

CleanAtlantic

Tackling marine litter in the Atlantic Area

Monitoring and Data Management

Partners: **IFREMER**, IEO, CEDRE, ARDITI, CEFAS, INTECMAR, DRGM, DROTA

Morgan Le Moigne (IFREMER)





Monitoring and Data Management

The **aim** of this Workpackage is to :

- **Reinforce and support harmonized monitoring** of Marine Litter in the framework of the Marine Strategy Framework Directive :
 - **Designing** software/database and applications for managing Marine Litter dataset and their interoperability with International Database (DATRAS/ICES, OSPAR beach/ MCS, EMODnet)
 - **Developping** new tools & new protocols for manitoring
 - **Bringing insight into the environmental impacts of** cigarette butts & cotton buds and Marine Litter as Non Indigenous Species vector

Results expected :

- ✓ **DB** interfaces and **apps**
- ✓ **Improvement** of monitoring MSFD indicators & monitoring strategy for ingestion & entanglement
- ✓ **Study** of harm caused by cotton buds & cigarette butts
- ✓ **Study** on marine litter as Non Indigenous species vector

Design software & Database

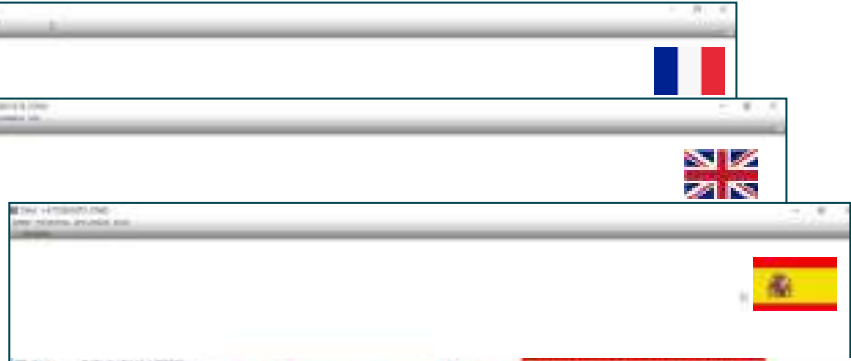
Design software & Database



Design software & Database



Design software & Database



Mandatory information

Sort by column: Move/Rotate

Select the visible columns

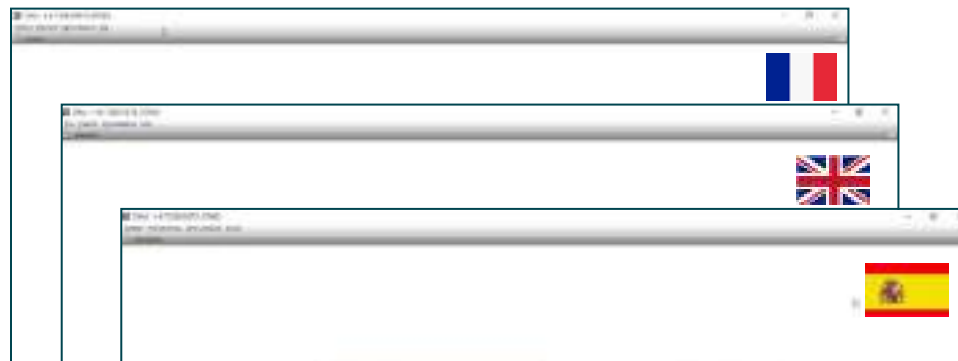
Authenticated person

Alarm

Connection to server



Design software & Database



Mandatory information **Sort by column: Move/Rotate** **Select the visible columns**

Program	Station	Date	Members	Comment	Status
DECHETS_POLLUTION_ECHOE...	882-0-004 - MPO South Bay of Biscay sub-region - France	22/06/2019	Arachon		Being entered
DECHETS_POLLUTION_ECHOE...	882-0-005 - MPO South Bay of Biscay sub-region - France	21/11/2019	Arachon		Being entered
DECHETS_POLLUTION_ECHOE...	882-0-004 - MPO South Bay of Biscay sub-region - France	24/02/2019	Arachon legs		Being entered
DECHETS_POLLUTION_ECHOE...	882-0-004 - MPO South Bay of Biscay sub-region - France	21/06/2019	Arachon		Being entered
DECHETS_POLLUTION_ECHOE...	882-0-004 - MPO South Bay of Biscay sub-region - France	21/06/2019	Bassin d'Arachon	Synchronized with the central	Validated
DECHETS_POLLUTION_ECHOE...	125-0-000 - MPO Western Mediterranean sub-region - France	02/03/2019	Baselac	Synchronized with the central	Validated
DECHETS_POLLUTION_ECHOE...	123-0-000 - MPO Western Mediterranean sub-region - France	30/05/2019	Clague Sanele	Synchronized with the central	Validated
DECHETS_POLLUTION_ECHOE...	123-0-000 - MPO Western Mediterranean sub-region - France	04/01/2019	Clague du Rie	Synchronized with the central	Validated
DECHETS_POLLUTION_ECHOE...	129-0-250 - Rhexion_sudcote_du_jacouthe_20 km	06/07/2019	ID_Archieve	Synchronized with the central	Validated
DECHETS_POLLUTION_ECHOE...	123-0-000 - MPO Western Mediterranean sub-region - France	14/09/2019	Yves Pichon 6	Synchronized with the central	Validated
DECHETS_POLLUTION_ECHOE...	123-0-000 - MPO Western Mediterranean sub-region - France	22/06/2019	Perf Data Lovers	Synchronized with the central	Validated

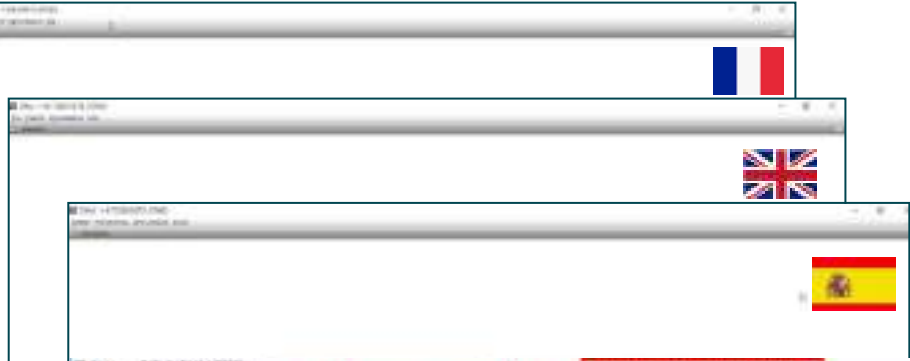
Map view of surveys and sampling operations

Bay of Biscay sub-region - France

Arachon (FR)



Design software & Database



Mandatory information

Sort by column : Move/Resize

Select the visible columns

This screenshot shows the left-hand side of the software interface. It includes a sidebar with filters for 'Program', 'Date', and 'Status'. Below the filters is a search bar and a 'Map view of survey and sampling operations' section. A small 'Enter' button is visible at the bottom left.

This screenshot shows a central window displaying a list of sampling operations. The list has columns for 'Program', 'Date', and 'Status'. A 'Map view of survey and sampling operations' section is visible below the list. A small 'Enter' button is visible at the bottom left.

Sampling operation list

Order changing

Data collected on the different samples

This screenshot shows a detailed view of a sampling operation. It includes a table with columns for 'Date', 'Time', 'Location', and 'Status'. A 'Map view of survey and sampling operations' section is visible below the table. A small 'Enter' button is visible at the bottom left.

Design software & Database

This screenshot shows a software interface with three overlapping windows. The top window has a French flag, the middle one a UK flag, and the bottom one a Spanish flag. The main window displays a data table with columns for 'Program' and 'Date'. A red box labeled 'Mandatory information' points to the 'Program' column, and another red box labeled 'Sort by column : Move/Resize' points to the table header. The interface includes various filters and search options on the left and right sides.

Five book covers for 'CleanAtlantic' are displayed in a row. Each cover features the title 'CleanAtlantic Tackling Marine Litter in the Atlantic Area' and a subtitle. The covers are numbered 1 through 5, representing different publications or reports. The background of the covers shows a blue ocean with white waves.

This screenshot shows a data entry interface with a table of sampling operations. A red box labeled 'Sampling operation list' points to a list of entries. Another red box labeled 'Order changing' points to a dropdown menu. A third red box labeled 'Data collected on the different samples' points to a table of data. The interface includes various filters and search options on the left and right sides.

Develop APPs

Develop APPs - Seafloor Litter

Welcome to the Cefas Seafloor Marine Litter App



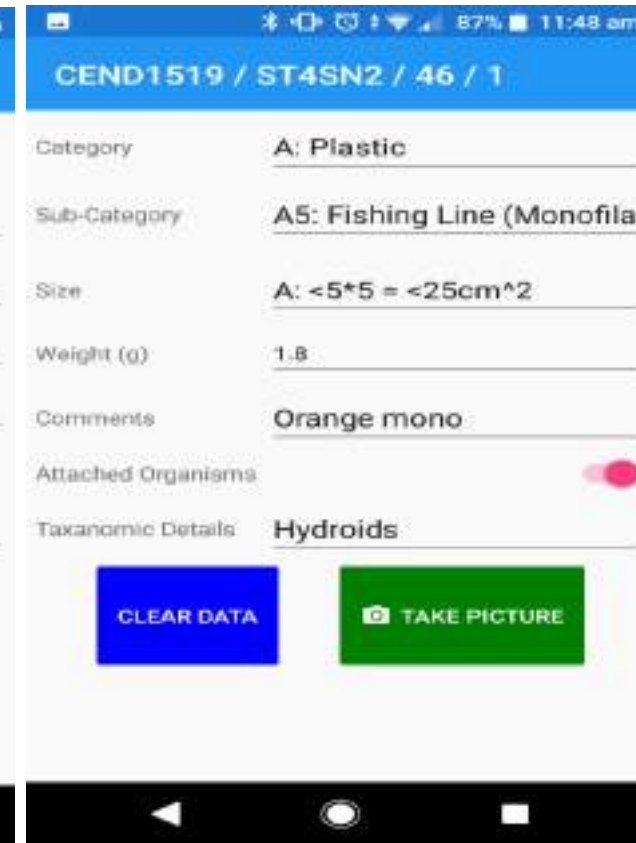
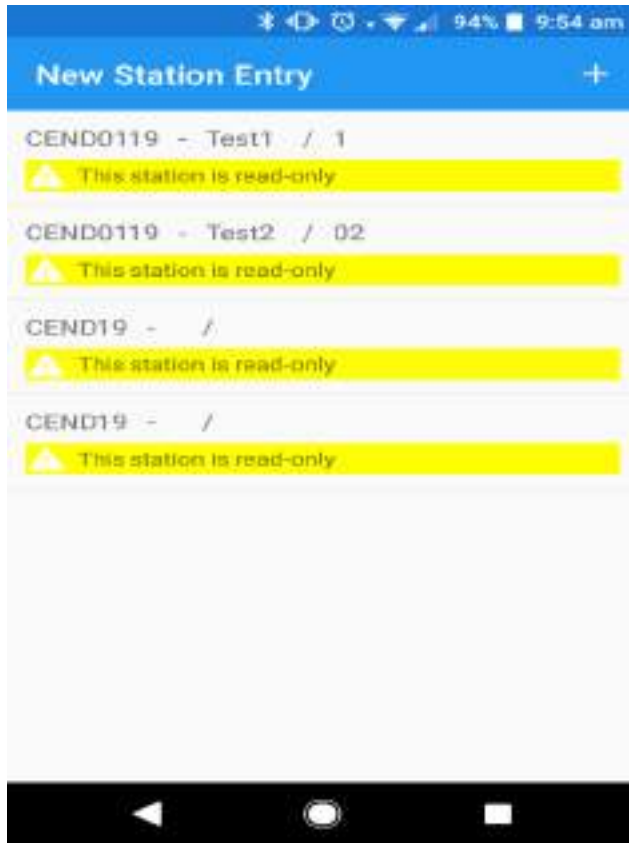
New Station
Entry

Review
Stations

- Improved data entry
 - Electronic
 - Instant transfer to database,
 - Reduced paper logs
 - Standardised entry and outputs.
- Android
- Development ongoing
- Tested onboard RV Cefas Endeavour during recent fisheries survey (March 2019).

Develop APPs - Seafloor Litter

First look:



Develop APPs – Hotspots coastline

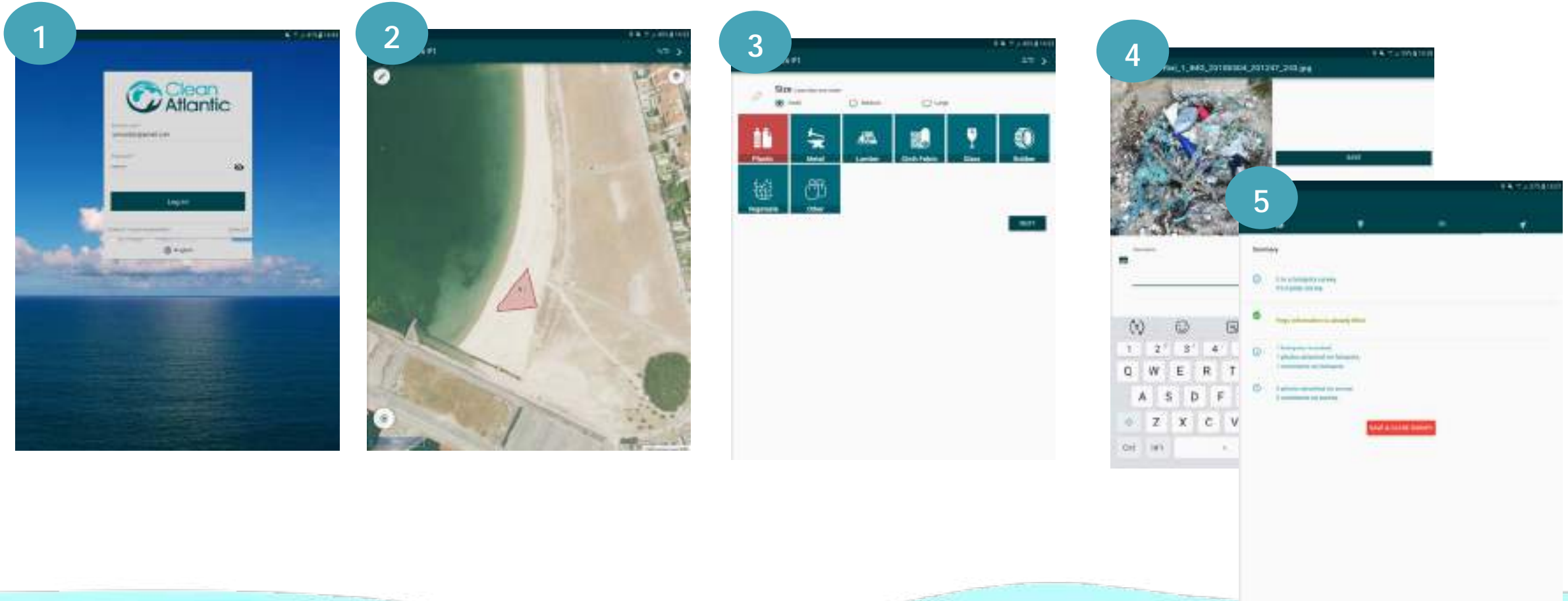
APP Mobile: The app allows the survey of hotspots along the coastline

- To be used by restricted users (password)
- Flexible in its scale of surveys (Segments of the shoreline predefined)
- Geolocated information
- Collected data stored in a postGIS DB
- Possibility of adding photos and comments
- Compatible with Android 5.x devices or higher



Develop APPs – Hotspots coastline

Digitization of the methodology (Tablets, Smartphone)



Develop APPs – Floating Litter

Boat Users



Detect Litter



Take Picture



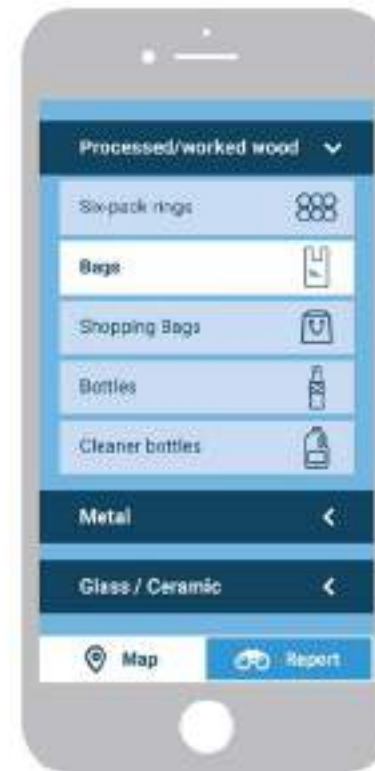
Harvest Data



LEVEL 1



LEVEL 2



LEVEL 3



REPORTING

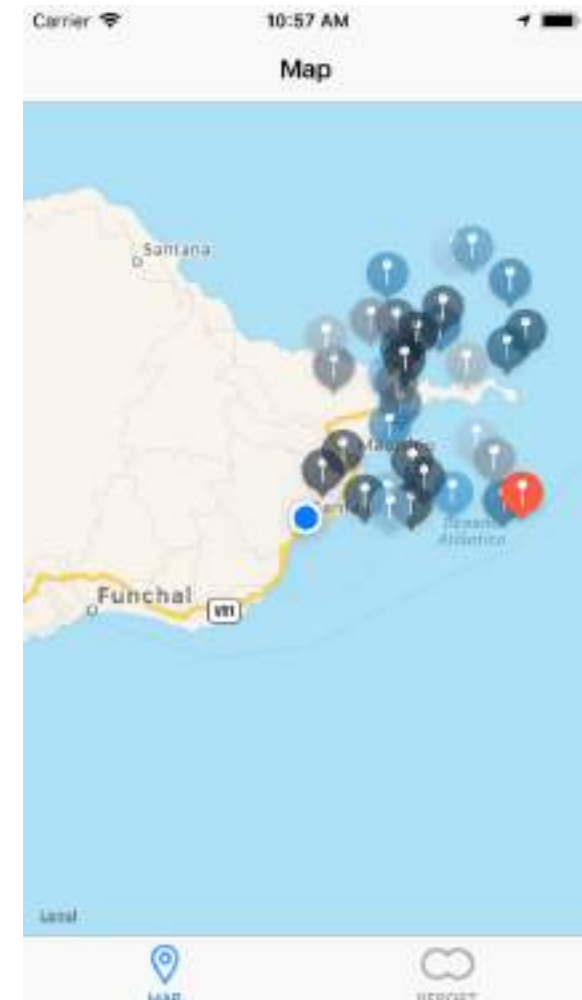
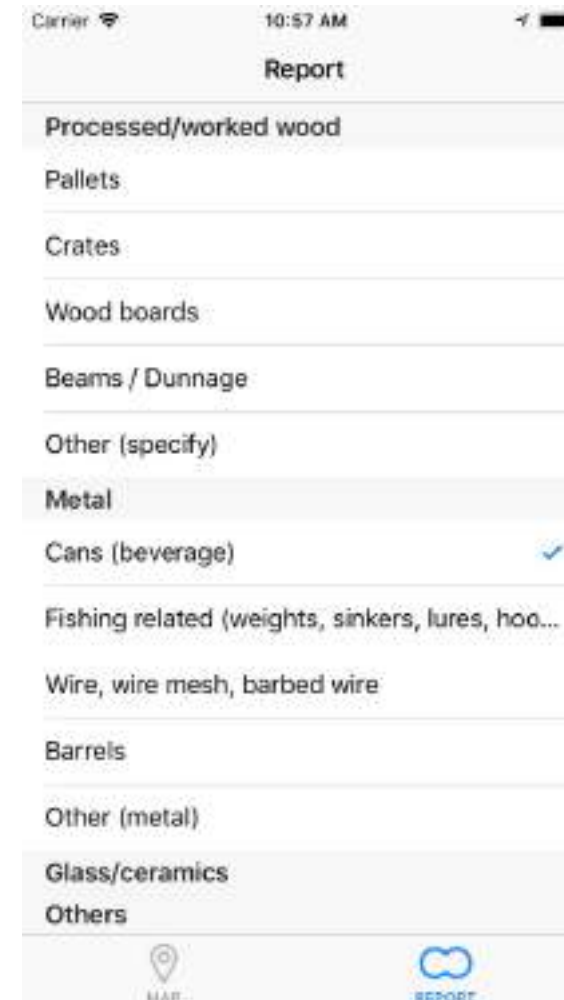
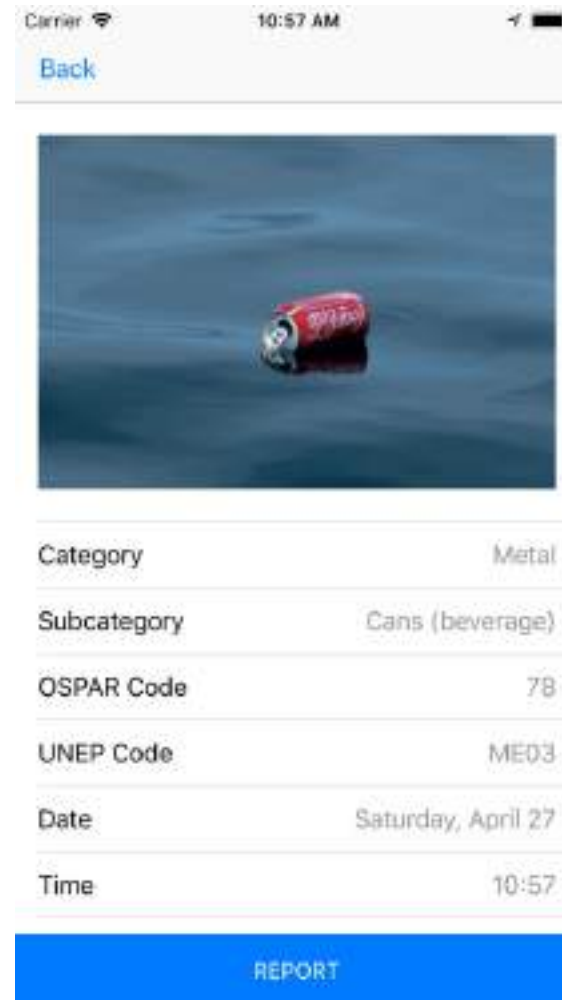


Develop APPs – Floating Litter

APP Development

APP has been further developed with classification and report ready to use; (iPhone 6 Simulator)

Still requires imagery to have geotags



Test new tools

New tools – Satellites

1. Mytiline (Greece) 20180607



VS



Bottom picture adapted from: <https://mmsg.aegean.gr/?content=&nav=55>

2. Eden project (UK) -ethylene tetrafluoroethylene



3. Thilafushi landfill (Maldives)

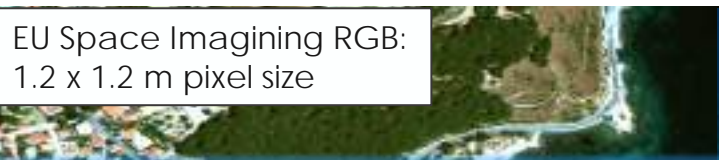


1. Mytiline (Greece) 20180607

Sentinel 2 RGB:
10 x 10 m pixel size



EU Space Imaging RGB:
1.2 x 1.2 m pixel size

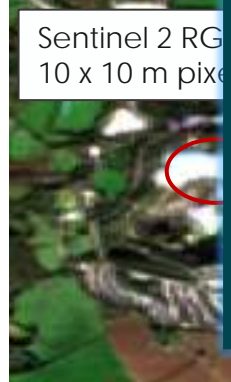


Conclusions :

- Both Eden and Mytilene case studies show specific patterns of spectral signature graphs, peaking at 842 nm (B8) with a sharp drop in 945 nm (B9) and the lowest reflectance at 2190 nm (B12).
- Thilafushi landfill did not show the same pattern due to mixed composition of litter. Further ground truthing needed

2. Eden pro

Sentinel 2 RGB:
10 x 10 m pixel size



3. Thilafushi landfill (Maldives)

Sentinel 2 RGB:
10 x 10 m pixel size



Model: MAVIC PRO 2



Coastal areas

New tools – Drones

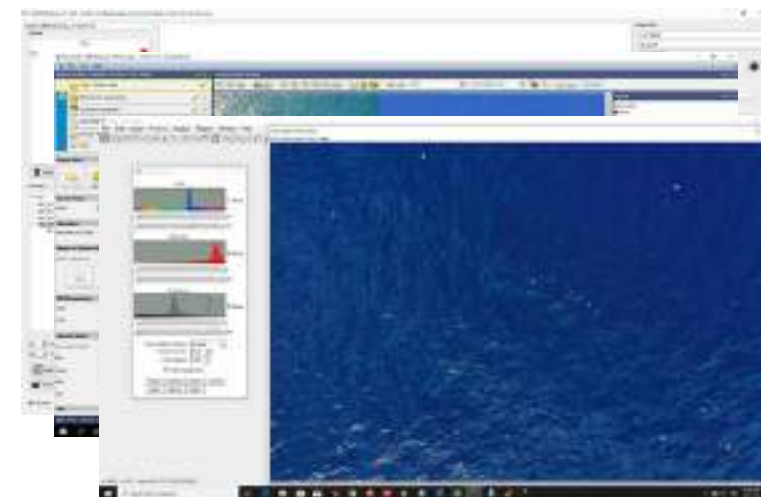


Pilot Area 2: Illas Atlánticas National Park



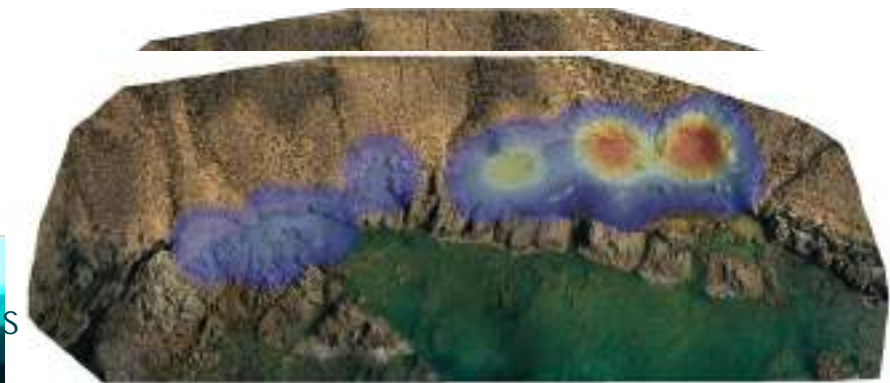
Floating Litter : Aerial surveys + softwares treatments :

- Count detected objects
- Automated Segmentation and classification based on shape and color profile
- Object detection through color threshold custom workflow

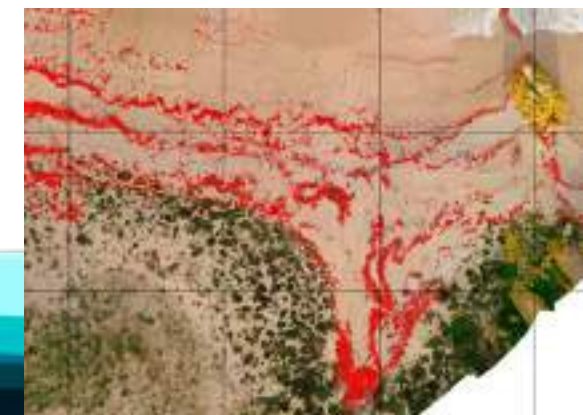


Beach/coastline : Aerial Surveys:

- Lack of accessibility
- Small beach with ML
- Analysis based on ranking provides a heat-map to identify accumulation areas



Analysis of the RGB that corresponds to the most usual hotspot found in Sálvora Island



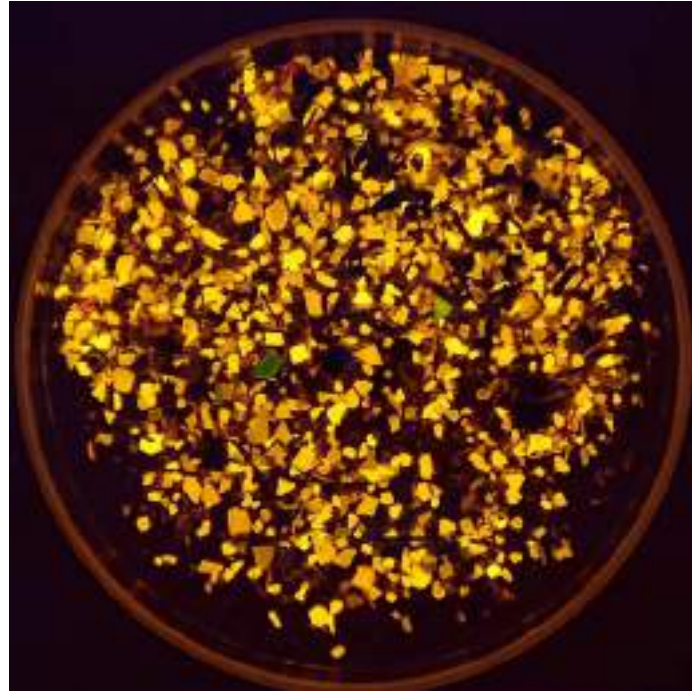
Development of new analytical methods

New analytical method - micro & mesoplastics

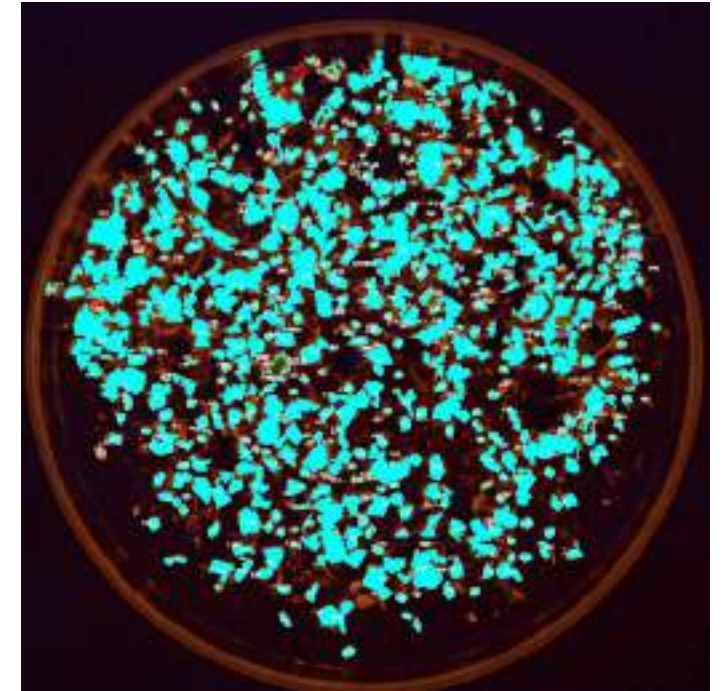
➤ Manual vs Imagery analysis



RGB Image



RED Band



Detection

Development of new protocols

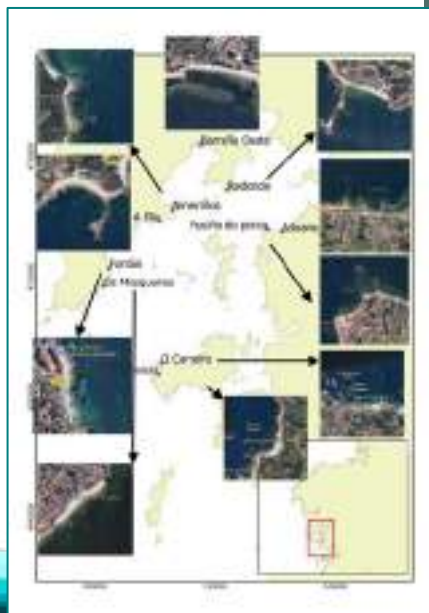
New protocols – Mapping hotspots coastline

Citizen science: High School “IES da Illa de Arousa”

- Specific monitoring survey form 39 beaches weekly
- Marine litter distribution along the coastline
- Hotspot characterization (size, composition)
- Count of mussel pegs (used as tracers)

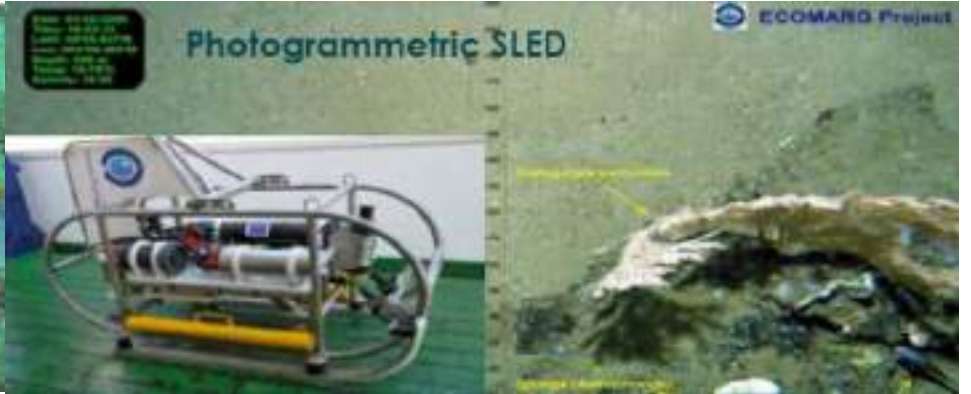
New surveys: Professional surveyors

- 10 beaches of Ría de Arousa, weekly
- Chosen to validate models (WP6)
- Same survey forms as students
- Apps and paper forms
- Training course for fill up it.



New protocols – Divers & ROV-Seabed Litter

- Scientific Divers
- Submarine, ROV, Photogrammetric SLED



Examples : **Entanglement impact** on benthic invertebrate fauna



Example : **Strangling impact** on benthic invertebrate fauna



New protocols – Divers & ROV-Seabed Litter

- Scientific Divers
- Submarine, ROV, Photogrammetric SLE



Protocol to be tested

CleanAtlantic

Tackling Marine Litter in the Atlantic Area

DELIVERABLE 2 – Towards a protocol for the observation of marine organisms entangled/strangled/covered by marine litter during ROV/campaigns

WP 5.3: Indicators for ingestion and entanglement/strangling
D10C4 – MSFD

Authors : O. Génigny ; F. Duto ; N. Le Moigne ; F. Galzeri



Examples : Entanglement on benthic invertebrate f



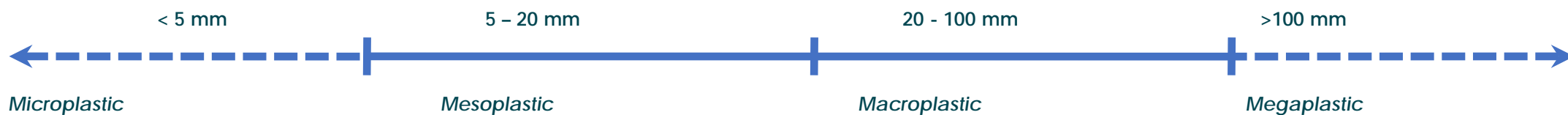
Example : Strangl benthic invertebr



Improvement of new analytical methods

Improvement monitoring MSFD protocols – Manta trawls

- Characterization of surface and subsurface meso-litter (0.5 – 2cm) by Manta trawl during fisheries surveys



Copyright : O. Gerigny / Ifremer

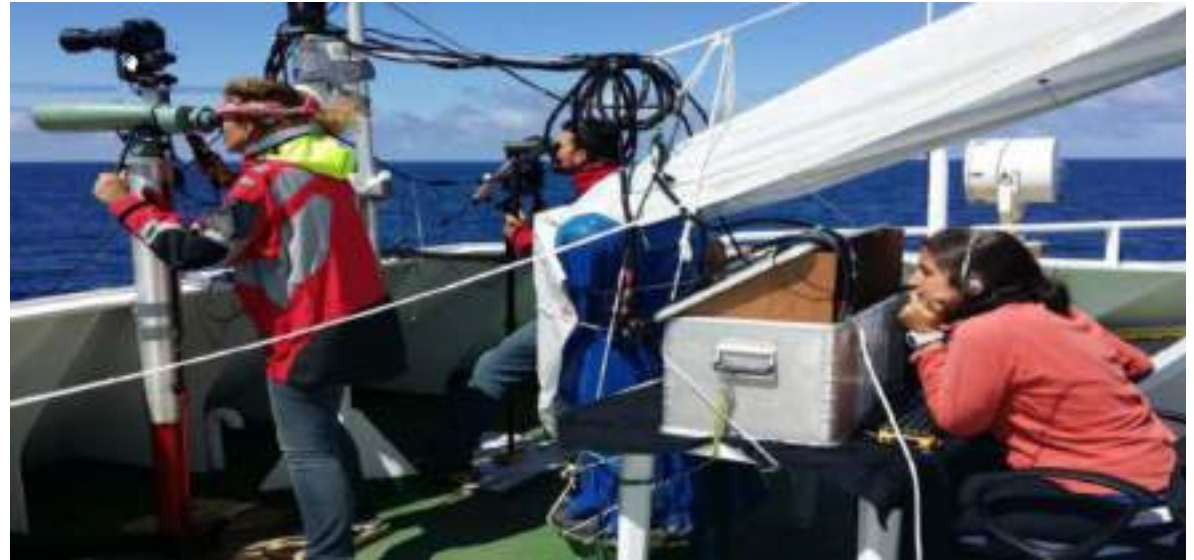


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Improvement monitoring MSFD protocols – Floating litter

- Top predator floating litter protocol implemented during fisheries surveys to be adapted to facilitate comparison with other sampling methods



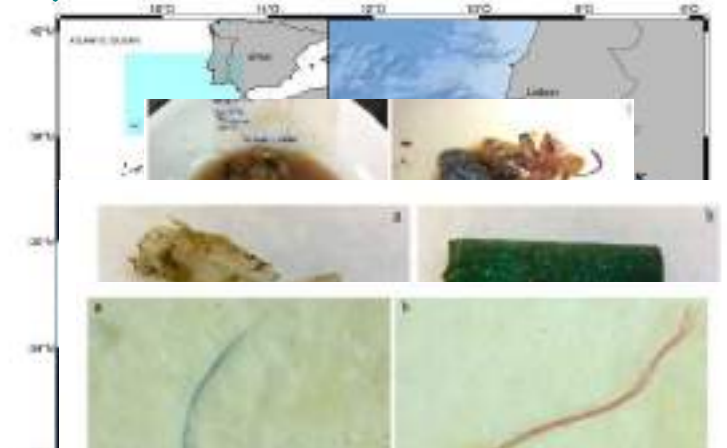
Knowledge improvement on ML impact on fauna D10C3

Impact on fauna - plastics ingested by fish

J. Gago, S. Portela, A.V. Filgueiras et al. / *Regional Studies in Marine Science* 33 (2020) 100977

Ingestion of plastic marine debris (macro and micro plastics) by a piscivorous predator, *Alepisaurus ferox* Lowe (1833).

- ✓ 27 specimens were captured in 2015 and 2016 in the North Atlantic
- ✓ stomachs dissected and inspected for plastic elements.
- **Macroplastic particles** : in 37% of fish, average weight of 0.46 ± 1.14 g - **film** most abundant category (60%). The main polymers (PP) & (PE).
- **Microplastics** : in 74% of the stomachs, item values per individual ranging from 0 to 16, average value of 4.7 ± 4.8 items per stomach. Only **microfibers** & **fragments** were observed, with microfibers (~85 %) = dominant type.



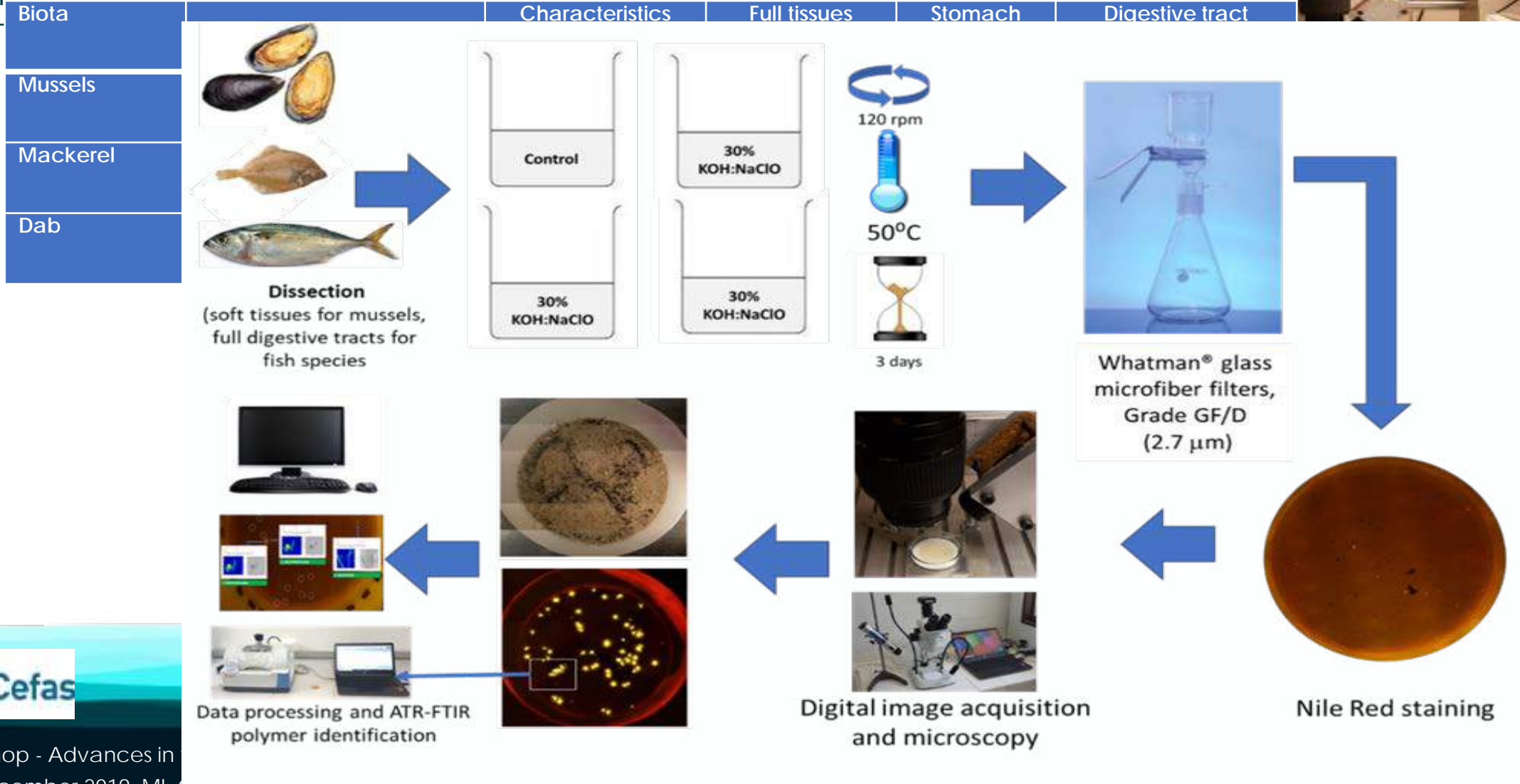
Impact on fauna - plastics ingested by molluscs & fishes

Dabs, mackerels, mussels – contamination surveys SW UK - Fisheries stomachs frozen

Method development for analysis

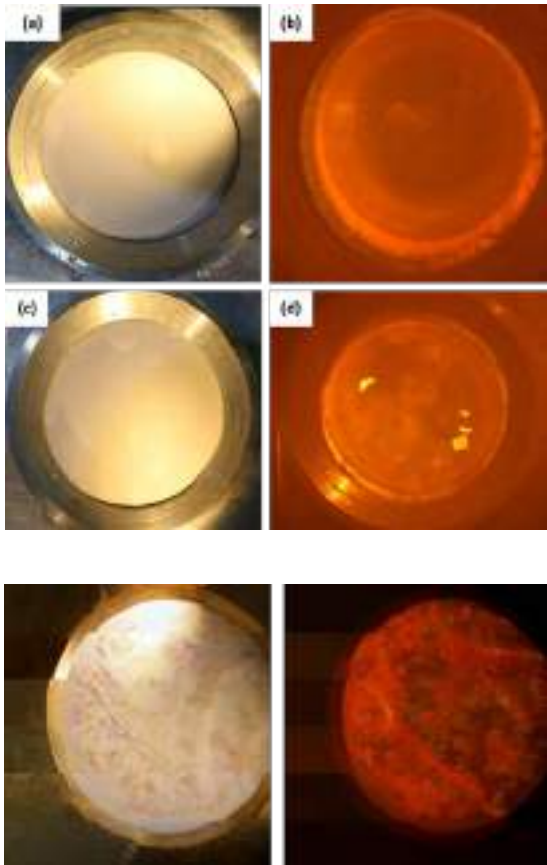
- digestion with chemicals and enzymes

- FTIR



Impact on fauna - plastics ingested by molluscs & fishes

Testing methods



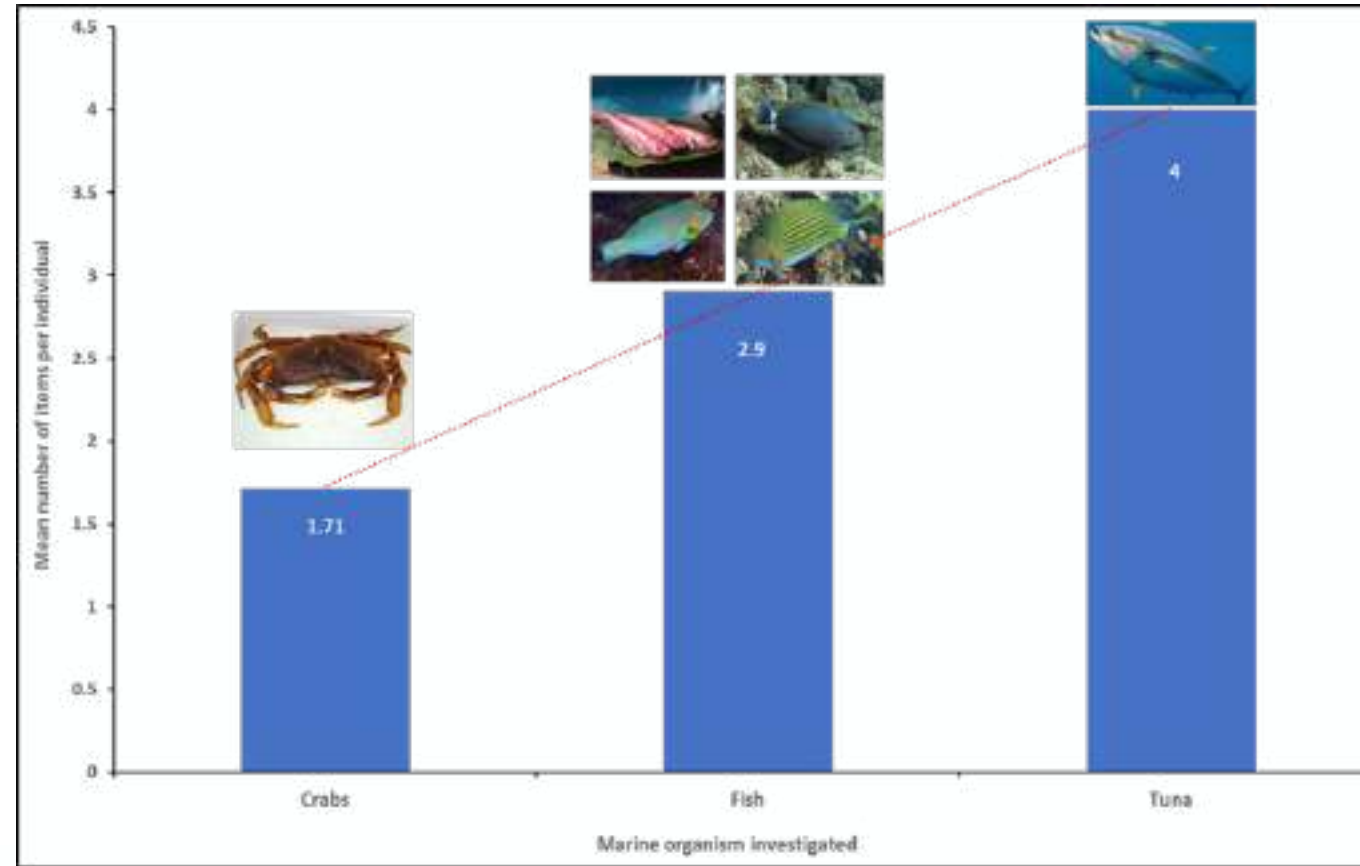
Method development South Pacific

Crustaceans
Reef & | Pelagic fish

35% of fish

57% of crabs

*Larger samples



Digital images of the filters following extraction of individual soft tissues of the stomach of a mackerel (*Scomber scombrus*) and staining using Nile Red. Imaging was conducted under blue light (420-470 nm).

Knowledge improvement on harm caused by cigarette butts & cotton buds

Study on butts and cotton buds

- Development of a methodology to obtain artificial cigarette butts
- Selection of different brands with different tar/nicotine contents
- Tests will also be done on real butts



©Cedre
F



©Cedre



©Cedre



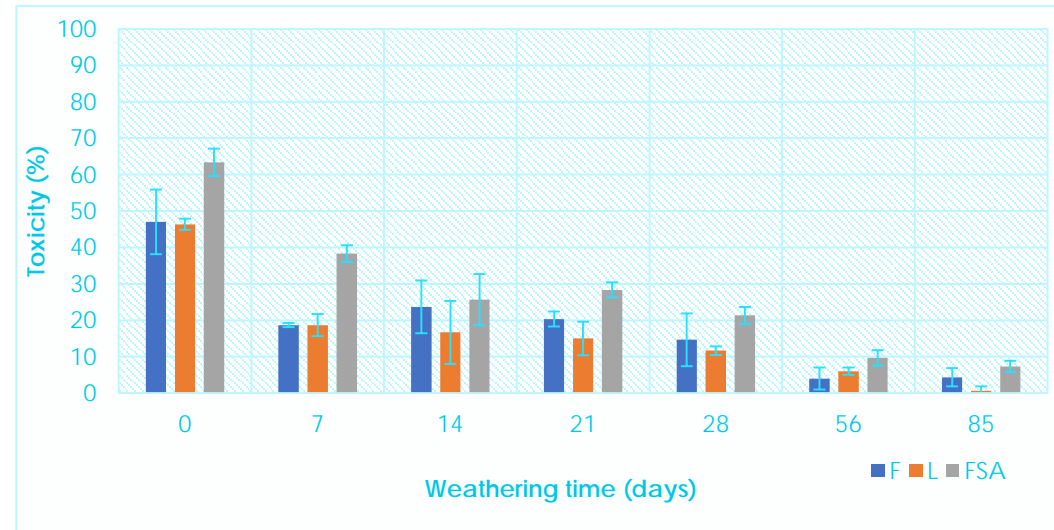
©Cedre

Study on butts and cotton buds

➤ physical behaviour and degradation processes of butts *on-going*

Degradation study on a beach

- February 2019: Launch of a one-year degradation study in Cedre artificial beach
- Sampling every 3 months to measure mass loss, contamination and toxicity of weathered butts
- Continuous recording of weather conditions

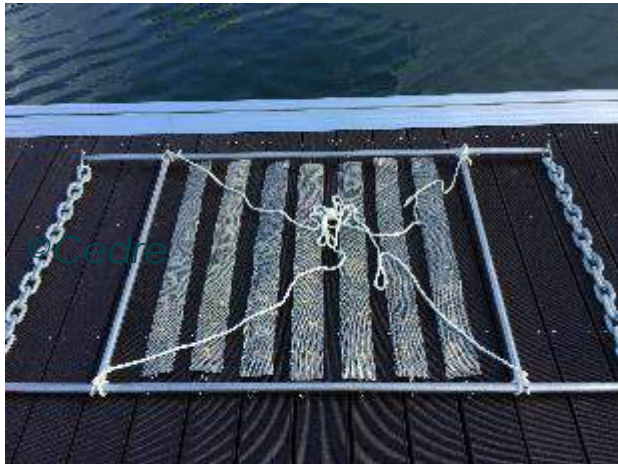


Study on butts and cotton buds

- physical behaviour and degradation processes of butts *on-going*

Degradation study underwater

- March 2019: Launch of a one-year degradation study in Brest Marina



Study on butts and cotton buds

➤ Selection of molecules to analyse:

- Based on the literature review and preliminary butts analyses
- Based on molecules properties (toxicity and/or solubility)
- Analytical methods are being developed for butts, seawater and biota matrices

Nicotine and derivatives	Phenol and derivatives	Other
(±)-Nicotine	Phenol	Indole
(-)-Cotinine	m-Cresol	Furfural
4-(Methylnitrosoamino)-1-(3-pyridinyl)-1-butanone	o-cresol	Triacetin
N-Nitrosoanabasine	p-cresol	PAHs
N-Nitrosoanatabine	4-Ethylphenol	Metals
N'-Nitrosonornicotine	2-Ethylphenol	
	Hydroquinone	
	1,2-Dihydroxybenzene	
	Resorcinol	

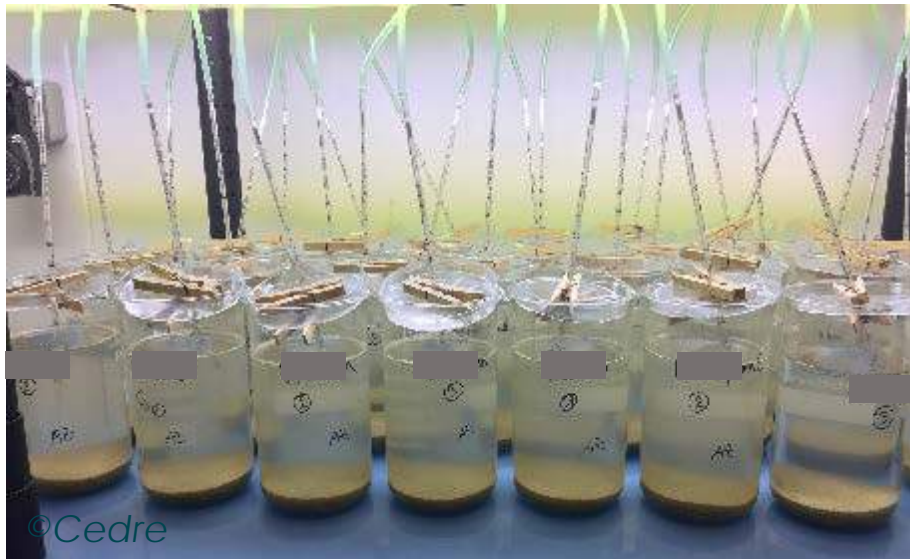


Study on butts and cotton buds

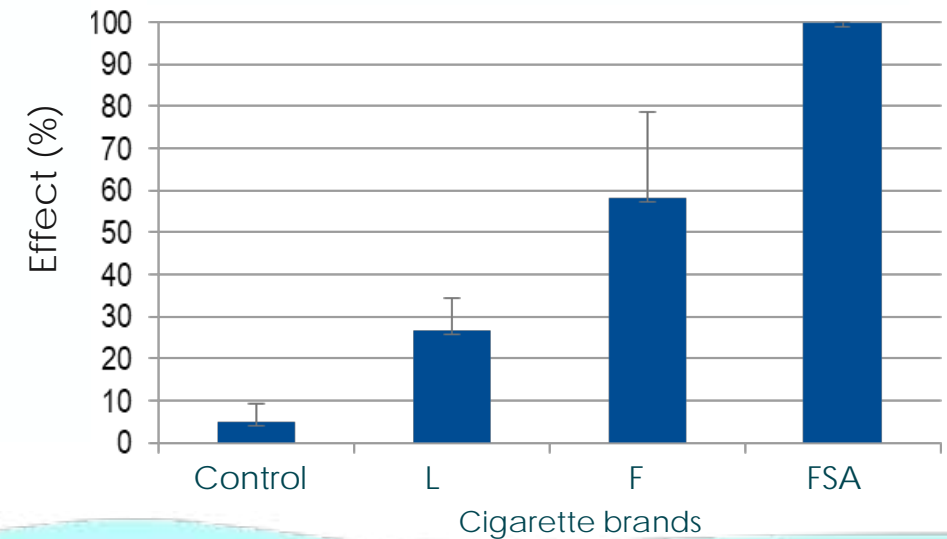
➤ Study of ecotoxicological effects of butts on marine organisms *on-going*

Ecotoxicity assessment on marine organisms (bacteria, invertebrate and fish)

- Acute effects (mortality)
- Physiological effects
- Developmental effects



Concentration of 1.2 butts/kg dw



Cigarette Butts

Exp 1: Arenicola (lug worm)

- Experiment start 4th December
- Smoked vs weathered
- 10 day exposure
 - Behaviour
 - Weights
- Sediment & water
- Chemistry
 - Metals
 - Procurement for wider screen



Cigarette Butts Exp 2: Oyster Embryo

Details to be confirmed

Knowledge improvement on marine litter as Non Indigenous Species vector

Study - marine litter as transport facilitator for nuisance biota

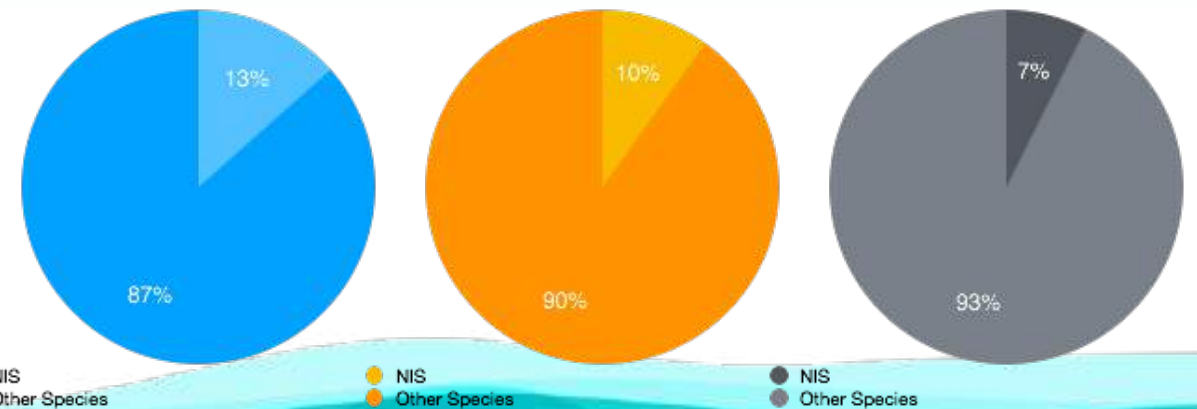
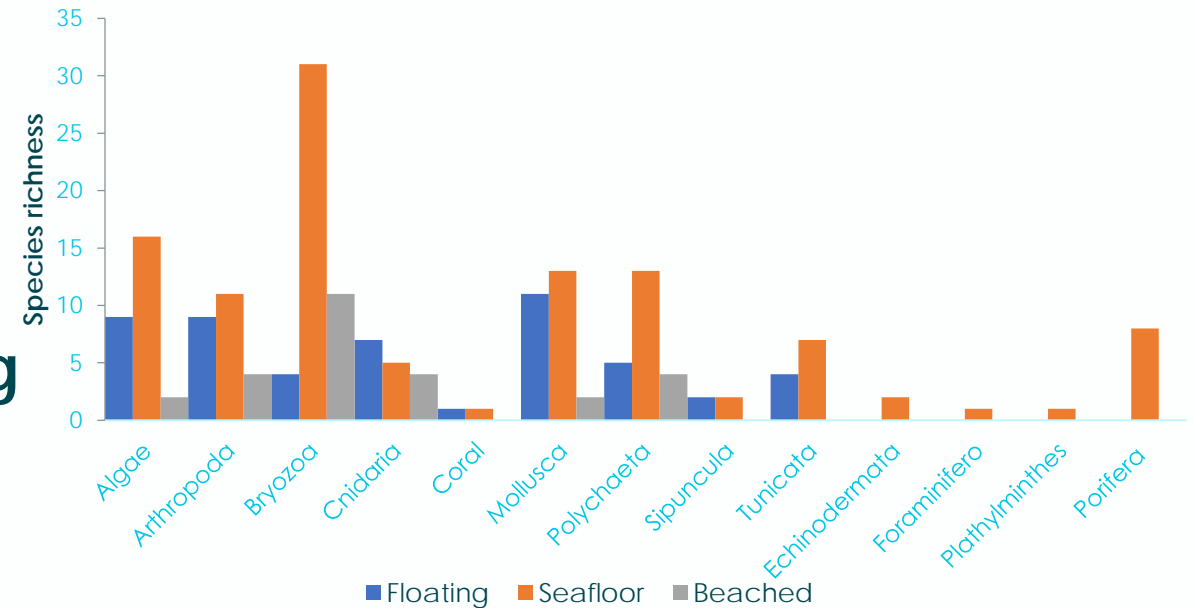
i. Compiling existing data from opportunistic sampling

- Analysis of association of biota in different ML
- NIS identification & Nuisance ranking
- Spatial analysis

ii. Design protocol proposal

iii. Promote further stakeholder engagement

Taxa associated with ML



Hitch-hikers on marine debris: understanding new arrivals in an offshore island
 João Canning-Clode¹, Ignacio Gestoso¹, Patrício Ramalhosa¹, João Monteiro¹, Maria João Lima², Rui Caldeira²

Thank you for your attention !

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