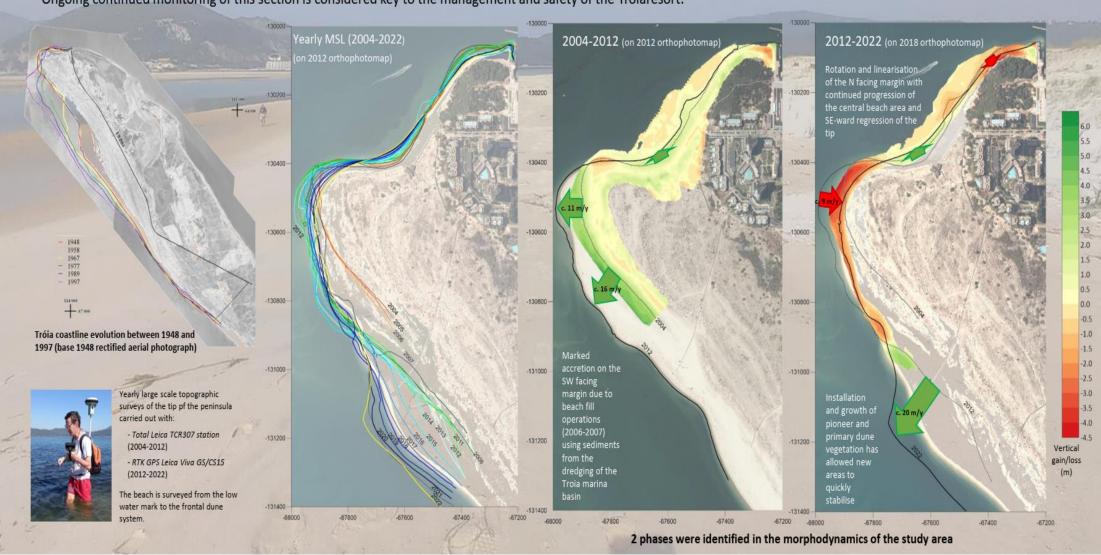
Maria Adelaide Ferreira (maferreira@fc.ul.pt), Francisco Andrade (faandrade@fc.ul.pt)

C Ciências ULisboa FCIência

During the 2<sup>nd</sup> half of the 20<sup>th</sup> century the coastline of the NW section of the Troia peninsula prograded significantly - more than 350 m between 1958 and 1997.

Planning of the Troiaresort in the early 2000s integrated known decadal coastal morphodynamics, creating a *non aedificandi* buffer to protect the most dynamic areas of the tip of the peninsula from construction.

Ongoing continued monitoring of this section is considered key to the management and safety of the Troiaresort.



# Estimating abundance of the stalked barnacle Pollicipes pollicipes: photo-quadrats vs drone imagery.



# Introduction

Managing marine resources requires information on their distribution and abundance at relevant scales (Bekkby et al. 2009), often challenging to obtain when sampling large areas and extreme habitats such as wave-swept

The stalked barnacle Pollicipes pollicipes is an important resource on the northeast Atlantic coast forming dense aggregations in wave-exposed locations, such as capes from Brittany to Senegal (Fig. 1) (Barnes 1996).

P. pollicipes abundance is usually assessed by methods such as image analysis of small-scale photo-quadrats (e.g. 50x50 cm) (Sousa et al. 2013). However, the access to sampling sites might carry logistical challenges (e.g. surveying remote areas might be difficult or hazardous) and spatiotemporal constraints imposed by the tidal cycle and sea conditions.

The use of unmanned aerial vehicles (drones) equipped with high-resolution digital cameras, might provide low-altitude aerial imagery of intertidal areas (Gomes et al. 2018), covering large spatial areas in a timely manner and with sufficient detail to monitor distribution patterns of small-sized organisms such as stalked barnacles.

We have tested the feasibility of using drones as an alternative method to estimate P. pollicipes abundance in intertidal rocky shores.







# Methods

Two sites with high abundance of stalked barnacles were sampled at Cape Sines (SW Portugal) in September

In each site, two vertical levels were defined: mid shore, that corresponds to the middle/upper of P. pollicipes intertidal distribution ( $\sim$ 1.5 m to 3 m above MLWS) and low shore that corresponds to the lower intertidal level of *P. pollicipes* distribution (~ MLWS to + 1.5 m) (Fig. 2).

Stalked barnacle percentage cover was estimated from images collected through photo-quadrats (50x50 cm; using 10 MP digital camera) and low-altitude (<5 m) drone (DJI phantom 4+ equipped with a 12 MP digital camera) survey methods, by superimposing equidistant points (~2.5 cm) to the area of interest in the image, and counting the number of intersection points of the grid (out of 100 intersection points) over barnacles. ImageJ sofware (www.imagej.nih.gov) was used for all image analyses (Fig. 2).

Spatial variability in P. pollicipes percentage cover was analysed by permutational univariate analysis of variance, PERMANOVA (Anderson, 2001) including three factors: 1) Method (fixed factor with two levels: photoquadrats and drone, 2) Habitat (fixed factor with two levels: mid shore and low shore) and 3) Site (random factor with 2 levels: Site 1 and Site 2. Sample size was n= 6 to 14 images.

Analyses were based on Euclidean distances of log(X+1) transformed data. Unrestricted permutation of raw data and Type III sums of squares were applied (Anderson et al., 2008). Homogeneity of univariate dispersion based on Euclidean distance was tested using PERMDISP (Anderson, 2006). When appropriate, pair-wise tests were conducted. The software PRIMER 6 and PERMANOVA+ (www.primeron et al. 2008) was used to perform all analyses



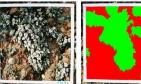




Fig. 2: Location of the study site at Cape Sines on the SW coast of Portugal in relation to Iberia (inset). Two vertical levels were considered in the Intertidal area of Cape Si Mid and Low shore. Aerial image of sampling sites and access to sampling sites (red – drone flight path; yellow – on foot path).

# **Direct sampling: Photo-quadrats**







# Close observation

- High resolution images
- Scaled images

- Limited survey (spatially and temporally)
- Access to sampling site might carry logistical constrains and hazards

### Remote sampling: Drone survey





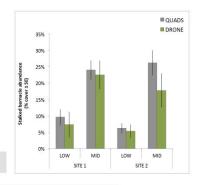
- Large survey coverage
- Less time consuming operations
- High resolution images

- Indirectly scaled images
- Skilled drone operator required

# Results

Both direct and remote survey methods described similar spatial patterns of abundance of the stalked barnacle P. pollicipes (p>0.05) (Fig. 3).

Stalked barnacle abundance, estimated as percentage cover, varied between 5% and 26% according to the intertidal vertical level (Mid > Low; p<0.05).



# Discussion

The study suggests that low-altitude drone survey is a suitable alternative method to effectively monitor the abundance and distribution patterns of the stalked barnacle P. pollicipes and possibly other intertidal organisms.

Among the advantages of using drones in such studies are the fairly low cost, the high resolution of the images, the large size of the area that can be covered, and the quantity of georeferenced data that can be produced in a single tidal cycle.

The application of drone technology and relevant imagery processing techniques to Pollicipes research may be complemented with work in the field to gather other important data (e.g. barnacle biomass, population size structure, among others) and used for producing high resolution maps of fishing grounds that can be efficiently transformed into a usable product for a broad range of ecological applications.

teado N. et al. (2013). Patterns of di

Coordination





Acknowledgments: This study is an output of the project "AL Percebe – State of the fishery of the stalked barnacle Pollicipes pollicipes at Cabo de Sines (SW Portugal ) and change in its management: towards co-management at a local level.







# SPATIO-TEMPORAL VARIABILITY

# OF NIS IN THE MARINAS OF MADEIRA ARCHIPELAGO

Cristiano Mancini<sup>1,2</sup>, Patricio Ramalhosa<sup>1</sup>, Jasmine Ferrario, Paola Parretti<sup>1</sup>

- 1- Marine and Environmental Sciences Centre, Agência Regional para o Desenvolvimento da Investigação, Tecnologia e Inovação (ARDITI), 9020-105 Funchal, PORTUGAL
- 2- Department of Earth and Environmental Sciences, University of Pavia, Via S. Epifanio 14, 27100 Pavia, Italy

# Introduction

The Madeira archipelago is located in a strategic position in the NE Atlantic being a stopover on marine routes between the European, African and American continents. Since 2014 there has been an increase in record of marine NIS (non-idigenous species) with recreational marinas and port becoming the main focus of invasion. Species abundance can vary with time and space. In this context, this work focused on 4 NIS (Botrylloides niger; Botryllus schlosseri, Parasmittina alba and Schizoporella errata) in 4 marinas (Funchal, Calheta, Porto Santo and Quinta do Lorde).

# **Objective**

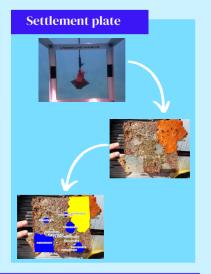
- Assess the abundance of 4 NIS"
- Access NIS variability across time (3 seasons for 3 years) and space (4 recreational marinas)

# Methodology

Settlement plates (8 replicates) are deployed in 4 recreational marinas. From 2018 to 2021, every season (summer, winter and spring) plates were retrieved from the water and photographed.

In total of 256 pictures were analyzed in Coral Point Count with excel.

Data about total area coved for each species within a plate were estimated.



# Results

# Botrylloides niger:

significant differences in seasonality in all marinas except for Quinta do Lorde

### Botryllus schlosseri

significant differences in seasonality in marina of Calheta and Funchal

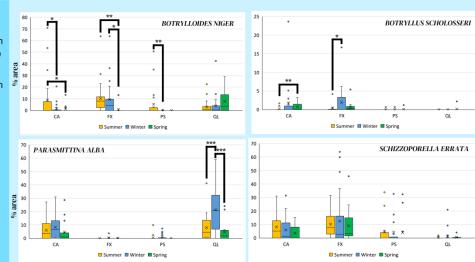
# Parasmittina alba

significant differences in seasonality only in the marina of Quinta do Lorde

# Schizoporella errata

No significant differences in seasonality in any of the 4 marinas

Considering the 4 species there are significant differences among the 4 marinas and between summer and winter seasons (*p*<0.05)





# **Conclusions**

Significant differences in NIS abundance were observed in the four marinas; More studies are needed to understand the factors related with these differences, a possible responsible could by the type of maritime traffic involved; A clear pattern for the seasons and years considered in the study was not observed; Information about the biological traits of the NIS could be important to evaluate seasonal patterns

# INTEGRATED APPROACH TO STUDY THE **MOVEMENT DYNAMICS OF THE MEAGRE**

<u>AUTHORS</u>: Marques J.P.; Reis-Santos P.; Tanner S.; Alexandre C.; Almeida A.R.; Alves M.J.; Amorim C.; Costa J.L.; Domingos I.; Fonseca P.; Jorge A.; Lança M.J.; Mateus C.S.; Prista N.; Silva M.; Stratoudakis Y.; Vieira M.; Almeida P.R.; Quintella B.R.

R&D UNIT MARE - Marine and Environmental Sciences Centre, Faculty of Sciences, University of Lisbon

CONTACT: jpmarques@fc.ul.pt

# **OBJECTIVE:**

Unravel the ecology of the meagre migrations in Portugal, emphasizing the spatial use of adults and juveniles in the Tagus estuary.

# THE MEAGRE (Argyrosomus regius)

Can live for more than 40 years - throughout its life cycle, several migrations occur between spawning, nursery, feeding and overwintering areas.

# METHODS:



Task 6 - Detection of spatial and temporal patterns of estuary use with passive acoustic monitoring.



Task 1 - Analysis of the population structure using microsatellite DNA markers.



Task 2 - Heart tissue fatty acid signature to discriminate stocks associated to estuaries.



Task 5 - Seasonal migration of adults and identification of spawning areas inferred from acoustic telemetry coupled with archival tags.

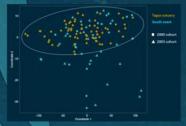


Task 3 - Assessing connectivity and ontogenic migrations with otolith chemistry.

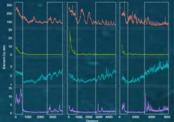


Task 4 - Estuarine habitat use by juvenile assessed with acoustic telemetry.

# SOME RESULTS:



Importance of the Tagus estuary as a spawning and nursery area with otolith core chemistry.



Reconstructing migration patterns with otolith chemistry, from the core to the edge.



Juvenile home range and core range assessed with acoustic telemetry.



Adult home range and core range assessed with acoustic telemetry.

# WHAT TO EXPECT?

The integrated analysis of the results, at the different temporal and spatial scales, will respond to the project objective and, at the same time, contribute to promote the sustainable management of fisheries targeting this species.

migracory.pt



beneficiaries:





UNIVERSIDADE

















# Induction of CYP1A1 by Benzo[a]pyrene and Phenanthrene in zebrafish hepatocytes

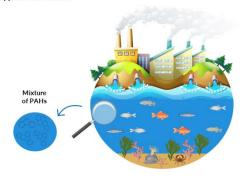
B. Matos<sup>1,\*</sup>, M. Diniz<sup>2</sup>, V. Branco<sup>3,4,\*</sup>, M. Martins<sup>1,\*</sup>

<sup>1</sup> Marine and Environmental Sciences Centre (MARE), NOVA School of Science and Technology (FCT NOVA), 2829-516 Caparica, Portugal; <sup>2</sup> UCIBIO—Applied Molecular Biosciences Unit, NOVA School of Science and Technology (FCT NOVA), 2829-516 Caparica, Portugal;; <sup>3</sup> Research Institute for Medicines (iMed.ULisboa), Faculty of Pharmacy, Universidade de Lisboa, 1649-003 Lisboa, Portugal;; <sup>4</sup> Centro de Investigação Interdisciplinar Egas Moniz (CiiEM), Instituto Universitário Egas Moniz (IUEM), Quinta da Granja, Monte de Caparica, 2829-511 Caparica, Portugal.

Corresponding authros: bi.matos@campus.fct.unl.pt; marta.martins@fct.unl.pt; vasco.branco@ff.ulisboa.pt

# INTRODUCTION

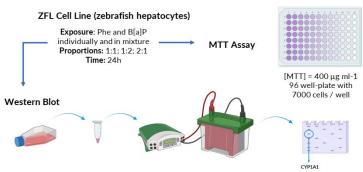
Polycyclic aromatic hydrocarbons (PAHs) are **persistent organic contaminants** found in the environment due to **anthropogenic** activities. They can accumulate in sediment beds in aquatic environments and can be harmful to organisms. Many PAHs are **procarcinogenic**. PAHs appear as **complex mixtures**, and research has focused on single compounds, despite mixtures having different toxicological effects. [1]



**Environmental guidelines** do not account for unpredictable effects of PAH mixtures.

The present work aimed to disclose the interaction effects of two PAHs that have different carcinogenic potentials and chemical structures, **Phenanthrene** and **Benzo[a]pyrene**, individually and in mixtures.

# **METHODOLOGY**



### Acknowledgements:

Fundação para a Ciência e a Tecnologia (FCT; <a href="www.fct.pt">www.fct.pt</a>) funded the present work by the Project PAHMIX (PTDC/CTA-AMB/29173/2017)) and by the project Nanoplastic Project - Nanoplastic Toxicity: from gut inflammation to systemic effects (2022.04884-PTDC), The strategic project UIDB/ 04292/2020 granted to MARE and the project LA/P/0069/2020 granted to the Associate Laboratory ARNET. Beatriz Matos is financed by FCT via PhD grant 2020.09005. BD. Vasco Branco and Marta Martins are financed by national funds via FCT through Norma Transitória — DL57/2016/CP1376/CT002 and the Scientific Employment Stimulus — Institutional Call (CEECINST/00102/2018), respectively.

# RESULTS

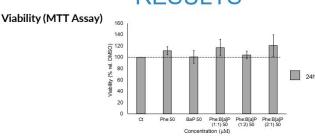


Figure 1 – Effect of exposure of different PAHs on cellular viability as evaluated by the MTT assay. Following exposure of ZFL cells for 24h, MTT reduction was evaluated. Ct – Control. Data represent the mean ±S.E. of 3 independent experiments.

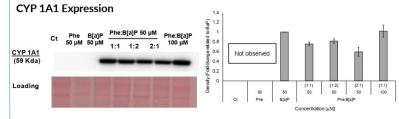


Figure 2 - Expression of CYP1A1 by Western blot after 24h of exposure in ZFL cells to different PAHs and their mixtures, Ct - Control. Data represent the mean ±S.E. of 3 independent experiments.

# Results showed:

- Viability did not decrease relative to control after 24h
- No expression of CYP1A1 protein levels was observed in the Control and Phenanthrene groups.
- Expression of CYP1A1 decreased relative to Bap when cells were exposed to binary Phe:BaP mixture in all proportions at 50μM.
- At 100 $\mu$ M, the expression of CYP1A1 in the mixture remains similar to BaP 50 $\mu$ M.

# DISCUSSION AND CONCLUSIONS

- Phe is a weak CYP 1A1 inducer [2], while BaP is a strong inducer [3]
- Mixtures with a final concentration of 50μM suggest that the inducing effect of BaP can be reduced by the presence of Phe;
- At a total concentration of  $100\mu M$ , there appears to be no change in CYP expression levels relatively to BaP exposure;
- PAHs have minimal influence on cellular viability, however, PAHs
  can induce the expression of metabolic enzymes, leading to the
  production of carcinogenic metabolites [1].

### References

- Bramatti., I.. et al. Interaction of Polycyclic Aromatic Hydrocarbon Compounds in Fish Primary Hepatocytes: From Molecular Mechanisms to Genotoxic Effects. SSRN Electron. J. 855. 158783 (2022).
- Billiard, S. M. S. M., Timme-Laragy, A. R., Wassenberg, D. M., Cockman, C. & Di Giulio, R. T. The role of the anyl hydrocarbon receptor pathway in mediating synergistic developmental toxicity of polycyclic aromatic hydrocarbons to zebrafish. *Toxicol. Sci.* 92, 526–536 (2006).
- Stoddard, E. G. et al. Exposure to an Environmental Mixture of Polycyclic Aromatic Hydrocarbons Induces Hepatic Cytochrome P45
   Enzymes in Mice. Chem. Res. Toxicol. 34, 2145–2156 (2021).











# ANTHROPOGENIC DEBRIS IN A TROPICAL SEABIRD COMMUNITY: INSIGHTS FROM TAXONOMY AND FORAGING DISTRIBUTION

Matos, Diana M.1, J.A. Ramos1, Filipa Bessa1, Vítor Silva1, Isabel Rodrigues2, Stefan Antunes2, I. dos Santos1, João Coentro1, A. L. C. Brandão3, L. A. E. Batista de Carvalho<sup>3</sup>, M. P. M. Marques<sup>3,4</sup>, Sara Santos<sup>1</sup>, V. H. Paiva<sup>1</sup>



NTRODUCTION















dianammatos92@outlook.com



Contact

\* Anthropogenic debris accumulate in natural ecosystems and cause damage to wildlife, disrupt natural processes, environmental degradation.1

anthropogenic pollution.2

\* Seabird species foraging over wider areas, including offshore and pelagic areas, have a higher likelihood of encountering debris.3

Seabirds are one of the animal groups most threatened

**Pelagic** Coastal

# Anthropogenic particles

WHICH ARE THE CHARACTERISTICS OF DEBRIS INGESTED BY SEABIRDS: TYPE, COLOUR, SIZE AND POLYMER

HOW TAXONOMY AND FORAGING DISTRIBUTION SEABIRDS INFLUENCE THEIR EXPOSURE TO ANTHROPOGENIC DEBRIS

# A TOTAL OF 280 SAMPLES



RESULTS & DISCUSSION

aik, José GB. "The

# LABORATORY WORK<sup>4</sup>



FREQUENCY OF OCCURRENCE (%)



% KOH (24-48 h)



Filtration, microfibre



- Brown booby (Sula leucogaster)
- Red-billed tropicbird (Phaethon aethereus)

Anthropogenic debris should be more prevalent in coastal areas, where human activities occur in higher number and frequency (e.g., fisheries). Higher occurrence of cellulosic based fibres, which may also be persistent

in the environment, may pose a potential threat to marine species.

Cape Verde shearwater (Calonectris edwardsii, Bulwer's petrel (Bulweria bulwerii) Boyd's shearwater (Puffinus Iherminieri boydi)

### Type Bulwer's petrel Tangle of Fibres Boyd's shearwater Cape Verde shearwater Red-billed tropicbird Brown booby Fragment 10 15 20 25 FREQUENCY OF OCCURRENCE (%) 10 20 30 40 50 60 70 FREQUENCY OF OCCURRENCE (%) Colour Multicolour Orange Polymers type Pink C. Varnish - 5.8% Red Yellow B. Polypropylene - 1.99 sparent A. Polyester- 7.7% Purple Natural - 28.8% Black 10 15 20 25 FREQUENCY OF OCCURRENCE (%) Size Anthropoger Small microparticles unknown - 28.8% All seabird species had anthropogenic debris in their faeces. Large microparticles Species with a more coastal foraging strategy exhibited higher occurrence and number of anthropogenic debris than pelagic species.

\*\*\*

17

# Acclimation period for Mytilus spp. prior to laboratory experiments: preliminary results

Cláudia Moreira<sup>1\*</sup>, A. Cristina S. Rocha<sup>1</sup>, Carlos Campos<sup>2</sup>, João Carlos Marques<sup>1</sup>, Tiago Verdelhos<sup>1,3</sup>

University of Coimbra, Department of Life Sciences, MARE - Marine and Environmental Sciences Centre, ARNET - Aquatic Research Network

- <sup>2</sup> Cawthron Institute, Nelson, New Zealand
- <sup>3</sup> CIVG Vasco da Gama Research Center / EUVG Vasco da Gama University School, Coimbra, Portugal
- \*e-mail address: claudia.moreira@uc.pt

# Introduction

Laboratory experiments using bivalves in aquaria require an acclimation period to guarantee that the animals are not stressed. Acclimation periods that are too short or too long can affect the results of an experiment. Nevertheless, few studies have determined optimal acclimation periods for bivalves prior to experiments (Widdows & Bayne, 1971, Thompson et al., 2012). Lack of consensus on this restricts our ability to compare data from different studies. In previous studies, in which Mytilus spp. was used, the acclimation periods used were 2 days (Pfeifer et al., 2005), 7 days (Coelho et al., 2021), 10 days (Matoo et al., 2021) and 14 days (Abidli et al., 2021).

### Aim

To determine an optimal acclimation period for Mytilus spp. prior to laboratory

# **Material and Methods**

In January 2022, adult mussels (Mytilus spp.) were hand-collected from natural growing areas in the south arm of the Mondego Estuary (Figure 1) during low tide, placed in coolboxes and taken to the laboratory for 14 days of acclimation period in a tank filled with estuarine water that was renewed every 4 days.

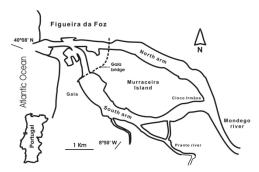


Figure 1. Location of the Mondego estuary on the northwest coast of Portugal (Castro & Freitas, 2006)



### Sampling Days

D0 - Mytilus spp. collection day D7 - After 7 days of acclimation D14 - After 14 days of acclimation

### **Digestive Gland**

GST - Glutathione S-Transferase LPO - Lipid Peroxidation

















# Results

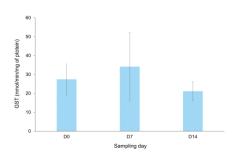


Figure 2. Activity of GST determined in the digestive gland of Mytilus spp. in different sampling days

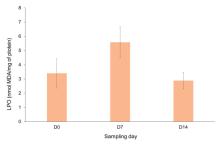


Figure 3. Levels of LPO determined in the digestive gland of Mytilus spp. in different sampling days

# **Conclusions and Future Directions**

- · The preliminary results of GST activity and LPO levels seem to indicate that there was some difference on the 7th day of acclimation and that 14th day had values closer to the mussel's collection day (D0). Could 14 days represent the optimal time for Mytilus spp. acclimation?
- To continue the analysis of the GST and LPO biomarkers and analyse others also important for the aim of this study, such as: Catalase (CAT), Acetylcholinesterase (AChE), Glutathione Peroxidase (GPx) and Glutathione Reductase (GR).
- To conduct statistical analysis to verify if there are significant differences between sampling days during the acclimation period of Mytilus spp..

# Acknowledgments

support of national funds through FCT, under the projects unbleNB42520200. UnbPN42520200, granted to MARE, and LAP/00582020, gnated to the Associate Laboratory ARNET. This work was also funded by FCT and University of Coimbra through the Decree-law S7/2016 contract of Talgo Verdelhos, subsidised by the European Social fund and Purbuges Ministry of Science, Technology and Higher Education (MCTES) through the Human Potential Programme (POPH). Lastly, this work was also funded by MARE and University of Coimbra through the Decree-law S7/2016 contract of A. Cristina Rocha. The authors also e all the colleagues who collaborated in the field and laboratory work

# References

Coelho, S. D., Vieira, H. C., Oliveira, J.M.M., Pires, S.F.S., Rocha, R.J.M., Rodrigues, A.C.M., Soares, A.M.V.M., Bordalo, M.D. 2021. How does Mytilus

Pfeifer, S., Schiedek, D., Dippner, J.W. 2005. Effect of temperature and salinity on acetylci stern Baltic Sea. Journal of Experimental Marine Biology and Ecology, 320: 93-103.

hompson, E.L., Taylor, D.A., Nair, S.V., Birch, G., Coleman, R., Raftos, D.A. 2012. Optimal acclims ournal of Molluscan Studies, 78 (3): 304-307.

Widdows, J., Bayne, B.L. 1971. Temperature acclimation of Mytilus edulis with reference to its energy budget. J. Mar. Bio. Assoc. UK, 51: 827-843

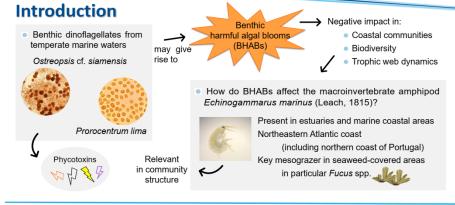


# Toxicity of Ostreopsis cf. siamensis and Prorocentrum lima: effects in the coastal amphipod Echinogammarus marinus

Ariana B. Moutinho<sup>1,3</sup>\*, Hugo R. Monteiro<sup>2</sup>, Jadilson M. Damasceno<sup>1</sup>, Helena David<sup>3</sup>, Ana Amorim<sup>3</sup>, Sara C. Novais<sup>1</sup>, Marco F.L. Lemos<sup>1</sup> & Tiago Simões<sup>1</sup>

<sup>1</sup> MARE – Marine and Environmental Sciences Centre & ARNET – Aquatic Research Network, ESTM, Polytechnic of Leiria, 2520-641 Peniche, Portugal <sup>2</sup> CBA – Biotechnology Centre of Azores, Faculty of Sciences and Technology, University of the Azores, 9500-321 Ponta Delgada, Azores, Portugal <sup>3</sup> MARE – Marine and Environmental Sciences Centre & ARNET – Aquatic Research Network Associate Laboratory, Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016 Lisbon, Portugal

\*ariana.moutinho@ipleiria.pt



# **Objectives**

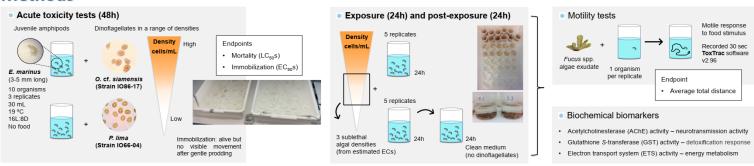
Evaluate lethal and sublethal effects of dinoflagellates Ostreopsis cf. siamensis and Prorocentrum lima on juveniles of the amphipod Echinogammarus marinus



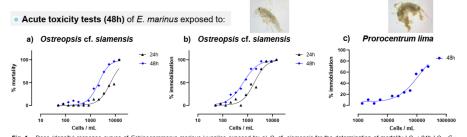


- Evaluate motility of E. marinus after exposure and post-exposure to sublethal algal densities
- possible mechanisms of BHAB toxicity

# Methods



# **Results and Discussion**



1 — Dose (density)-response curves of Echinogammarus marinus juveniles exposed to: a) O. cf. siamensis for the determination of mortality LC 48h LC<sub>20</sub> i<sup>2</sup>= 0.92; b) O. cf. siamensis for the eletermination of immobilization EC<sub>20</sub> 24h EC<sub>20</sub> i<sup>2</sup>= 0.93, dsh EC<sub>20</sub> i<sup>2</sup>= 0.95; c) P lima for the obligation: if only 16 in a contract the contract of the contract the nation of mortality LC<sub>50</sub>: 24h LC<sub>50</sub>

	Ostreopsis cf. siamensis (IO86-17)			Prorocentrum lima (IO66-04)	
Cells / mL	EC <sub>50</sub> (95% CI)	LC <sub>50</sub> (95% CI)	EC <sub>50</sub> (95% CI)	LC <sub>50</sub> (95% CI)	
24h	1844 (1571-2157)	6520 (5491-7732)	> 241 800	> 241 800	
48h	664 (579-761)	2143 (1833-2500)	111 851 (80 913-154 291)	> 241 800	

Table I – Estimated 24h and 48h EC<sub>56</sub>S and LC<sub>56</sub>S for juvenile *E. marinus* exposed to toxic dinoflagellates. LC<sub>56</sub>S and EC<sub>56</sub>S were estimated using four-parameter logistic curves. CI, confidence interval.

Exposure (24h) and post-exposure (24h)
 Biochemical biomarkers

Ostreopsis cf. siamensis had a more pronounced effect than P. lima in acute toxicity thresholds, presenting higher toxicity to E. marinus juveniles than P. lima

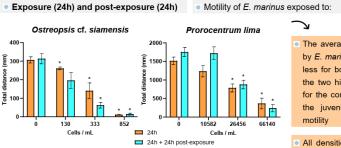
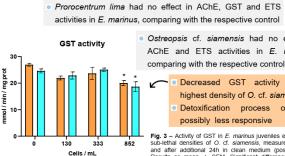


Fig. 2 – Average total distance travelled by E. marinus juveniles exposed to 3 sub-lethal densities of O. cf. rig. 2 — Average total sustaince dravieled by 2: mannins poverines exposed to 3 stan-tental tensines of 0 cm. siamensis and P lima, measured after 24h and after additional 24h in clean medium (post-exposure). Error bars represent the SEM. Significant differences from the respective control (0 cells/mL) are indicated by \* (0 ≤ 0.05, two-way ANOVA, Dunnett post-hoof test).

The average distance covered by E. marinus was significantly less for both dinoflagellates at the two highest densities than for the controls, indicating that the juveniles did not regain motility

All densities of O. cf. siamensis affected the motility of E. marinus



Ostreopsis cf. siamensis had no effect in AChE and ETS activities in E. marinus,

Decreased GST activity at the highest density of O. cf. siamensis Detoxification process of GST possibly less responsive

Fig. 3 – Activity of GST in *E. marinus* juveniles exposed to 3 sub-lethal densities of *O. ct. siamensis*, measured after 24h and after additional 24h in clean medium (post-exposure). Results as mean ± SEM. Significant differences from the respective control (0 cells/mL) are indicated by \* ( $p \le 0.05$ , two-way ANOVA, Dunnett post-hoc test).

# **Conclusions**

- Results suggest that the benthic dinoflagellate O. cf. siamensis may be more toxic for E. marinus juveniles than P. lima, in terms of mortality, immobilization and motility.
- At the biochemical level, the detoxification response of GST appears to be affected, revealing a decrease of activity at the highest density O. cf. siamensis (852 cells/mL), for both 24h of exposure and additional 24h in clean medium
- Overall, the present study puts in evidence the noxious effects of the two benthic microalgae species on the gammarid here tested, which may translate into potential consequences for the coastal trophic web dynamics and biodiversity.



24h + 24h post-exposure











# The establishment of a regional stranding network on the

# southwest coast of mainland Portugal (Alentejo): first results and challenges



F. Neves<sup>1\*</sup>, B. Simões<sup>1</sup>, I. Correia<sup>1</sup>, M. Rolim<sup>4</sup>, D. Jacinto<sup>1</sup>, T. Silva<sup>1</sup>, M. Segueira<sup>2</sup>, T. Cruz<sup>1,3</sup>, J. J. Castro<sup>1,3</sup>

1 MARE - Marine and Environmental Sciences Centre / ARNET - Aquatic Research Network, Laboratório de Ciências do Mar da Universidade de Évora ("fcfn@uevora.pt) <sup>2</sup> Instituto da Conservação da Natureza e das Florestas. Portuga

<sup>3</sup> Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Portugal 4cF3c- Centre for Fcology Fvolution and Environmental Changes. Azorean Riodiversity Group. CHANGE - Global Change and Sustainability Institute. Faculty of Sciences and Technology University of the Azore

The Portuguese Stranding Network (established in 1979) has collected data over the years along the coast of mainland Portugal, Currently, this network is divided into several regional stranding networks (Fig. 1) to allow a faster and more complete response to the stranding of marine mammals and reptiles. The data analysed here refers to strandings of cetaceans detected on the southwest coast of continental Portugal, the Alenteio region, between 2010 and 2022 (Fig. 2, Fig. 3).

In this work we provide insights regarding the first results of the establishment of a regional stranding network on the Alenteio coast comparing periods before and after the implementation of a Regional Stranding Network, using different variables (Table 1 and



ARROJAL udy area. Purple line – Rede Norte; Green line; Rede de Lisboa e Vale do

Regional Stranding Networ 30 25 20 15 Fig. 2. Annual number of stranding events detected per year on the Alentejo region between 2010 and Other adontoceti: 3% Delphinidae NI; Balaenoptera acutorostrata: 4% Other misticeti: 2% Turcione truncatue Stenella coerulegalha: 9% Phocoena phocoena: 8%

Fig. 3. Percentage by taxa of the total number of strandings detected on the Alentein region between 2010

Significant differences (PERMANOVA Pseudo-F = 9.842; Pvalue =0.01) were observed between the periods before and after the implementation of the Regional

Stranding Network (Fig. 4), with an improvement in the information gathered in the period after this

At the same time, the creation of the Regional Stranding Network has also been contributing to a better coordination between the different entities involved in the response to strandings and allowing

the collection of a higher number of biological samples for the Portuguese Marine Animal Tissue

This work highlights the importance of a dedicated

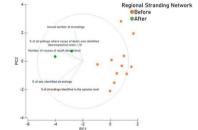
team in the field. The regional stranding networks

should be maintained allowing more and better information to be collected on each stranded animal,

Table 1. Mean and standard error of each variable in the periods before and after the implementation of the Regional Stranding Network ("Quantity of causes of death determined" show the type of causes of death determined in both

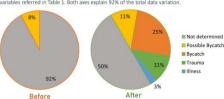
# Regional Stranding Network

	-	9
	Before	After
Annual number of strandings	18 ± 3	29 ± 5
% of strandings where cause of death was identified (decomposition state ≤ 3)	6 ± 4	51 ± 6
% of sex-identified strandings	35 ± 4	64 ± 6
% of strandings identified to the species level	68 ± 4	85 ± 6
Number of causes of death determined	Possible bycatch	Possible bycatch     Bycatch     Trauma     Illness



Teio: Orange line - Study area Alenteio region, SW mainland Portugal: Blue

implementation of the Regional Stranding Network) using principal component analysis and variables referred in Table 1. Both axes explain 92% of the total data variation.



Regional Stranding Network

Fig 5. Cause of death in strandings detected during the periods before and after the implementation of the Regional Stranding Networ

In addition, the use of unmanned aerial vehicles is being implemented in the detection of strandings (Fig. 6C). It has also been given emphasis to scientific outreach activities, with the aim of disseminating the project and drawing attention to the stranding topic (Fig. 6D). Between 2021 and 2022, 17 outreach activities were carried out with an estimated audience of 1250 people from different ages and backgrounds.



implementation.

Bank (Figs. 6A, 6B).

on an ongoing basis.

Fig. 6. A. Operation of the regional stranding network; B. Laboratory necropsy of a common dolphin; C. Use of drone to find a stranding; D. Outreach activity

### Acknowledgments

This work was funded by the Fundo Ambiental of Portugal and was developed with the partnership of ICNF. Stranding records until May 2021 were provided by ICNF. The authors would also like to thank all the entities and citizens who contributed to this work. This study had the support of FCT through the strategic project UIDB/04292/2020 awarded to MARE and through project LA/P/0069/2020 granted to the Associate Laboratory ARNET.













# made at the stage of the s Pollicipes pollicipes at Berlengas Nature Reserve (Portugal)

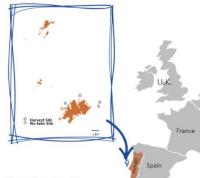
F. Neves 1, A. Sousa 1, D. Jacinto 1, S. Maia 2, N. Penteado 1, T. Silva 1, S. M. Leandro 3, D. Mateus 1, J.J. Castro 1, and T. Cruz 1, and T

# PROFESSIONAL HARVESTING AT RNB

Implemented in 2000 (changed in 2011) including:

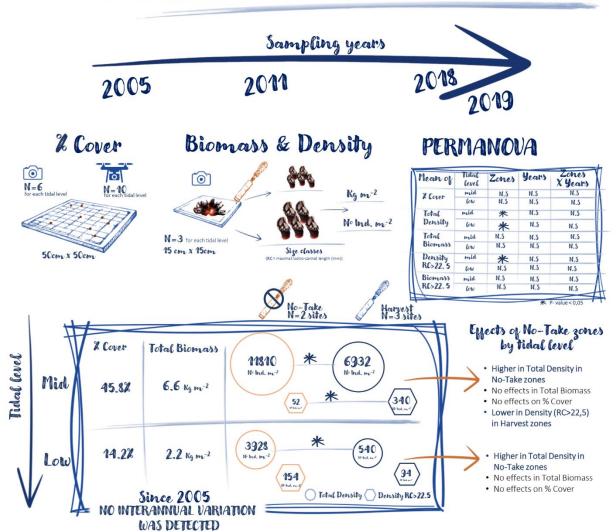


- The stalked barnacle Pollicipes pollicipes is intensively harvested on rocky shores of Portugal and Spain occurring on very exposed shores.
- Statistical data about this fishery in Portugal underestimate the fishing effort.
- Need for independent estimates of abundance and size of P. pollicipes to be integrated in management decisions



DO NO-TAKE ZONES AFFECT ABUNDANCE AND SIZE?

# DOES ABUNDANCE AND SIZE CHANGE OVER TIME?



# Differences in Total Density

Total density of barnacles in no-take zones was higher than in harvest zones, while total biomass was similar between zones. This pattern suggests that individual biomass per barnacle is lower in no-take sites comparing with harvest ones, which might indicate a lower quality of barnacles in no-take sites. Although there are observations that exploitation might happen in no-take sites, a lower fishing effort is assumed in no-take sites. Consequently, the higher density in no-take sites might be due to this lower fishing effort, but can also be explained by an apparent higher recruitment in these sites (Cruz et al. 2016).

### ACKNOWI FOGEMETS

# Differences in Density (RC> 22.5mm)

In the mid shore, density of large-sized barnacles (RC>22.5mm) was higher in the harvest zone than in the no-take zone, while biomass of these barnacles was similar. This seems to indicate that in the mid shore, barnacles reach a higher size in the harvest zone comparing with the no-take zone. This was not observed in the low shore, probably because there is a higher fishing pressure upon large sized barnacles in the low shore. Why do barnacles reach a bigger size in the mid shore of harvest sites? One explanation is the overall density that is higher in the no-take zone and this might limit growth in the no-take sites. Alternatively, there might be a higher growth rate in the harvest zone comparing with the notake sites. In fact, preliminary observations of individual growth rate in both zones seem to indicate a lower growth in the no-take zone.

## REFERENCES











# Sea lamprey adaptation in a climate change scenario: from genes to sustainable fisheries



Oliveira I.C. <sup>1,2</sup>, Almeida P. R. <sup>1,2</sup>, Salzburger W. <sup>3</sup>, & Mateus C. S. <sup>1,2</sup> icso@uevora.pt

# INTRODUCTION

# Sea lamprey (Petromyzon marinus, L.):

- Parasitic and anadromous species
- · "Vulnerable" in the Iberian Peninsula
- · Good model for evolution studies
- Distribution in the north, west of the Atlantic Ocean and Mediterranean Sea
- Cultural and Socioeconomic relevance

# Photography, Esmeralda Pereira





Figure 1. Study area identifies the respective four river basins selected for the study.

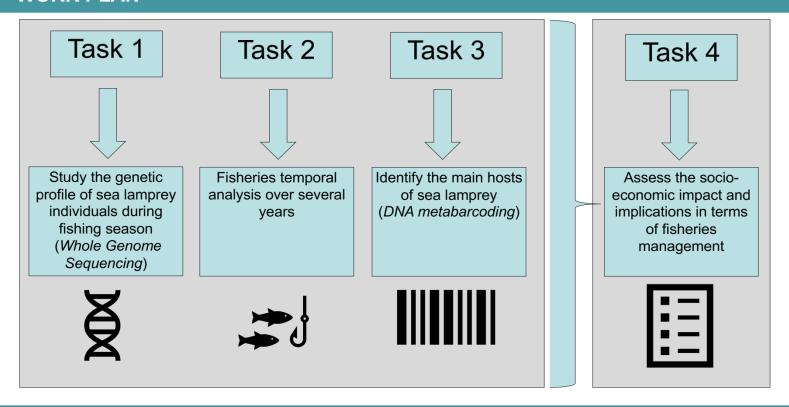
# Problematic

Could sea lamprey fisheries promote an artificial selection of genetic profiles better adapted to environmental pressures?

Could the decline in sea lamprey populations be associated with the availability of their preferred hosts at sea?

Is the sustainability of sea lamprey fisheries compromised?

# **WORK PLAN**



# **ACKNOWLEDGMENTS**











Study supported by Fundação para a Ciência e a Tecnologia (FCT) through the strategic project UIDB/04292/2020 awarded to MARE and through project LA/P/0069/2020 granted to the Associate Laboratory ARNET. A PhD grant was attributed by FCT to Inês Oliveira (2022.10442.BD). Catarina S. Mateus was funded by FCT within the project "EVOLAMP - Genomic footprints of the evolution of alternative life histories in lampreys" (PTDC/BIA-EVL/30695/2017). This study also received support from the project AN@DROMOS.PT - Operational Plan for the Monitoring and Management of Anadromous Fish in Portugal (MAR-01.03.02-FEAM-0002) and DiadSea - Transnational cooperation to improve the management and conservation of diadromous fish in the sea (EAPA 0011/2022).



# -Study of fish migrations and life-story strategies -

Migratory dynamic of catadromous thinlip grey mullet

Esmeralda Pereira\*1, Bernardo Quintella 2, Maria João Lança 3, Catarina Mateus 1 & Pedro Raposo de Almeida 1

<sup>†</sup> MARE – Centro de Ciências do Mar e do Ambiente / ARNET - Rede de Investigação Aquática, Universidad: tro de Ciências do Mar e do Ambiente / ARNET - Rede de Investigação Aquática, Faculdade de Ciências, Ui



# **Investigation developed:**

# Fish movement and behaviour

Sampling campaigns | Fish sampling campaigns and visual counts

- · Population biomass and size structure
- Circadian rhythm

Analyze species seasonal movements, diel patterns and infer the environmental triggers of specie's migratory movements.







Biotelemetry | Passive telemetry (pit-tags), radio and acoustic telemetry

- · Site fidelity
- · Activity patterns and habitat use
- · Short and long-Distance migratory movements and species behaviour

Unravel biological aspects of species migration and identify obstacles to migration.







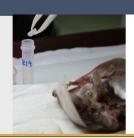
# Life-history tactics and ontogenic movements

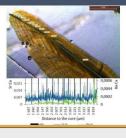
# **Otolith Microchemistry**

Laser ablation inductively coupled plasma mass spectrometry

Isotopic chemical analysis of Sr:Ca and Ba:Ca composition

Infer habitat use patterns (presence, timing and habitat transitions), reconstruct migration histories and identifying behaviorally groups of fishes, or contingents.







# Fish condition and metabolism

# **Lipid composition**

- · Proximate composition and nutritional quality
- Fatty acid composition
- Population discrimination-profiles

Study the role of different migratory behaviors and breeding strategies on fish metabolism, and both the quantity and quality of the lipid's reserves.



# Connectivity patterns and gene flow

# Molecular tools | Microsatellite DNA markers

- · Fine scale population structure of migratory fishes,
- Genetic differenciation at different geographical scales
- Demographic dynamics

Assess how complex life history traits and migratory dynamics shape the populations structure and connectivity.



Applications:

Habitat restoration and river connectivity

Fish pass improvement and monitoring

Fisheries management

Ecossistem services & Food production

Acknowledgement:

































Encontro Dia do MARE – Figueira da Foz, Novembro 2023

Contact/resources:

# Gestão e conservação de espécies potamódromas: dinâmica de movimentos, fidelidade espacial e migrações parciais

# Ana Sofia Rato<sup>1</sup>, Carlos M. Alexandre<sup>1</sup>, Isabel P. Lima<sup>2,3</sup> & Pedro R. Almeida<sup>1,4</sup>

MARE — Centro de Ciências do Mar e do Ambiente/ARNET — Rede de Investigação Aquática, Instituto de Investigação e Formação Avançada, Universidade de Évora, Évora, Portugal



- MARE Centro de Ciências do Mar e do Ambiente/ARNET Rede de Investigação Aquática, Universidade de Coimbra, Coimbra, Portugal
- Departamento de Engenharia Civil, Faculdade de Ciências e Tecnologias, Universidade de Coimbra, Coimbra, Portugal
- Departamento de Biologia, Escola de Ciências e Tecnologias, Universidade de Évora, Évora, Portugal





Espécies-alvo

Aumentar o conhecimento sobre a dinâmica espacial das espécies potamódromas, e os fatores biológicos e ambientais que regulam esses movimentos, mais especificamente:

- Avaliar e identificar a dinâmica de movimentos das espécies potamódromas;
- Identificar o grau de fidelidade espacial das espécies-alvo, seleção de habitat e respetivos padrões de residência/migração;
- Identificar os fatores ambientais, hidráulicos e hidrológicos que influenciam estes comportamentos;
- Adequar medidas e programas de aestão dirigidas a estas espécies.

Luciobarbus bocagei Steindachner, 1864 Estado de conservação: Pouco Preocupante Espécie potamódroma



Pseudochondrostoma polylepis Steindachner, 1864 Estado de conservação: Pouco Preocupante Espécie potamódroma





# Tarefa 1. Padrão de movimentos e comportamentos migratórios de espécies potamódromas

- Passagem Para Peixes do Açude-Ponte de Coimbra
- Contabilização e medição de indivíduos de ambas as espécies-alvo
- Relação com preditores ambientais









### Tarefa 2. Dinâmica migratória de espécies potamódromas

- Bacia hidrográfica do rio Mondego
- Marcação com marcas PIT de indivíduos das ambas as espécies-alvo
- Antena de deteção PIT fixa (Passagem Para Peixes do Açude-Ponte de Coimbra) e métodos de marcação-recaptura
- Avaliação dos parâmetros biológicos: sexo, idade, estado de maturação das gónadas, condição corporal
- Caracterização e mapeamento de habitat disponível

# Tarefa 3. Residência vs migração e seleção de habitat

- Sub-bacia do rio Tua, bacia hidrográfica do rio Douro
- Marcação de barbo-comum com transmissores acústicos (duração da bateria ca. 24 meses)
- Deteção contínua através de rede passiva de deteção acústica
- Caracterização de variáveis ambientais



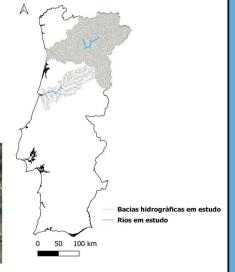


### Tarefa 4. Grau de fidelidade espacial

- Rio Douro, sub-bacia do rio Tua, sub-bacia do rio Pinhão
- Marcação de barbo-comum com transmissores acústicos (duração da bateria ca. 24 meses)
- Deteção contínua através de rede passiva de deteção acústica
- Caracterização de variáveis ambientais
- Translocação experimental entre os rios Tua e Pinhão (25 km de distância entre si)



















# Tarefa 5. Enquadramento e gestão das espécies potamódromas no âmbito da atividade piscatória

Realização de inquéritos para avaliar a importância das espécies potamódromas como espécies alvo e/ou acessórias:

- Pescadores profissionais
- Pescadores recreativos









# **Financiamento**

- Bolsa doutoramento FCT: 2021.05339.BD
- Projetos financiados pela FCT com referências UIDB/04292/2020 atribuído LA/P/0069/2020 atribuído ao Laboratório Associado





# Installation of a passive acoustic monitoring network (F-PODs) to detect toothed cetaceans (odontocete) on the Alentejo coast: preliminary



B. Reis<sup>1\*</sup>, F. Neves<sup>1</sup>, T. Silva<sup>1</sup>, T. Cruz<sup>1,2</sup>, J. J. Castro<sup>1,2</sup> and D. Jacinto<sup>1</sup>

<sup>1</sup>MARE – Marine and Environmental Sciences Center / ARNET – Aquatic Research Network, Laboratório de Clências do Mar da Universidade de Évora, Sines, Portugal ('beatriz.reis@ua.pt)

<sup>2</sup>Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Portugal

# Introduction

Odontocetes (toothed cetaceans) have the capacity to echolocate, which allows them to exchange information and coordinate their behavior using clicks (Fig. 1). In this way, it is not necessary to observe them in order to detect them. Technological development in recent decades has brought various devices for this specific purpose.

In this study, an array of passive acoustic detection sensors was deployed in the coastal waters of the Alentejo region with the objective of collecting information about the presence of cetaceans. Here, we show some preliminary results obtained with this passive acoustic monitoring network.

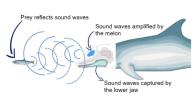


Fig. 1 – Echolocation (adapted from International Whaling Commission 2023).



# **Methods**

During the course of this work, a total of 4 F-PODs was deployed between the "Porto de Sines" and "Cabo Sardão" in SW mainland Portugal (Fig. 2). The F-PODs were deployed by scuba divers (Fig. 3 – A, B) on May 31, June 1 and 2, 2023, at an operating depth between 20 and 25 meters, about 1-2 meters from the substrate (Fig. 3 – C, D).

F-PODs are passive acoustic detection sensors made up of a polypropylene tube with a hydrophone at the top end capable of detecting echolocation clicks between 20 kHz and 160 kHz emitted by odontocetes (Chelonia Ltd., 2023). The data are collected on an SD card in the form of files that are analyzed by the F-PODs app, F-POD.exe, with KERNO-F version 1.0 (Fig. 6).

This app allows us to define the quality (Q) of the information displayed (high - Hi; moderate - Mod; and low - Lo; Fig. 6). It also allows us to select which class of species we want to detect (Fig. 6): NBHF (Narrow band high frequency), with the default setting corresponds to harbour porpoises (Fig. 4 - A); Other cetaceans ("Other Cet") which corresponds to other species of odontocetes that may be detected in the area, such as the bottlenose dolphin (Fig. 4 - B), the common dolphin (Fig. 4 - C) and the striped dolphin (Fig. 4 – D); Sonars; and Unclassed (Chelonia Ltd., 2023).



Fig. 4 – A - Harbour porpoise; B - Bottlenose dolphin; C - Common dolphin; D - Striped dolphin. (species illustrations by João T. Tavares; illustrations are not on scale).

Since the F-PODs only detect clicks and not the number of individuals or the species that are passing nearby the sensors, visual surveys are being carried out on land with a telescope (Fig. 5).

# **Results and Discussion**

From June 2 to August 21, 2023, over the course of 81 days, data collected by the F-POD 7306 submerged in an area adjacent to "Porto de Sines" (Fig. 2) revealed that the presence of "Other Cetaceans" was identified on 40 days, constituting 49.6% of the observation period (Fig. 7). Further examination on an hourly basis revealed a higher frequency of clicks during nighttime hours (see Fig. 8).

This study marks the first implementation of a passive acoustic monitoring network along the Alentejo coast for cetacean detection. The initial results are promising, revealing substantial potential for studying the occurrence and behavioral patterns of toothed cetaceans. This pioneering effort underscores the importance of passive acoustic monitoring in advancing conservation efforts and ecological studies of protected species, such as dolphins, shedding light on critical aspects of their habitat and behavior.

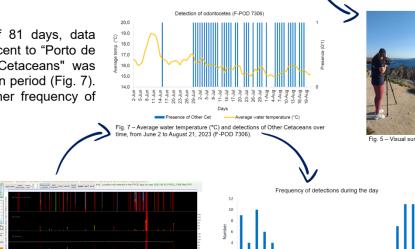


Fig. 6 – Results obtained for the different parameters (f1 - frequency; f2 - class of species; f3 – quality of cliks; f4 – cliks per second) observed on a 1-hour scale (F-POD 7306, from June 2 to August 21, 2023). ncy of positive cetacean detections tections (n=40 days; F-POD 7306).

# Acknowledgments

This study was supported through the projects "ATLAZUL – Impulsionar a Aliança Litoral Atlântica para o Crescimento Azul", funded by the Interreg Programme POCTED, "ARROJAL - Apoio à Rede Nacional de Arrojamentos - Rede Regional do Alentejo" funded by the Fundo Ambiental, and by the Foundation for Science and Technology, through the strategic project UID/MAR/ 04292/2019 granted to MARE (Marine and Environmental Sciences Centre) and the project LA/P/0069/ 2020 granted to the Associate Laboratory ARNET ne authors would also like to thank Bernardo Quintella, Ana Filipa Silva and João Pedro Marques (University of Lisbon, MARE/ARNET) for helping in the deployment of the sensors.



Chelonia Ltd. (2023). https://www.chelonia.co.uk/ International Whaling Commission (2023). https://iwc.int/en/













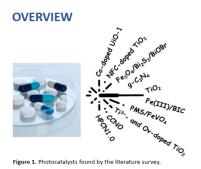


# Novel photocatalysts for pharmaceuticals removal from wastewater: a literature survey and a perspective for healthy freshwater ecosystems



F. Rodrigues<sup>1,6\*</sup>, M.J. Feio<sup>1</sup>, A.R. Calapez<sup>1</sup>, N. Simões<sup>2</sup>, A.M.P.T. Pereira<sup>3</sup>, L.J.G. Silva<sup>3</sup>, A. Freitas<sup>4,5</sup>, L. Durães<sup>6</sup>

1 University of Coimbra, MARE, Department of Life Sciences, Largo Marquês de Pombal, 3004-517 Coimbra, Portugal; 2 University of Coimbra, INESC Coimbra, Department of Civil Engineering, Rua Luis Reis Santos, 3030-788 Coimbra, Portugal; <sup>3</sup> University of Coimbra, LAQV/REQUIMTE, Faculty of Pharmacy, Azinhaga de Santa Comba, 300-548 Coimbra, Portugal; 4 LAQV/REQUIMTE, Rua Dom Manuel II, Apartado 55142, 4051-401 Porto, Portugal; 5 INIAV, I.P., Avenida da República, Quinta do Marquês, 2780-157 Oeiras, Portugal; <sup>6</sup> University of Coimbra, CIEPQPF, Department of Chemical Engineering, Rua Sílvio Lima, 3030-790 Coimbra, Portugal; \*fernanda.rodrigues@student.uc.pt

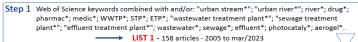


- Widely used for human and veterinary purposes in modern society;
- Present in wastewaters and if not appropriately treated or irregular discharges occur, they contaminate streams/rivers;
- Contaminants of Emerging Concern CECs:
- persist in freshwater ecosystems; lead to multidrug-resistant microorganisms;
- ✓ risk factors for health of humans, animals and plants, especially in urban areas.

### **OBJECTIVES**

- Address the state-of-art of scientific literature about the novel photocatalysts used to remove pharmaceuticals present in wastewater:
- Analyse their potential to improve water quality of urban streams by removal of pharmaceuticals found in collected samples, reducing risks for the ecosystem and human health.

# **METHODOLOGY**



- Step 2 Pre-selected articles of List 1 actually related to the theme: photocatalysis treatment, with the concern of pharmaceuticals in wastewater discharges to freshwater ecosystems (rivers and LIST 2 - 95 articles - 2005 to mar/2023 streams).
- Step 3 Final list with articles of List 2 that really reported tests with photocatalysts in wastewater and river water matrices. LIST 3 - 10 articles - 2018 to mar/2023
- Step 4 Analysis of studied pharmaceuticals and their groups, types of photocatalyst and radiation, removal
- Step 5 Evaluation of the potential of photocatalysts from List 3 to remove the same pharmaceuticals detected in the urban streams water from an original sampling campaign conducted by the authors of this work in November 2022, in Coimbra, Portugal.

Table 1. Articles of List 2.		
Period	Number of articles	%
2005 to 2017	26	27
2018 to mar/2023	69	73
TOTAL	95	100

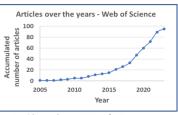
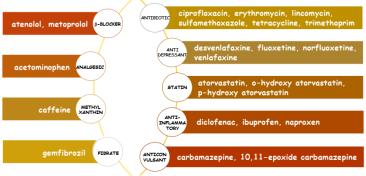


Figure 2. Articles over the years 2005-mar/2023

# RESULTS

23 pharmaceuticals | 9 groups | sulfamethoxazole and antibiotic (most frequent ones).



utic groups studied by photocatalysis in 2018-mar/2023







### Table 2. List of articles analysed in this work (List 3).

Dof	Pharmaceutical	Dhotocatalust	Removal Efficiency		
Ref.	Pharmaceutical	Photocatalyst	Wastewater	River water	
[1]	tetracycline	Co-doped UiO-1	87.1%	88.5%	
[2]	erythromycin, ciprofloxacin, sulfamethoxazole	NFC-doped TiO <sub>2</sub>	ca. 100%	-	
[3]	diclofenac, ibuprofen	Fe <sub>3</sub> O <sub>4</sub> /Bi <sub>2</sub> S <sub>3</sub> /BiOBr	54.9%, 58.9%	55.65%, 68.66%	
[4]	diclofenac   metoprolol	g-C <sub>3</sub> N <sub>4</sub>	ca. 100%	ca. 100%	
[5]	lincomycin   desvenlafaxine   atorvastatin, o-hydroxy atorvastatin, p-hydroxy atorvastatin   naproxen <sup>a</sup>	TiO <sub>2</sub>	ca. 100%	-	
[6]	ciprofloxacin	Fe(III)/BIC	84.71%	76.49%	
[7]	sulfamethoxazole	PMS/FeVO <sub>4</sub>	97.5%	95.6%	
[8]	tetracycline	Ti <sup>3+</sup> - and Ov-doped TiO <sub>2</sub>	52.68%	70.76%	
[9]	naproxen	CCNO	60.9%	64.8%	
[10]	sulfamethoxazole	HPCN1.0	ca. 99%	ca. 99%	

a Other pharmaceuticals, by groups, with different removal efficiencies: sulfamethoxazole, trimethoprim | fluoxetine, norfluoxetine, venlafaxine | diclofenac, ibuprofen | carbamazepine, 10,11-epoxide carbamazepine | atenolol | acetaminophen | caffeine | gemfibrozil.

- Radiation sources: VIS [2,3,4,7,8,9,10], UV [5], UV-VIS [6] and sunlight (simulated) [1];
- Matrices: domestic [2,3,4,5,9,10], hospital / medical [8,6,7] and pharmaceutical / industrial wastewaters [1,2], river waters [1,3,4,6,7,8,9,10];
- Removal efficiencies: ca. 100% [2,4,5,7,10], 75-90% [1,6] and 50-70% [3,8,9];
- Removal times: 30-60 min [1,4,6,7,8,10], 120-240 min [3,5] and 420-600 min [2,9];
- Wastewater treatment: very good removal efficiencies in a shorter time for g-C<sub>3</sub>N<sub>4</sub> [4], PMS/FeVO<sub>4</sub> [7] and HPCN1.0 [10];
- Coimbra's urban streams campaign (autumn of 2022): only 2 samples detected pharmaceuticals studied by the literature review: US10 (Arregaça, 40°11'51.9"N, 8°25'03.8"W), US11 (São Miguel, 40°13'39.1"N, 8°26'15.3"W) | ciprofloxacin (5.228 ng/L - US10; 2.067 ng/L - US11), diclofenac (29.291 ng/L - US10; 8.214 ng/L - US11);
- Tests with river water: Fe(III)/BIC [6] the only one tested for the removal of ciprofloxacin (76.49% in 60 min) | Fe<sub>3</sub>O<sub>4</sub>/Bi<sub>2</sub>S<sub>3</sub>/BiOBr [3] and g-C<sub>3</sub>N<sub>4</sub> [4] - tested to remove diclofenac (55.65% in 240 min, ca. 100% in 60 min, respectively);
- Considering also the good removal efficiency to the same pharmaceuticals from wastewater: effluents with these pollutants could be previously treated with Fe(III)/BIC [6] and  $g-C_3N_4$  [4].

# **CONCLUSIONS**

- Three photocatalysts with excellent removal efficiency and time (ca. 100% up to 60 min): important result to reduce costs (large amounts of wastewater to be treated);
- Two efficient photocatalysts indicated to treat ciprofloxacin and diclofenac:
- Good options to avoid contamination or improve water quality, but new technologies are lacking for other pharmaceuticals present in urban freshwater ecosystems.

### **REFERENCES**

- [1] J. Cao et al., Chemical Engineering Journal, 353 (2018) 126-137.
- [2] R. Ata, G. Töre, Journal of Environmental Management, 233 (2019) 673-680.
- [3] S. Li et al., Chemical Engineering Journal, 378 (2019) 122169.
- [4] M. Barros et al., Journal of Environmental Chemical Engineering, 9 (2021) 104747.
- [5] A. Fattahi et al., Catalysts, 11-5 (2021) 576.
- [6] S. Li et al., Applied Surface Science, 566 (2021) 150658.
- [7] J. Zhang et al., Chemical Engineering Journal, 403 (2021) 126384.
- [8] X. Chen et al., Chemical Engineering Journal, 427 (2022) 130945.
- [9] Y. Wang et al., Separation and Purification Technology, 296 (2022) 121425.
- [10] C. Tan et al., Chemosphere, 310 (2023) 136686.

# **ACKNOWLEDGEMENTS**

Fundação para a Ciência e Tecnologia, I. P. (FCT), under the studentship reference 2022.14367.BD, and the strategic projects UID/EQU/00102/2020,  $\label{eq:uidb} \mbox{UIDB/04292/2020, $LA/P/0069/2020, $UIDB/00308/2020, $and $a$ $PI$}$ CEEC contract (MJF); POCI-01-0145-FEDER-006910; European Regional Development Fund (ERDF), through COMPETE 2020; and European Commission, Horizon Europe program (OneAquaHealth project, GA: 101086521).





# **Nature-based Solutions and Coastal Resilience:**

# How can nature protect us from nature?

Catarina Jóia Santos 1,\*, José Carlos Ferreira1, Michael W. Beck 2

- 1. ARNET Aquatic Research Network/MARE Marine and Environmental Sciences Centre, Department of Environmental Sciences and Engineering, NOVA School of Science and Technology, NOVA University Lisbon, 2829-516 Caparica, Portugal
- 2. Center for Coastal Climate Resilience, Institute of Marine Sciences, University of California at Santa Cruz, California 95064, United
- \* csj.santos@fct.unl.pt

# **INTRODUCTION**

Coastal areas are complex and dynamic environments which have high productivity, biodiversity, and ecological value [1]. Consequently, they are extremely attractive:

- 600 million people worldwide reside in low-lying coastal areas [2];
- In the European Union (EU), approximately 40% of the Gross Domestic Product is generated in coastal areas [1], [3].

In a contexto of climate change, this attractivenesse enhances the exposure of coastal areas to extreme flooding, erosion, sea level rise episodes, and respective consequences [1], [3-4].

To address the growing coastal challenges, there are three main categories of response: relocation of coastal communities; accommodation to cope with flooding; and protection of assets and people [5]. Although effective in reducing the exposure to coastal hazards, relocation of populations further inland is not a popular alternative, due to place attachment and high costs [5-6]. Alongside accommodation, it assumes a great loss of coastal functions and benefits [6]. Protection strategies therefore rise as effective alternatives, the most common being conventional grey infrastructures, although in recent years innovative and greener alternatives have been gaining popularity – Nature-based Solutions (NBS) being a major example [7].

# **COASTAL PROTECTION EVOLUTION**

Extreme coastal events have always occurred, with the concept of coastal protection going as far back as the 13th century [8-9]. Historical records, however, only dates to the second half of the 19th century, when the first protection strategies started being implemented - stockate barriers, wooden walls with rock foundations, and experimental groins [8-10].

# 19th – 20th Century

- · Physical demarcation of land-sea boundary + coastal squeeze
- · Expansion of human territory
- · Artificialization of shoreline and decrease in ecosystem services

Hard Forms

Grey Infrastructure

**Engineered Strategies** 

· Hard protection strategies (groynes. seawalls, breakwaters [11-12]

# Late 20th Century & 21st Century

- · Environmentalism movements
- · Publication of Coastal Zone Management Act (1972)
- Integrated Coastal Zone Management Concept (1992)
- · Proliferation of "building with nature" concepts [13-14].

The paradigm of coastal protection has started shifting to a more sustainable ground [9]:

**Growing Sustainability Axis** 

Soft Forms

Green Infrastructure

Nature-based Strategies

# WHAT EXACTLY ARE NBS FOR COASTAL PROTECTION?

Nature-based solutions are ecosystem-based approaches, which are designed to adapt and mitigate climate change impacts and natural disasters, by protecting, managing, and restoring ecosystems. NBS build resilience and improve human health, meaning they provide additional co-benefits to coastal protection - in the form of ecosystem services [15-17]. There are three types of NBS, according to a growing degree of intervention on the coastal ecosystem [15], [18]:

- TYPE 1: Minimal interventions performed on the ecosystems (direct use or conservation of the coastal system)
- TYPE 2: Restoration and/or rehabilitation of degraded coastal ecosystems, to improve delivery of ecosystem services
- TYPE 3: Intensive management or even design of new ecosystems (ecosystem immitation approach of habitats who have previously existed in the area, but have since disappeared)

salt marshes, mangrove forests, seagrass beds (clockwise direction)

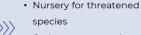






Dunes, coral and oyster reefs, salt marshes, mangrove forests, and seagrass beds are examples of NBS for coastal protection. These increase the adaptative capacity, resilience, and coastal protection efficiency of coastal ecosystems. These living shorelines create a physical barrier between sea and shoreline - therefore protecting the coast and dissipating wave energy.

CO-BENEFITS PROVIDED [16]



- Carbon sequestration
- · Water quality regulation
- Habitat
- · Food production Nature-based
  - tourism

# **CONCLUSIONS**

NBS are sustainable and adaptative: they adapt to changing environments, keeping pace with sea-level rise, and can be used in combination with other strategies (either other NBS or conventional structures). In addition to wave energy dissipation and erosion control, they provide a multitude of co-benefits, in the form of ecosystem services, highly contributting to coastal resilience. Despite this, they are still an emergent topic and have a few setbacks [15], [18]:



Require deep knowledge of ecosystems



implementation and long-term



Lack of cost-benefit Site-specific and and long-term efficiency analysis



not one-size-fits-all solution



and population support (novel

Funded by











Lack of political

COLUMNIADAZIFO.

SERICA, M. R. Bastos, J. C. Ferreira, and J. A. Dias, "Is the Sea the Enemy? Oxforice (Portugal)". Water (Switzerland), vol. 14, no. 18, Sep. 2022, doi: 10.3390/.

The changing paradigm of coastal management. The vol. 695. Elsevier B.V., Dec. 10, 2019. doi: 10.1016/j.scindow.2019.138907.

The changing paradigm of coastal management. The vol. 695. Elsevier B.V., Dec. 10, 2019. doi: 10.1016/j.scindow.2019.138907.

The changing paradigm of coastal management. The changing paradigm of changing para

s, oor. viv.016/Jenvres.2017.11.038. for assessing and implementing the co-benefits of nature-based solution, Nov. 2017, doi:10.1016/j.enset.2017.07.008. I K. Schwerdtner Máñez, "An operationalized classification of Nature Base

# MOTING SUSTAINABLE MARINE PLANNING IN THE ARCTIC AND ANTARCTIC

vsi\*, Rui Rosai, Renuka Badhez, Charles N. Ehlerz, Susie M. Grantz, Kevin A. Hughesz, Anton P. Van de Putte4, José C. Xavierz, 6, Catarina Frazão Santosi.8

**POLAR REGIONS** 



- Habitat de
- New routes of shipping access in the Arctic;
- Economic, political, cultural, and societal



# Climate Change;

- Pollution; Loss of ice-dependent species; Wildlife disturbance and non-native species introductions, Loss of natural services provided by marine ecosystems;
- Tourism; Overfishing...
- The Antarctic Treaty System (ATS) govern Antarctica and the Southern Ocean to the south of  $60^{\circ}\text{S}$ .
- - 1972 Convention on the Conservation of Antarctic Seals; 1980 Convention on the Conservation of Antarctic Marine Living Resources (CAMLR Convention);

  - 1991 Environmental Protocol (Madrid Protocol).

# METODOLOGY

(1) using an online survey



Survey: Ocean Planning in the Poles

205 RESPONSES

(2) developing a small number of dedicated, formal semi-structured interviews







RECOMMENDATIONS FOR THE ANTARCTIC REGION:



# MAJOR PROBLEMS IN POLAR REGIONS:





Overfishing



Climate Change; Loss of natural services: Loss of ice-dependent species:





New Maritime Transportation Routes in the Artic Region







- At the Antarctic Treaty Consultative Meetings more goals and objectives for the treaty member states were established.
- Creation of an Adaptive Tourism Management with the program establishment permanent Tourism
- Advisory Group:
   Creation of an effort map that categorizes all anthropogenic activities in the region;

# RECOMMENDATION FOR THE ARCTIC REGION:

- Organize Ocean Governance Conference involving all stakeholders in the region.
- Creation of an map that categorizes all anthropogenic activities in the region;













Planning in the Antarctic region



# Effects of hydrodynamic conditions and feeding period on size, growth and cirral behavior of the stalked-barnacle Pollicipes pollicipes



M. I. Seabra<sup>1</sup>, M. Santos<sup>2</sup>, D. Jacinto<sup>1</sup>, D. Mateus<sup>1</sup>, J. N. Fernandes<sup>1</sup>, A. Pombo<sup>2</sup>, T. Silva<sup>1</sup>, J. J. Castro<sup>1,3</sup>, and T. Cruz<sup>1,3</sup>

- Universidade de Évora, MARE Marine and Environmental Sciences Centre, Laboratório de Ciências do Mar, Sines, Portugal; Email: iseabra@uevora.pt
   Polytechnic institute of Leiria, MARE Marine and Environmental Sciences Centre, ESTM, Peniche, Portugal
   Universidade de Évora, Departamento de Biologia, Escola de Ciências e Tecnologia, Évora, Portugal

### INTRODUCTION

The stalked barnacle Pollicipes pollicipes is abundant in extremely wave-exposed rocky intertidal habitats along the Northeast Atlantic coast (Fig. 1), being rare in sheltered conditions. Environmental hydrodynamics might shape barnacle assemblages by affecting individual filter-feeding behaviour and growth [e.g. Barnes and Reese 1959, Norton 1996, Franco 2014].

According to Norton (1996), there is a relationship between the rate of seawater flow and the frequency of P. pollicipes cirral beat needed for body water exchange and respiration: cirri beat more frequently under low flow conditions, whereas cirri are more permanently extended under high flow

A recent study performed under laboratory conditions indicated that hydrodynamic conditions did not affect survival, but had consistent effects on size and growth of P. pollicipes, which grew faster at high turbulence [unpublished data]. These results could be explained by an enhancement of the respiratory efficiency due to cirral extension under high turbulence, and consequently by a higher allocation of energy to growth. However, it is possible that under high turbulence, growth could have been affected by a maintenance of feeding for some time after the end of daily feeding period.



The aim of the present study was to test if size, growth and cirral behaviour are affected by hydrodynamic conditions and by the length of the fe

### **M**ETHODS

Artificial collectors ("barticles") deployment:
Barticles (Fig. 2) were deployed in July 2017 at the intertidal zone of a very exposed rocky shore (Cape of Sines, Portugal – Fig. 3).

# Marking, relocation to laboratorial conditions and set-up of the

experiment:
In October 2018, wild juvenile barnacles, that were attached to barticles (Fig. 4) were collected, marked with calcein (after Jacinto et al 2015) and randomly allocated to twelve well-aerated seawater aquaria (relocation within 24 hours on PVC boards – Fig. 5, 6 and 7). The experimental design considered two orthogonal factors: Turbulence (fixed factor, 4 levels) and Feeding period (fixed factor, 3 levels) – see Table 1. Hydrodynamic conditions were set-up by using a flow pump to increase water turbulence within each aquarium (Fig. 5). One aquarium was randomly allocated to each of the twelve conditions. Each aquarium contained 6 barticles with an average of 12 barnacles per barticle. Artemia nauplii at a concentration of 2 nauplii per ml was supplied daily to all treatments. of 2 nauplii per ml was supplied daily to all treatments

### Video-recording of cirral behaviour:

Video-recording of criral behaviour:

On 2 dates during the experimental period, behaviour of the cirri was investigated by filming barnacles attached to a barticle (Fig. 8) in each treatment during periods of 2 minutes before the feeding period and 2

### Collection, processing and analyses:

were collected and processed in the On December 2018, all barticles were collected and processed in the laboratory (Fig. 9) for analyses of barnacle size (maximum rostrum-carina distance – RC – Fig. 10) and growth. Individual growth was assessed as monthly growth rate (aRC30) estimates obtained by measuring the marginal increment of one of the scutal plates of the barnacle's capitulum after the calcein mark and converted into RC units (as described in Jacinto et al 2015, see Fig. 11 and 12). Size and growth were analysed by two-way ANOVA followed by SNK tests (GMAV-5 software) and cirral behaviour by PERMANOVA followed by Pair-wise tests (PERMANOVA-/ PRIMER v7).















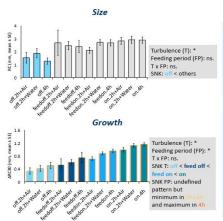






Turbulence (4 levels) Feeding Period (3 levels)	"off" Pump permanently turned off		"feed off" Pump turned off only during feeding		"feed on" Pump turned on only during feeding		"on" Pump permanently turned on	
"2h+Air" 2h feeding followed	20h	4h	20h	4h	20h	4h	20h	4h
by 2h emersion			6	6		6	6	66
	off.2h+Air		feedoff.2h+Air		feedon.2h+A	ir	on.2h+Air	
"2h+Water" 2h feeding followed by 2h immersion			6	6		6	6	66
by 211 milliersion	off.2h+Water		feedoff.2h+Water		feedon.2h+Wa	ster	on.2h+Wate	r
"4h" 4h feeding			6			6	6	6
	off.4h		feedoff.4h		feedon.4h		on.4h	

# **RESULTS AND DISCUSSION**



Cirral Behaviour Before feeding 1.2 Turbulence (T): \* Feeding period (FP): ns. T x FP: ns. Pair-wise: During feeding 1.8

Size of Pollicipes pollicipes was significantly lower in treatments where the flow pump was permanently off. This showed that increased water turbulence had a positive effect on the size of cultured barnacles.

Both tested factors affected the growth of P. pollicipes during the experimental period Growth was significantly different among the four levels of turbulence, being lowest under "off" (no turbulence), higher under "feed off" (turbulence during 20-22h per day but not during the feeding period), even higher under "feed on" (turbulence only during the second period). but not during the elevaing period), even higher under "one" (continuous turbulence only during 2-4h of daily feeding period), and highest under "on" (continuous turbulence) conditions—average growth (increment of RC per month) of 0.41, 0.63, 0.85 and 1.1 mm, respectively. The growth difference between "feed off" and "feed on" conditions might indicate that turbulence is more important during feeding than non-feeding periods. Although the pattern was not defined, there was a gradient in the growth of individuals under the three levels of feeding nation beginned lowest in "gab-late" intermediate in the "Dawlate" and levels of feeding period, being lowest in "2h+Air", intermediate in the "2h+Water" and highest in "4h" – average of 0.64, 0.75 and 0.84 mm, respectively. The difference between "2h+Air" and "4h" revealed that growth was not linearly related with the length of the feeding period (doubling the time of daily feeding did not double growth).

feeding period (doubling the time of daily feeding did not double growth).

Before feeding, the frequency of cirral extensions of the filmed individuals varied significantly among turbulence levels, being approximately 4 times lower under "on" conditions. During feeding, there was a significant interaction between the two tested factors but there were no clear patterns on the frequency of cirral extensions among treatments. Our results on cirral behaviour indicated that, during non-feeding periods and under continuous turbulence, cirri beat less frequently, possibly due tenhancement of the respiratory efficiency provided by turbulence. During feeding, cirral movements are probably associated with different vital functions (respiration and feeding). and feeding).

Main conclusion: Our results suggest that two different mechanisms contribute to the positive effect of turbulence on P. pollicipes growth: i) higher allocation of energy to growth likely due to energy saving in the movement of cirri for respiration and ii) higher ingestion/assimilation of food.

project "AQUAPOLLIS + Ay-. rtos de Sines e do Algarve S.A. Co-funding: Acknowledgments: This study is an output of the project "AQUAPOLLIS + Aquaculture of the stalked barnacle (Pollicipes pollicipes)" and had the support Coordination:

(2014). Applications of dilated barnates (Politipes politipes): PMD them have Solvens, Necessite University, Necessite University, Necessite University, Necessite University, Necessite University, Necessite University of Politipes politipes (Gerini, 1996) (Cirispedia Lepadomorpha). Doctoral dissentation, University of Visies, 79, 2726.
Petitalson, N., Peerka, D., Sousa, A., Cruz, T. (2015) Grown rate variation of the stakes barnate Politipes politipes (Civistoeix Cirispedia) using control annual confidence of Mantana, 79 (1911-1916).















# Assessing the impact of tidal aliasing on remote sensing observations of transitional waters: a Case study of the Tagus estuary using Sentinel-2 MSI data

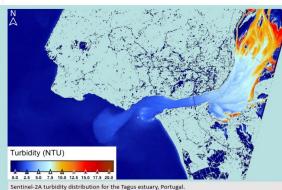
gsent@ciencias.ulisboa.pt

Giulia Sent<sup>1</sup>, Evangelos Spyrakos<sup>2</sup>, Ana Brito<sup>1</sup>, Thomas Jackson<sup>3</sup>, Vanda Brotas<sup>1</sup>, Emmanuel Nwokocha<sup>3</sup>, Elizabeth Atwood<sup>3</sup>, Steve Groom<sup>3</sup>

<sup>1</sup>MARE - ULisboa, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal <sup>2</sup> University of Stirling, Earth and Planetary Observation Sciences (EPOS), Biological and Environmental Sciences, Faculty of Natural Sciences, Stirling, UK <sup>3</sup>Plymouth Marine Laboratory, Prospect Place, PL1 3DH, UK

### **BACKGROUND**

- · Tides can be a significant factor influencing water dynamics in transitional waters, driving fluctuations in water parameters. Therefore, to assess patterns and trends over time, traditional in-situ samplings are often carried out at
- Remote Sensing (RS) techniques, particularly optical sensors on Sun-synchronous satellites, are a growingly employed tool for synoptic monitoring of water quality, due to the capability to provide cost-effective systematic observations
- In areas with semi-diurnal tides, the timing of tidal peaks may shift each solar day resulting in the satellite observing a different tidal condition at each overpass over the same geographic area, effectively aliasing smaller scale fluctuations.
- · The tidal aliasing can create non-obvious biases when using RS data for long-term monitoring of tidally-dominated systems, leading to mis-interpretation of patterns and incorrect estimates of periodicities.



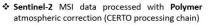
OBJECTIVE: Evaluate the influence of tidal aliasing on the applicability of RS data for long-term monitoring of a tidally-dominated system (Tagus Estuary, Portugal)

# **METHODS**









- 4 60m spatial resolution, the average value of the pixels inside the red box in Fig.1 was used.
- \* Temporal coverage: 2016-2020
- \* Remote Sensing Reflectance (Rrs) converted to turbidity using Nechad et al. (2009) at 705 nm.

Fig. 1. Sentinel-2 true colour imagery of the Tagus Estuary, acquired on polygon indicate the sampling area.

### TIDAL CLASSIFICATION

- Valid pixels were classified by tidal condition as explained in Fig. 2.
- Low tide condition (1h around low tide peak) was selected due to low tidal current velocity and availability of images

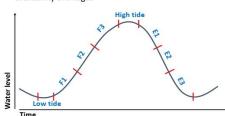
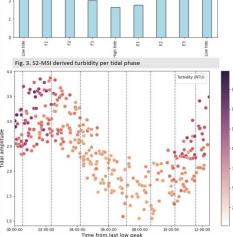
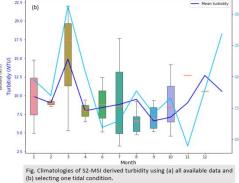


Fig. 2. Schematic representation of the rationale used for the labelling of the tidal condition for a semi-diurnal tidal wave.

# PRELIMINARY RESULTS S2-MSI derived turbidity - All data



S2-MSI derived turbidity - Low tide



# CONSIDERATIONS

- The turbidity values of each tidal phase showed a gradient expected for a tidally dominated estuary, with low turbidity at high water conditions and higher turbidity at low water (Fig. 3).
- Due to image acquisition by a Sun-synchronous satellite, not all tidal conditions are sampled, being the high water conditions observed uniquely under Neap tides and low water conditions under Spring tides (Fig. 4). Therefore, further analysis are required to study the turbidity response to the different drivers. Turbidity maxima observed by S2-MSI can be due to low water conditions, Spring tides conditions, or a combination of both.
- There is a rapidly increasing number of studies that apply RS tools for transitional waters monitoring. However, the tidal condition is not taken into consideration when analysing time-series. For meaningful application and interpretation of RS data of a tidally-dominated systems, it is crucial to remove the variability given by the different tidal conditions. Grouping the dataset by similar tidal condition can unravel smaller scale fluctuations (Fig. 5a and 5b).
- Selecting a tidal phase where the tidal currents are low (slack water) is advised due to more stable conditions of the water column.

Acknowledgments: Giulia Sent was supported by the doctoral Grant financed by the Portuguese Foundation for Science and Technology (FCT), and with funds from FCT, under MIT Portugal Program. CERTO (Copernicus Evolution - Research for harmonized and Transitional water Observation) project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870349.







# IN-SITU CAGE CONDITIONING PROMOTES THE ESTABLISHMENT OF RELEASED HATCHERY-REARED DUSKY GROUPERS IN THE WILD



Ana Filipa Silva <sup>1,2</sup> João J. Castro <sup>2,3</sup>, Esmeralda Pereira <sup>2,3</sup>, João Pedro Marques <sup>1,2</sup>, Bruno Pinto <sup>1,2</sup>, Teresa Silva <sup>2,3</sup>, Pedro Raposo de Almeida <sup>2,3</sup>, Bernardo Ruivo Quintella <sup>2,2</sup>

# WHAT? HOW?

Releasing trial to assess the influence of *in*-situ acclimatization on the establishment of 15 hatchery-reared adult dusky groupers in the wild:

8 groupers in-situ acclimatized for 1 month in a fish farm net cage before the release (treatment)

7 groupers directly released in the wild (control)





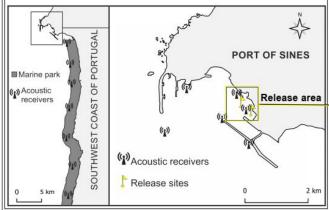


Watch the videos of the releasing here!

2-year monitoring period with acoustic telemetry to detect the presence of the groupers

# WHERE? WHEN?

Portugal SW coast, Port of Sines, 2021 - 2023

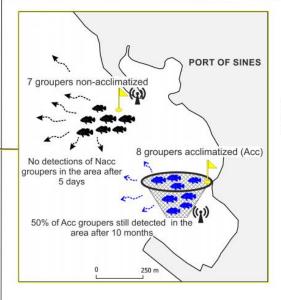


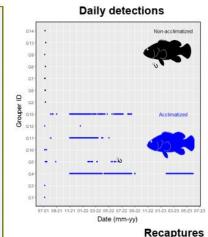
# **WHAT RESULTS?**

Non-acclimatized groupers undetected after 5 days

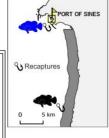
After 10 months 50% of the acclimatized groupers remained in the area, one was still present 2 years later

Two recaptures: one acclimatized grouper in the port, one non-acclimatized grouper 16 km to south





# Recaptures



# **WHAT'S NEXT?**

MEROSW project (on-going)

Assess the restocking effect of a large scale releasing action with *in-situ* acclimatized juvenile hatchery-reared dusky groupers





Ciências III isboa























# **Dive Reporter - Mobile Application for Crowdsourcing Marine Biodiversity**



Francisco Silva<sup>1,2</sup>, Matej Buzinkai<sup>1</sup>, Claudio Rodrigues<sup>1,2</sup>, Ruben Freitas<sup>1,2</sup>, Sahar Chebaane<sup>1</sup>, Paola Parretti<sup>1</sup>, Susanne Schäfer<sup>1</sup>, Rodrigo Silva¹, Francesca Gizzi¹, Silvia Almeida¹, Sonia KM Gueroun¹, João Canning-Clode¹³, João Gama Monteiro¹⁴, Marko Radeta¹.2.5

- 1. Marine and Environmental Sciences Centre / ARNET Aquatic Research Network, Agência Regional para o Desenvolvimento da Investigação Tecnologia e Inovação (ARDITI), Funchal, Madeira, Portugal 2. Wave Labs, Faculty of Exact Sciences and Engineering, University of Madeira, Portugal 3. Smithsonian Environmental Research Center, USA 4-Faculty of Life Sciences, Universidade da Madeira, Portugal 5. Department of Astronomy, Faculty of Mathematics, University of Belgrade, Serbia

# Introduction

Long-term monitoring of local ecosystems and biodiversity is crucial to detect shifts in key biological traits. Continuous monitoring enables, for example, the early detection of non-indigenous species' arrival and rapid response to potential biological invasions. Common monitoring methods usually require much time or are expensive. Dive Reporter leverages recreational SCUBA divers to gather data using divemasters as a filter for that data.







Figure 1: App interface

# How to

The Dive Reporter application was created to track 24 key species in the Madeira archipelago. Developed in collaboration with 13 local dive centers, the debriefing process involves divergasters inputting details such as dive location, duration, the count of divers, and the abundance of species in 4 categories (Figure 1). Presently, three interfaces - app, kiosk, and web - are available.



Figure 2: Dive centres participating in the program



Figure 3: Dive spots covered in the program

# **Possible outcomes**

In the initial four months of implementing the monitoring program using Dive Reporter, 224 reports from 30 distinct diving locations were obtained, with active participation from ten dive centers (Figure 2). The distribution and abundance of each of the 24 monitored species can be visually represented on a map. For example, harpoon weed (Asparagopsis sp.) has been reported in 186 instances in 24 locations on the south coast and one location on the north coast of Madeira Island (Figure 4). Over the long term, the continuous operation of the monitoring program is expected to identify long-term trends in the 24 monitored species and differences between locations.



Figure 4: Harpoon weed distribution and abundance around Madeira based on reports

If you are interested in expanding the Dive Reporter program to other areas or projects, contact us at sschaefer@mare-centre.pt















# Temporal and spatial variation of abundance and size of the stalked barnacle (Pollicipes pollicipes) in Continental Portugal

A. Sousa\*1,2, D. Jacinto¹, F. Neves¹, S. Maia², N. Penteado¹, D. Mateus¹, J. N. Fernandes¹, M. I. Seabra¹, T. Silva¹, S. M. Leandro³, J.J. Castro¹,4 and T. Cruz ¹,4

<sup>1</sup> MARE – Marine and Environmental Sciences Centre, Laboratório de Ciências do Mar, Universidade de Évora, Sines, Portugal, <sup>2</sup> MARE – Marine and Environmental Sciences Centre, Polytechnic Institute of Leiria, Peniche, <sup>3</sup> MARE – Marine and Environmental Sciences Centre, ESTM, Polytechnic Institute of Leiria, Peniche, Portugal Portugal, <sup>4</sup> Departamento de Biologia, Escola de Ciências e Tecnologia, Universidade de Évora, Portugal a l'alinasousa@gmail.com



### **INTRODUCTION**

# Pollicipes pollicipes (crustacean)

- Inhabits very exposed rocky shores
- Most important fishing resource on rocky shores of continental Portugal (exploited by recreational and professional fishers)
- Specific regulations on this fishery are different along the Portuguese coast

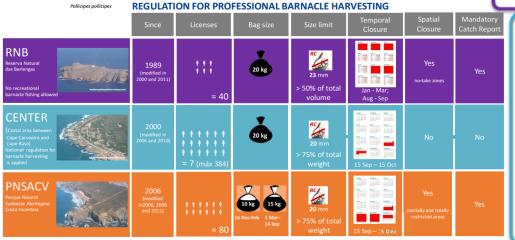
### To investigate

- If abundance and size change along P. pollicipes Central and SW Portugal distribution?
- · If abundance and size change over time?



**RNB** 

**CENTER** 



### **METHODOLOGY**

- 3 sites sampled in each region

  - Percentage cover:

    ✓ Photos of 50x50 cm quadrats, haphazardly located (n=6), in two tidal levels **Density and Biomass:**
  - Total scraping of 15x15 quadrats, positioned on P. pollicipes clusters (n=3), in two tidal levels
- Sorted by size class (RC<20mm and RC>20mm)
- Density and biomass data corrected (kg m<sup>-2</sup> and ind. m<sup>-2</sup>)

# Sampling years 2011

Sampling regions

**RNB** 

CENTER

**PNSACV** 

# **PERMANOVA**

	MID tidal level			LOW tidal level		
Mean of	Year	Region	Year x Region	Year	Region	Year x Region
% Cover	n.s.	*	n.s.	n.s.	n.s.	n.s.
Total Density	n.s.	*	n.s.	n.s.	*	n.s.
Density RC>20mm	n.s.	*	n.s.	n.s.	n.s.	n.s.
Total Biomass	n.s.	*	n.s.	n.s.	n.s.	n.s.
Biomass RC>20mm	n.s.	*	n.s.	n.s.	n.s.	n.s.

# **RESULTS**

- ✓ No interannual variation was detected Regional variability in MID tidal level Percentage cover:
  - ✓ Lowest at CENTER

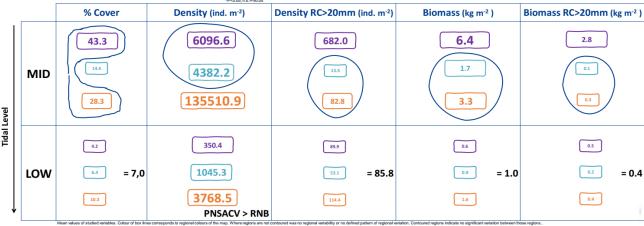
### **Density and Biomass:**

- ✓ Highest total density at PNSACV and highest density of P. pollicipes with RC>20mm at
- ✓ Total biomass and biomass of P. pollicipes with RC>20mm both highest at RNB

No regional variability in percentage cover, biomass and density RC>20mm on the LOW tidal level

Regional variability in total density on the LOW tidal level

✓ higher in PNSACV than in RNB



CENTER - lowest % cover and low values of density and biomass (at mid tidal level) which could be related with:

- Less management rules and management considered weak by most of the fishers (Cruz et al. 2015)
- Higher fishing effort (total number of fishers (commercial and recreational) might be higher than in the more regulated regions (Cruz et al. 2015))

ISACV - highest total density (at mid tidal level) which could be related with a higher recruitment (Cruz et al. 2016). More intense intraspecific competition?

RNB - highest total biomass and a higher density and biomass of P. pollicipes with RC>20mm (at mid tidal level) which could be related with:

- Management considered acceptable by most of the fishers (Cruz et al. 2015, Sousa et al.
- First region in Portugal to be specifically managed in relation to this fishery Less effort? Higher growth? Older barnacles?



**PNSACV** 





# radiação gama a partir de dados de offshore

João M. Sousa<sup>1</sup>, Luís V. Duarte<sup>1</sup>, Sérgio L. R. Sêco<sup>2</sup>

<sup>1</sup>Universidade de Coimbra, MARE-ARNET e Departamento de Ciências da Terra, Coimbra, Portuga 🏻 2Universidade de Coimbra, IDL e Departamento de Ciências da Terra, Coimbra, Portugal

### Introdução

A Bacia Lusitânica (BL) beneficia de um conhecimento estratigráfico bastante detalhado em *onshore* que não é substanciado pelos dados de subsuperfície. Estudos baseados na análise de Radiação Gama Total (RGT) e radioelementos têm revelado um enorme potencial na definição estratigráfica de sucessões margo-calcárias e, em especial, de unidades margosas ricas em matéria orgânica, como é o caso das unidades do Jurássico Inferior da BL (e.g. Correia *et al.*, 2012; Sêco *et al.*, 2018, 2019). A Formação (Fm) de Coimbra (Fig. 18 e Fig. 2) é a primeira unidade de registo marinho à escala bacinal (Fig. 2) (Duarte *et al.* 2022). Inicialmente de um paleoambiente marinho restrito, com fácies dolomíticas e microbiais, incluindo estromatólitos (Fig. 2) evoluiria com a abertura ao meio marinho, à presença de fácies carbonatadas com fauna bentónica e nectónica, incluindo as primeiras amonites registadas na BL (Dommergues *et al.* 2010; Azerédo *et al.* 2010; Duarte *et al.* 2020;

Baseado no estudo de 11 sondagens do offshore da BL, o presente trabalho pretende:

- a) fazer o reconhecimento da variação litostratigráfica com base no RGT, bem como reavaliar os limites litostratigráficos da Fm de Coimbra;
- b) fazer uma análise sequencial da Fm de Coimbra de modo a identificar as fases mais marinhas;
- c) identificar os principais intervalos margosos, por vezes ricos em matéria orgânica, com impactos nos sistemas petrolíferos.

# Metodologia

- A espectrometria de radiação gama é uma técnica baseada nos espectros de radiação emitidos pelos radioelementos K-40, Th-232 e U-238.
- Em rochas sedimentares o K e Th estão associados a sedimentos silto-argillosos em ambientes hemipelágicos ou a sedimentos terrígenos de origem continental; o U está associado a ambientes marinhos redutores/anóxicos onde frequentemente se acumula matéria orgânica (e.g. Bábek et al. 2013; Simicek & Bábek 2015; Gama & Schwart 2022).
- Em sucessões margo-calcárias a variação crescente e decrescente dos valores de RGT são indicadoras de intervalos transgressivos e regressivos, respetivamente, com os valores máximos a corresponderem a intervalos de máxima inundação, e os valores mínimos a corresponderem a limites de sequência (Sêco et al. 2018; Sousa et al. 2023).
- A investigação envolveu a delimitação rigorosa dos limites litostratigráficos da Fm de Coimbra, baseado em características litológicas e nos padrões de variação de RGT de Sêco et al. (2018) Posteriormente identificaram-se os intervalos de maiores contagens com os principais intervalos margosos identificados em Duarte et al. (2022) (Fig. 1B), e fez-se a interpretação sequencial da sucessão estratigráfica, à semelhança do preconizado em Sêco et al. (2018, 2019).

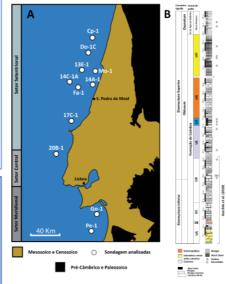


Fig. 1. A – Localização geográfica das sondagens analisadas do offshore da BL; B – Log litostratigráfico da Fm de Coimbra na secção de referência de S. Pedro de Moel (in Duarte et al. 2022).

### Resultados

- RGT da Fm de Coimbra com variação de 4 a 110 API. Sucessões carbonatadas 5 e os 60 API; sucessões margosas - 20 e os 110 API (Fig. 3).
- Primeiros limites litostratigráficos nas sondagens Cp-1, Go-1 e Pe-1; Erros em limites litostratigráficos da Fm de Coimbra em dezenas de metros em várias sondagens.
- Correlação entre quatro principais intervalos margosos identificados em Duarte et al. (2022) (Unidade A, D F e H, ou os seus equivalentes laterais).
- · Descontinuidades no norte da BL com o Cretácico Inferior, e a sul, com o Jurássico Médio (Fig. 3).
- Média de espessura máxima aparente de 140 metros na região norte da BL (ver também a correlação superficie-subsuperficie em Sêco et al., 2018), onde se detetam a maior parte dos indicios de hidrocarbonetos presentes nesta unidade (Do-1C, Mo-1 e 14A-1) (Fig. 3).

### Discussão e Considerações Finais

- Variação do RGT, intrinsecamente relacionado com características sedimentares e paleogeográficas, em relação à proximidade continental e a profundidade da coluna de água com condições anóxicas/redutoras ou oxidantes (Fia 3)
  - Locais de mar proximal 17C-1.
  - Locais de coluna de água mais profunda com condições redutoras 14A-1 e Do-1C.
  - Locais de baixa coluna de água Pe-1.
- Entre os quatro intervalos margosos principais (incluídos nas unidades A, D, F e H, definidas em Duarte et al., 2022) definem três ciclos T-R de 3º ordem, inseridos num ciclo transgressivo de 2º ordem, com a sua expressão máxima no topo da Fm de Água de Madeiros (ver também Duarte et al. 2022) (Fig. 3).
- Grande contraste faciológico da Fm de Coimbra em S. Pedro de Moel e do NW da BL no geral, com todo o
  que se observa no resto da bacia.
- Plataforma carbonatada controlado por altos estruturais de natureza halocinética ou tectónica, condicionando o espaço de acomodação sedimentar e a grande variabilidade faciológica da Fm de Coimbra (e.g. Alves et al. 2002; Rasmussen et al. 1998).
- Este trabalho vem demonstrar o sucesso da aplicação da espectrometria de raios gama na interpretação de sucessões carbonatadas e fornecer novos dados e questões quanto ao estudo estratigráfico e evolução da Fm de Coimbra, e da Bacia Lusitânica.





formações de Coimbra e Água de Madeiros, junto à Ponta da Papôa em Peniche.

Offshore

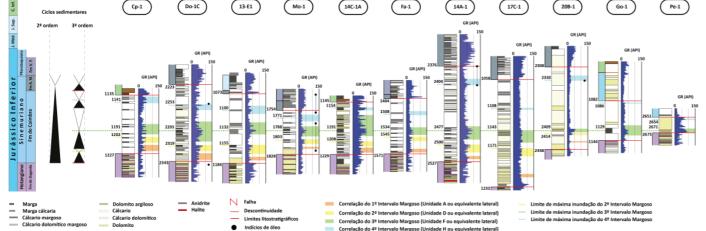


Fig. 3. Colunas litostratigráficas e diagrafías de RGT das sondagens analisadas do offshore da BL. É apresentada a análise sequencial de 2ª e 3ª ordem de acordo com a identificação dos quatro principais intervalos margosos identificados em Duarte et al. (2022), bem como os indícios de hidrocarbonetos presentes neste intervalo (adaptado de Sousa et al. 2023).

Agradecimentos: Os autores agradecem à ENMC/UPEP, atual competência da DGEG, pela disponibilidade dos relatórios das sondagens. À FCT, através dos projetos UIDB/04292/2020, UIDP/04292/2020, e LA/P/0069/2020.

### Referências bibliográficas

Ass, E., Seedings, A., Uniford, A., Uniford, A., Company, A., Seedings, A., Seed













# **blueTIDE**

LITERACIA DO OCEANO PARA UMA EDUCAÇÃO INTEGRADA E DINÂMICA

OCEAN LITERACY FOR AN INTEGRATED AND DYNAMIC EDUCATION

Teixeira, Z. Rocha, C., Veríssimo, H., Verdelhos, T., Marques, JC, Cotrim, S., Elias, C., Mouga, T., Ferreira, SMF, Costa, L., Sequeira, V., França, S., Correia, M.J., Medeiros, J.P., Adão, H., Castro, J., Cruz, T., Costa, A., Santo, C.E., Fernandes, J.N., Mamede, M., Costa, M., Jacinto, D., Celestino, S., Silva, T., Seabra, I.

zara.teixeira@uc.pt

Na zona entremarés rochosa é fácil observar espécies muito diferentes. Porquê? Umas vivem muito tempo debaixo de água, enquanto que outras vivem várias horas fora de água, durante a maré baixa.

### **MISSÃO**

MISSION

Divulgar o que a ciência conhece sobre este *habitat*, para que a sua importância seja mais bem compreendida e a sua conservação mais respeitada e promovida.



Animal invertebrado, do grupo dos crustáceos, no interior de uma concha de outro animal.

Invertebrate of the crustacean group, inside the shell of another animal..



Pepino-do-mar. Animal invertebrado da classe equinoderme

Sea cucumber. Invertebrate animal of the class echinoderm.

áreas geográficas

# TRAZEMOS O MAR ÀS ESCOLAS

BRINGING THE SEA TO SCHOOLS

Em sala de aula, os alunos descobrem as características deste *habitat*. Que espécies aí vivem? Como se relacionam entre si? Como são afetadas pela água, sal e sol?





Jogo "Quem é quem - Biodiversidade da zona entremarés rochosa."

Game "Who's who - Biodiversity of the rocky intertidal zone"

### LEVAMOS AS ESCOLAS AO MAR

TAKING SCHOOLS TO THE SEA

Na praia, as crianças experienciam *in loco* o que aprenderam em sala de aula e celebram a diversidade biológica através de jogos divertidos.



Visita a uma zona rochosa entremarés.

Visit to a rocky intertidal zone.



Festa na Praia. Tarde de jogos didáticos sobre a biodiversidade. Beach party. Afternoon of educational games about biodiversity.

# TREINAMOS PROFESSORES

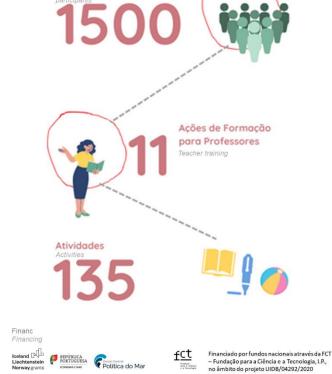
TRAINING TEACHERS

Para que sejam autónomos no desenvolvimento de atividades sobre a zona entremarés rochosa.



"Um Pé na Maré" Ação de Formação para professores. Figueira da Foz, Peniche, Setúbal e Sines. Training action for teachers.





# O QUE AS CRIANÇAS SABEM E QUEREM SABER SOBRE AS ALTERAÇÕES CLIMÁTICAS: UMA AUTOAVALIAÇÃO DE CONHECIMENTOS PRÉVIOS

Teixeira, Z., Morgado, R., Marques, C., Gonçalves, C., Carvalho. P., Cunha, A., Moreira, C.

# **NECESSIDADE**



Poderá a auto-percepção do conhecimento e interesses das crianças relativamente às alterações climáticas apoiar a conceção de iniciativas de educação ambiental?



# 166 INQUÉRITOS ABERTOS

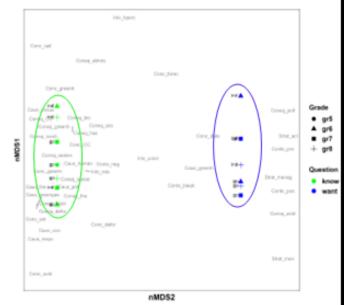
alunos 5º a 8º ano

2 questões sobre ALTERAÇÕES CLIMÁTICAS

> O que sabemos? O que queremos saber?

Há diferenças significativas nas respostas às duas questões.

Não há diferenças significativas entre ciclos de ensino, nem entre inquéritos individuais vs grupo.



# O QUE DESCOBRIMOS?

As crianças declararam conhecero conceito de alterações climáticas e as suas causas e consequências específicas (DOWE SABEMOS), mas foram geralmente incapazes de especificar os tópicos sobre os quais estão interessadas em aprender (DOWE QUEREMOS SABER). E quando estes foram especificados, correspondem a tópicos que já conhecem - alterações no gelo marinho, poluição e biota.

Resultados sugerem que confiar apenas nos interesses das crianças pode dar origem a 'corredores de informação'. As iniciativas futuras devem então alargar os campos de conhecimento através da introdução de abordagens inovadoras que ultrapassem os pressupostos dos investigadores, ao mesmo tempo que têm em conta as experiências e a realidade das crianças.



Quinta do Sal Ciência Viva

A Universidade de Coimbra, o município da Figueira da Foz, a Agência Ciência Viva e o VilVite – Bergen Science Center juntam-se para **renovar armazéns tradicionais** e **revitalizar tradições e saberes**, associados à extração de sal tradicional.

The University of Coimbra, the municipality of Figueira da Foz, Ciência Viva Agency and VilVite – Bergen Science Center are joining forces to renovate traditional warehouses and revitalize traditions and knowledge, associated with traditional salt extraction.

# Estamos a dar vida à Quinta Ciência Viva do Sal.

Um espaço que mescla a ruralidade das quintas com a interatividade e a curiosidade dos centros de ciência.

Bringing to life the Living Salt Science Farm.

A space that blends the rurality of farms with the interactivity and curiosity of science centres.

# O QUE ESTARÁ À SUA ESPERA? WHAT IS WAITING FOR YOU?



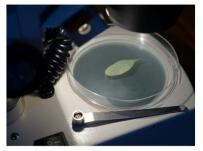
# **SENTIR** FEEL

Armazéns e zona envolvente renovados, para que possa sentir o Salgado.



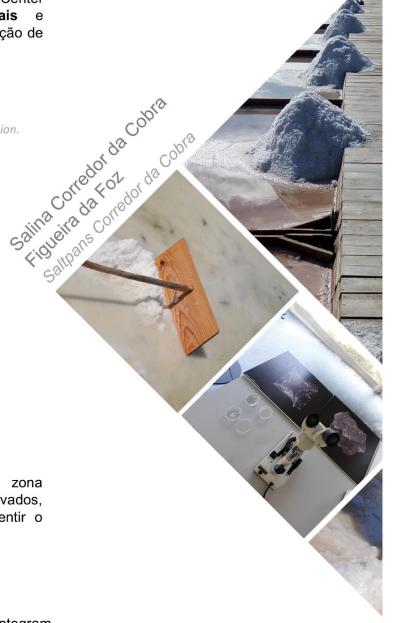
# RER COLLECT

Experiências que integram os produtos e os saberes da salina, tal como rer o sal, para que se sinta mais próximo da atividade de extração de sal tradicional.



# CRIAR CREATE

Um espaço colaborativo de investigação e inovação, para criar produtos e serviços que valorizem o Salgado.

















Financiado por fundos nacionais através da FCT – Fundação para a Ciência e a Tecnologia, I.P., no âmbito do projeto UIDB/04292/2020 Phytoplankton and Remote Sensing:

MARE Service Pigments Analysis

Scientific Responsible

Vanda Brotas

Technique Responsible Andreia Tracana (HPLC)



Contact

aftracana@ciencias.ulisboa.pt

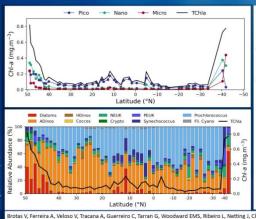


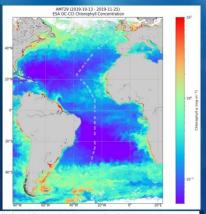
The MARE group **Phytoplankton and Remote Sensing** studies phytoplankton ecology (focusing on photosynthetic pigments, water quality, biodiversity and community structure, phytoplankton size classes and functional types and microscope species identification, and remote sensing of ocean colour.

The analysis of High-Performance Liquid Chromatography (HPLC) of photosynthetic pigments started in 2000, targeting microphytobenthos communities of intertidal mudflats, and estuarine phytoplankton.

Presently, we cover all aquatic ecosystems, namely, open ocean, coastal areas, estuaries and inland waters.



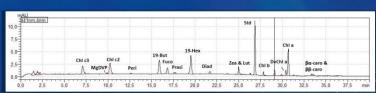




Determined using HPLC Shimadzu Prominence-I® LC 2030C 3D Plus with C8 method developed by Zapata et al. (2000) to ocean water and culture samples and C18 method (Brotas and Plante-Cuny, 1996) to estuaries and inland waters samples.



rotas V, Ferreira A, Veloso V, Tracana A, Guerreiro C, Tarran G, Woodward EMS, Ribeiro L, Netting J, Clewley D and Groom S (2023) Assessing phytoplankton community composition the Atlantic Ocean from in situ and satellite observations. Front. Mar. Sci. 10:1229692. doi: 10.3389/fmars.2023.1229692



Calibrated 28 pigments performed with standards from DHI (Hørsholm, Denmark)

We work with national institutes and with international institutes such as Plymouth Marine Laboratory (PML) and Natural Oceanography Centre in the UK, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI) in Germany, Plataforma Oceánica de Canarias and Instituto Español de Oceanografía in Spain.

We participate in inter-comparison exercises organized by JRC, in order to assess the quality of the data used in support to remote sensing activities; with other international laboratories including accredited and quality-certified laboratories.

https://op.europa.eu/en/publication-detail/-/publication/a94f0657-7c36-11ed-9887-01aa75ed71a1/language-en







We sample from all types of water.

Brotas, V. & M. R. Plante-Cuny, 1996. Identification et quantification des pigments chlorophylliens et caroténoïdes des sédiments marins. Choix d'un protocole d'analyse par HPLC. Oceanologica Acta, 19(6): 623-63 Mendes, C.R., P. Cartaxana and V. Brotas, 2007. HPLC determination of microalgae pigments: comparing resolution and sensitivity of a C18 and a C8 method. Limnology and Oceanography: Methods 5: 363-370.

Zapata, M., Rodriguez, F., Garrido, J.L., 2000. Separation of chlorophylis and carotenoids from marine phytoplankton: a new HPLC method using a reversed phase C8 column and pyridine-containing mobile phases. Mar. Ecol. Prog. Ser. 195, 29-4



















# WWW.ENCONTROMARE.COM

29 e 30 de novembro 2023 Centro de Artes e Espectáculos | Campus UC Figueira da Foz























