

# CLEANATLANTIC CONFERENCE

*Vigo, 21st June*

09.00 – 16.30 h  
(UTC+2h00, Madrid, Bruselas)

## Advances on the knowledge of Marine litter as NIS Vector Results phase 1

Joao Monteiro, Paola Paretto (ARDITI, MARE)

**Peter Barry** (Cefas)

**Morgan Le Moigne** (Ifremer)



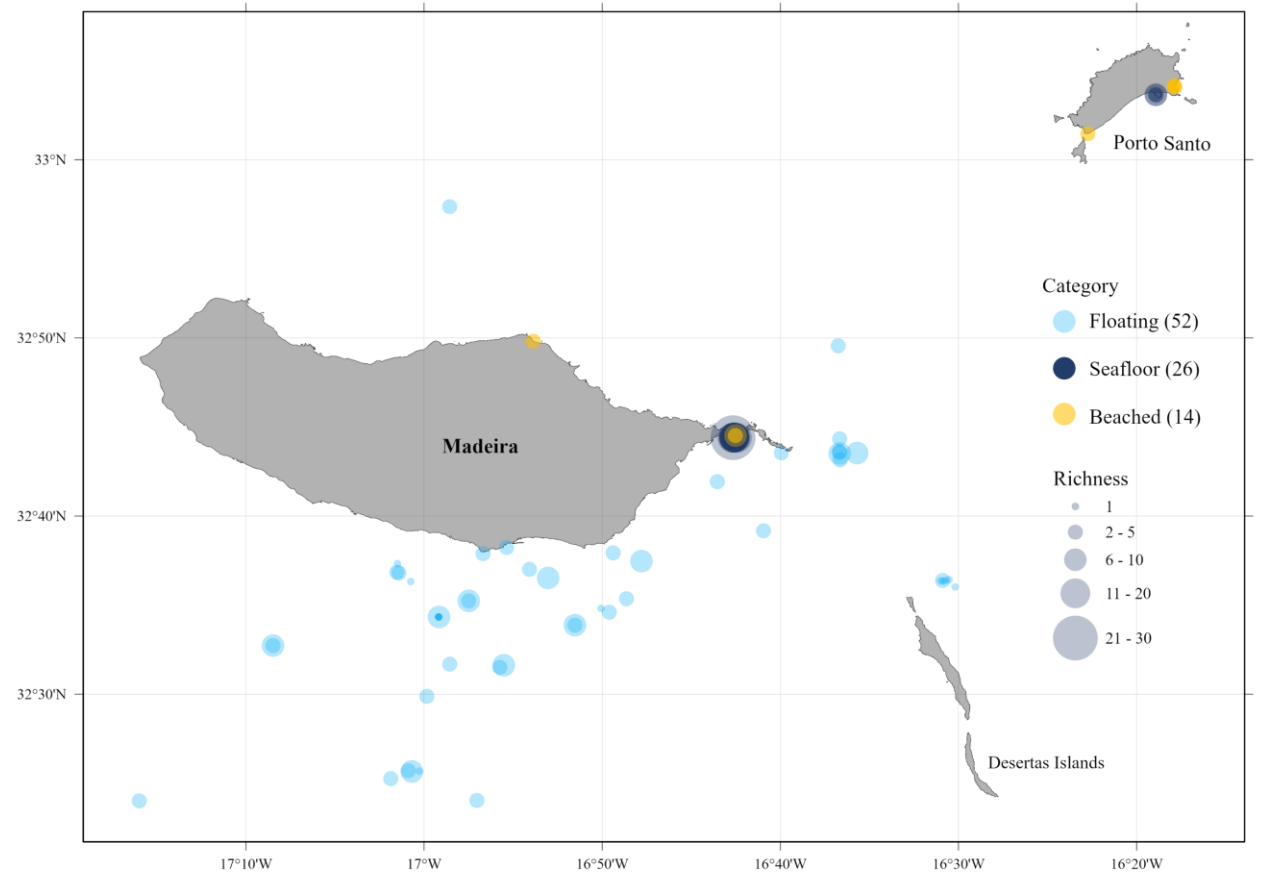
# Marine litter transport of NIS and pests

## Reports/scientific papers:

1. Evaluation of marine litter as transport facilitator for nuisance biota

## Opportunistic sampling ongoing :

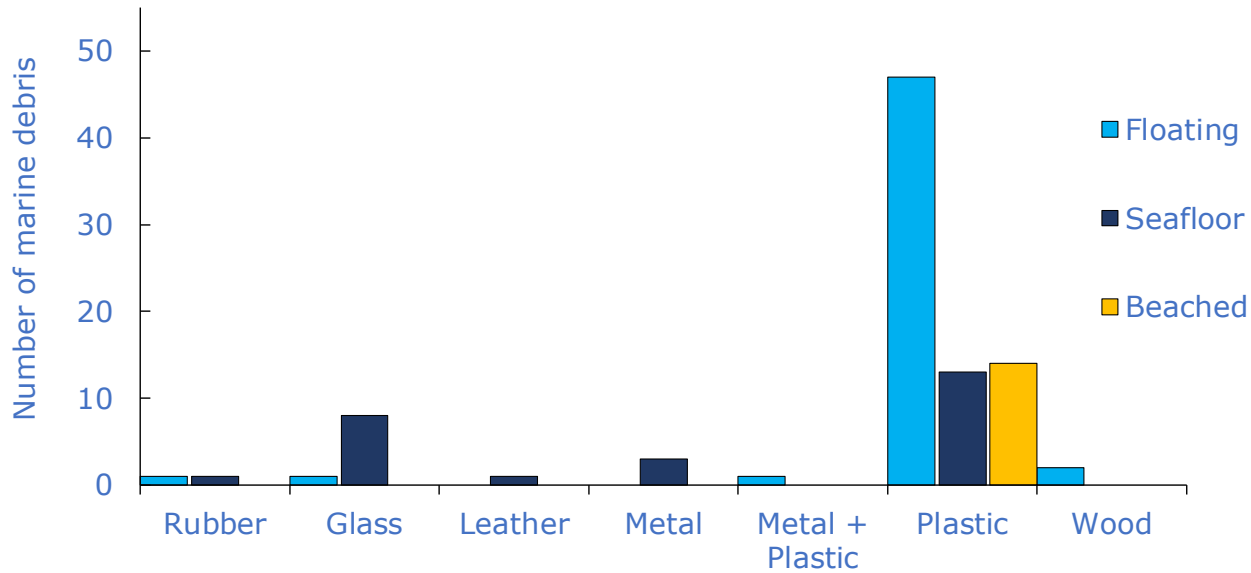
- Stakeholder engagement
- Item retrieval with GPS logging and pictures
- Item recovery and inspection
- Taxa identification



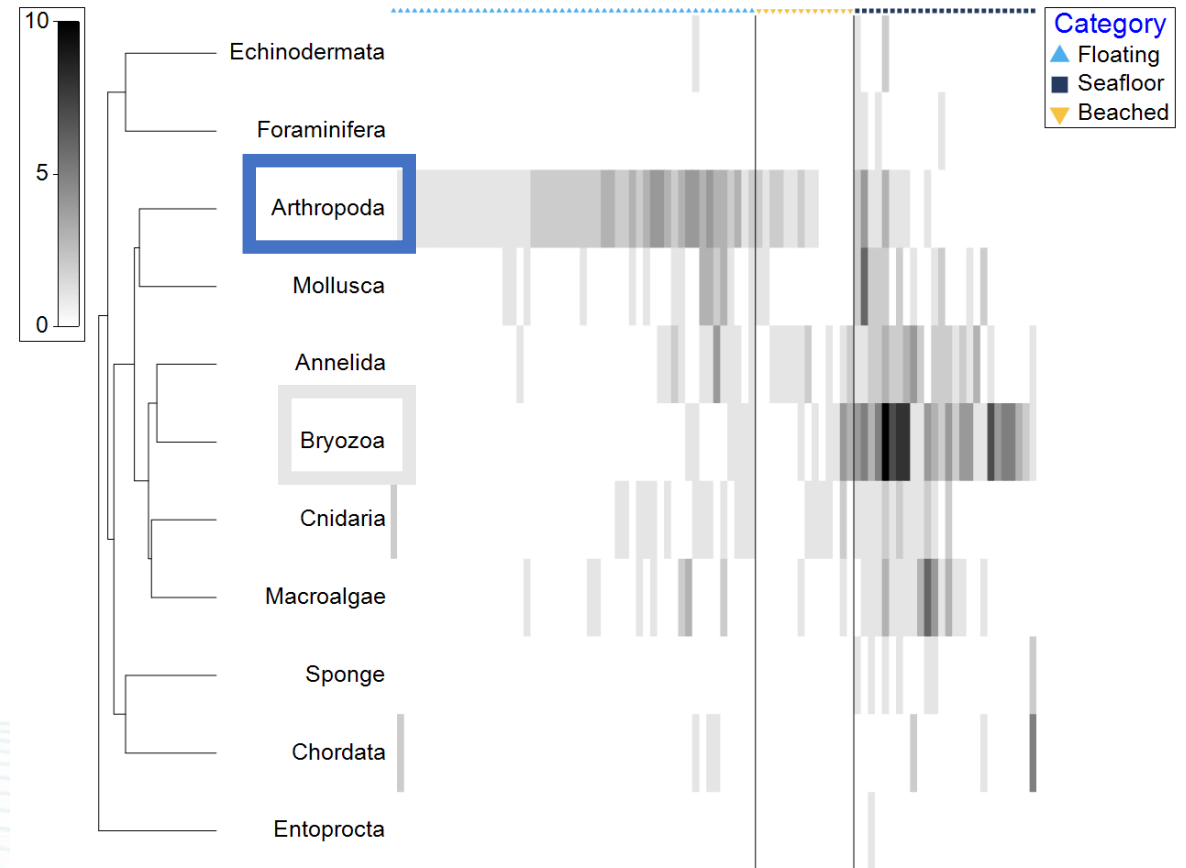
# Marine litter transport of NIS and pests



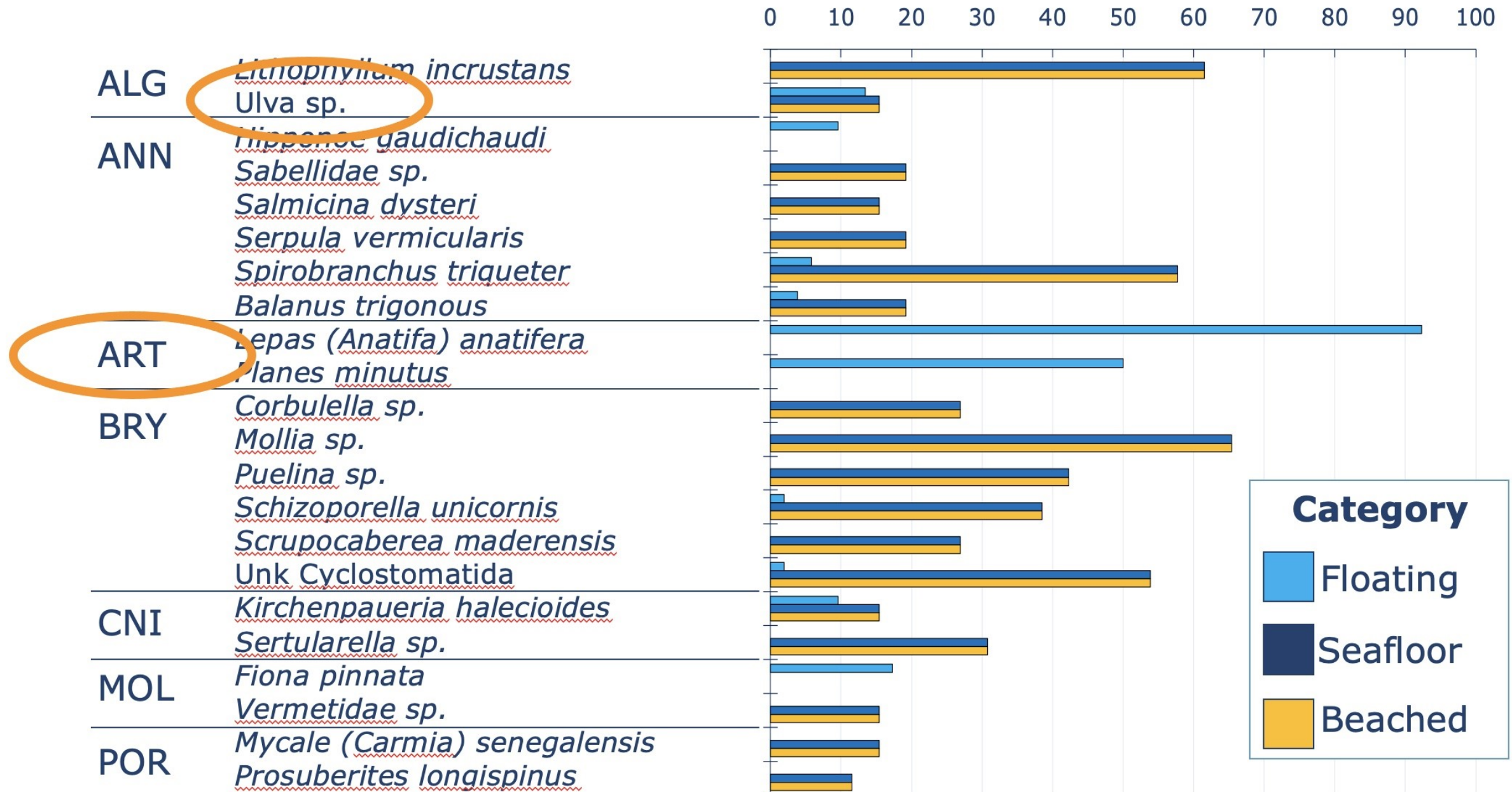
What we found:



108 Species





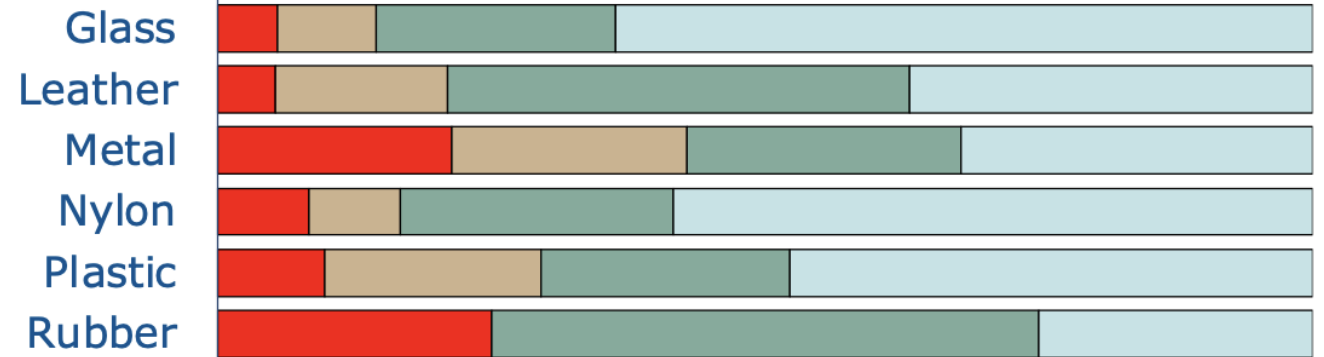


# Status

## Floating



## Seafloor



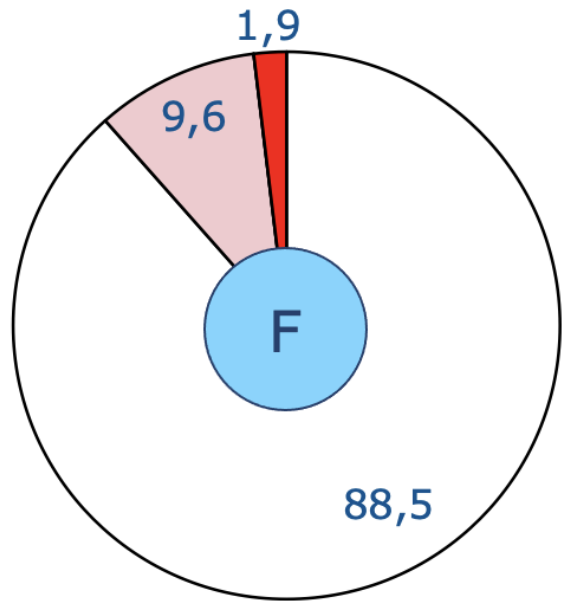
## Beach



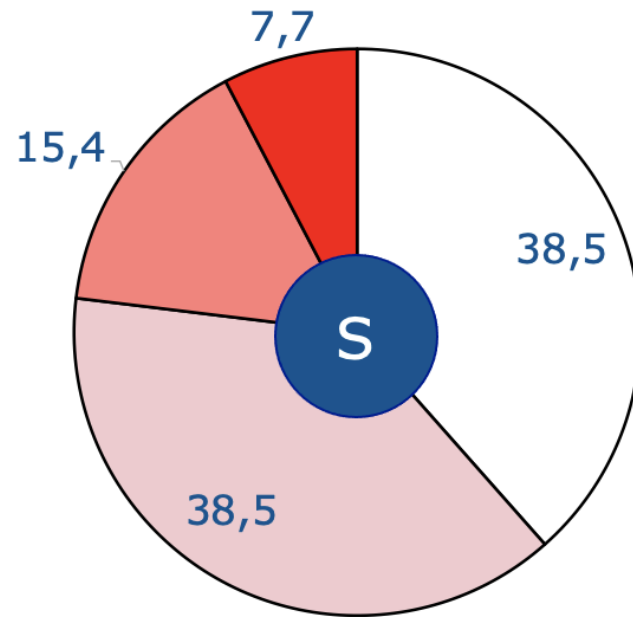
0 20 40 60 80 100



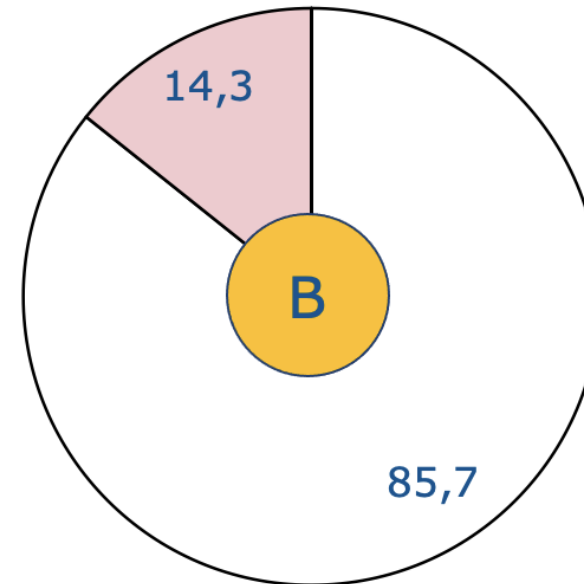
# Non-indigenous species



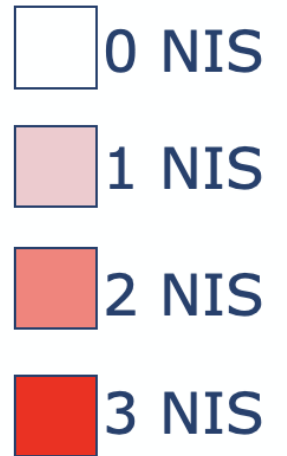
Floating



Seafloor



Beached



Advances on the knowledge of Marine litter  
as NIS Vector

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CONFERENCE

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**Could seafloor litter be facilitating  
the spread of non-indigenous  
species?**

Studies in UK & French waters

**Peter Barry** (Cefas)

**Morgan Le Moigne** (Ifremer)

Amelia Curd, Gabin Droual, Enora Prado, Lena Thomas, Maria El Rakwe (Ifremer)



# Aims of CleanAtlantic

*“to protect biodiversity and ecosystem services in the Atlantic Area by improving capabilities to monitor, prevent and remove (macro) litter”*

- Protect biodiversity – **theory** is that NIS are using litter to drift, settle or spawn from, i.e., the stepping-stone theory
- Improve capabilities to monitor – **could** be cost-effective way to combine monitoring
- Prevent and remove – **if NIS are settling**, and using litter as a spawning platform, we can interrupt this

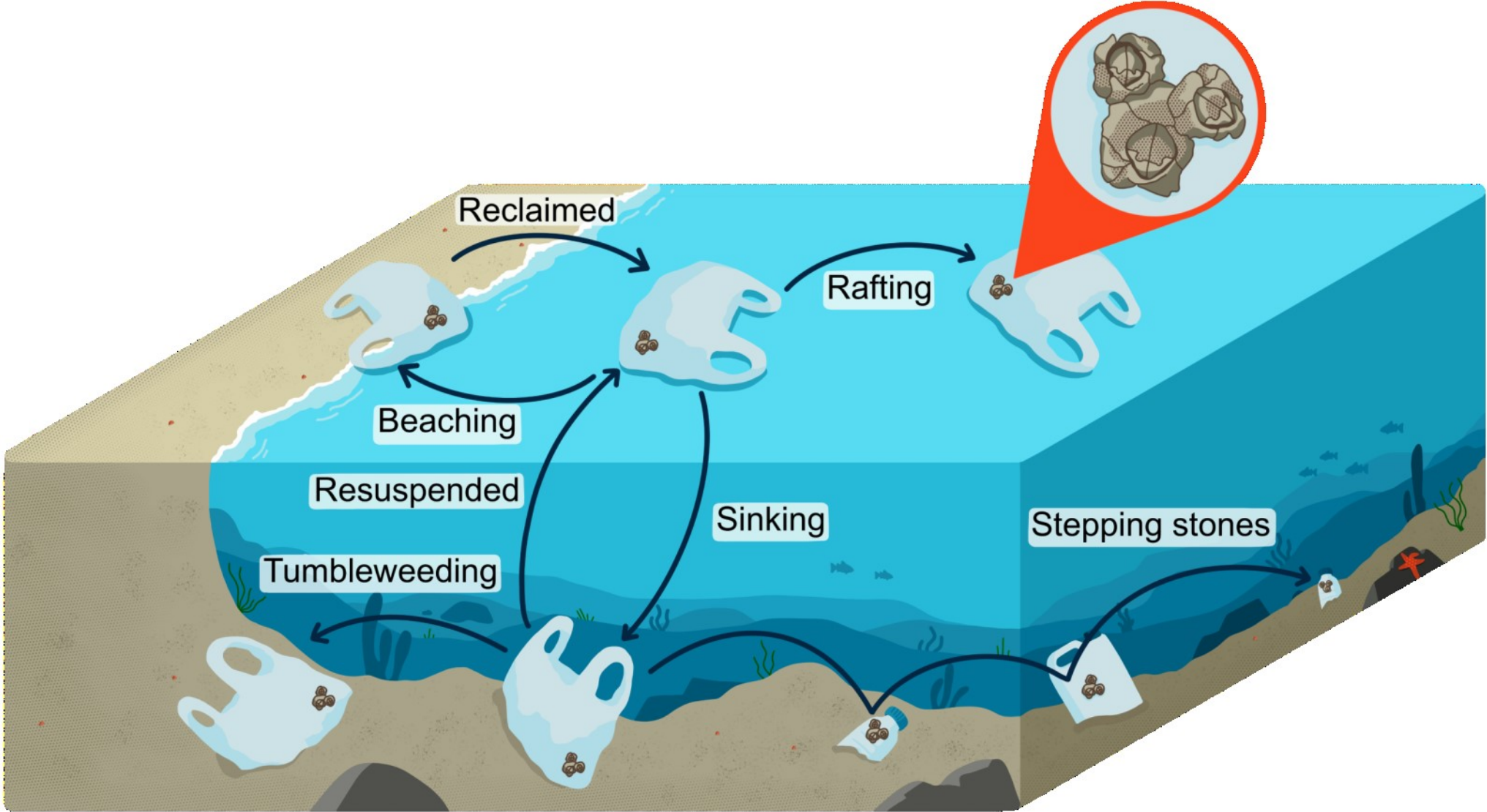
Need to investigate

## Advance Research

- Observations
- Gather Evidence
- Conclusions and recommendations



# Role of Marine Litter in moving NIS



# Interaction with coast



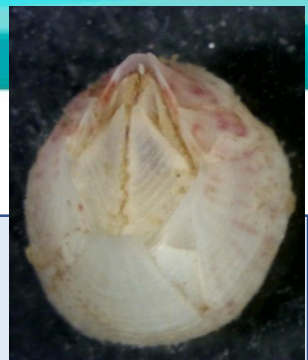
37 metres depth,  
Carmarthen Bay, Wales

Distance  
to land  
~ 15KM



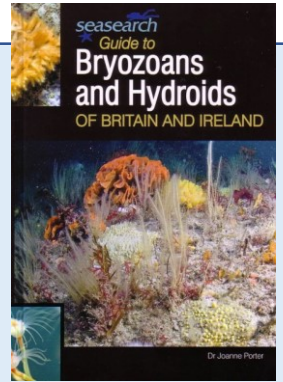


# Process



Collection

Preservation

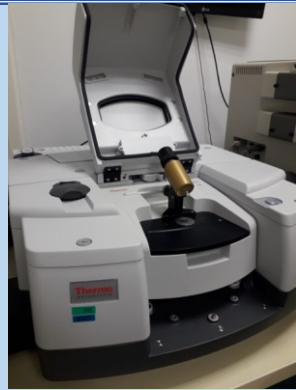


Animal identification

Non-indigenous species



Size / flexibility

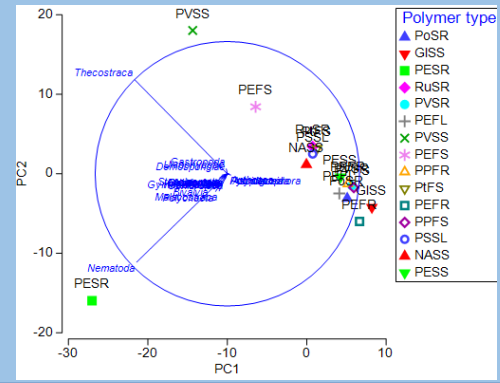


Polymer identification

Litter characterisation

Combine data

Identify patterns



Target species / litter types



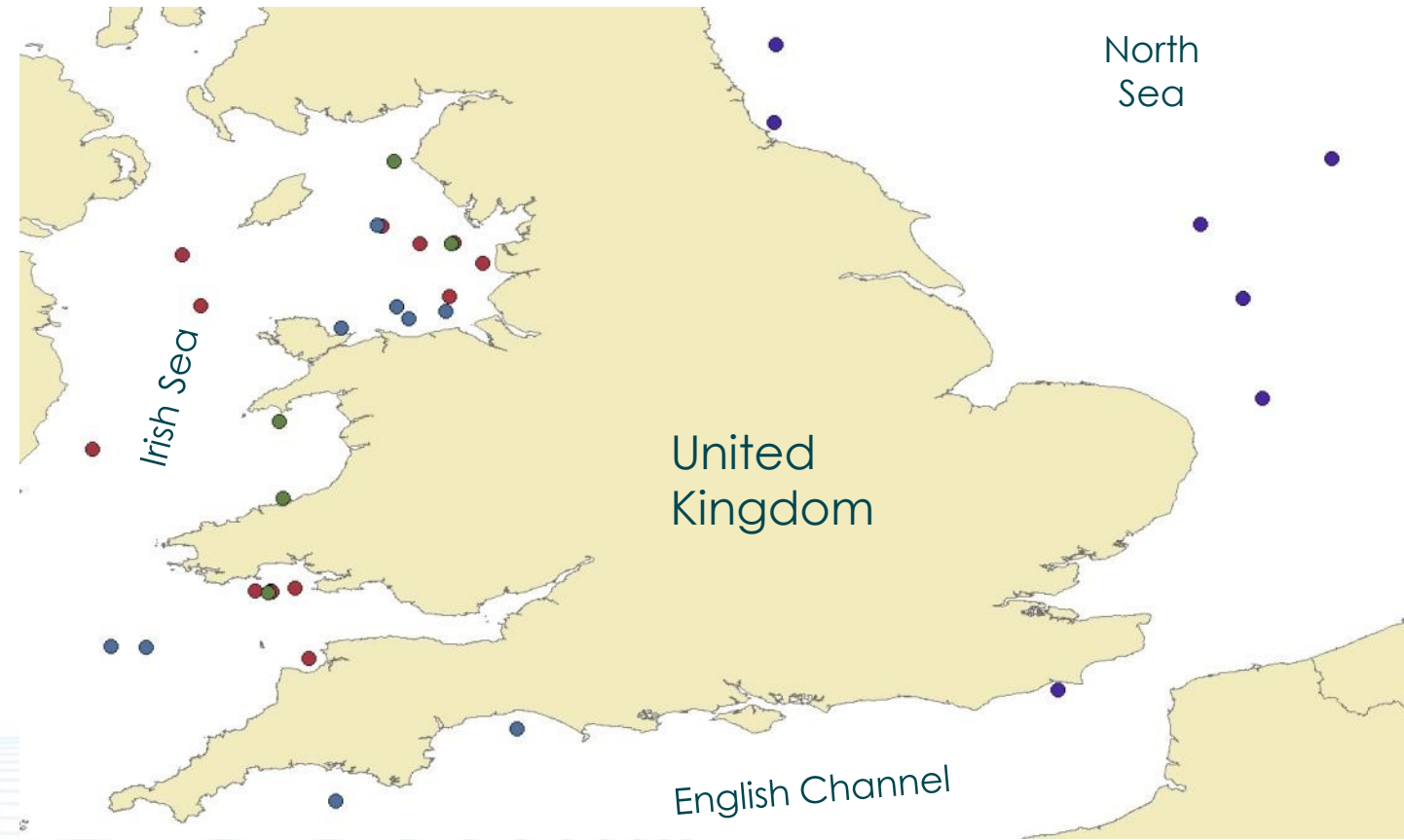
# UK: Clean Seas Environmental Monitoring Programme

## CSEMP

*“Integrated approach for environmental monitoring within the UK’s coastal and estuarine areas”*  
- Cefas

### Monitoring:

- Chemical contaminants
- Eutrophication
- Microbiological contaminants
- Algal toxins
- Litter

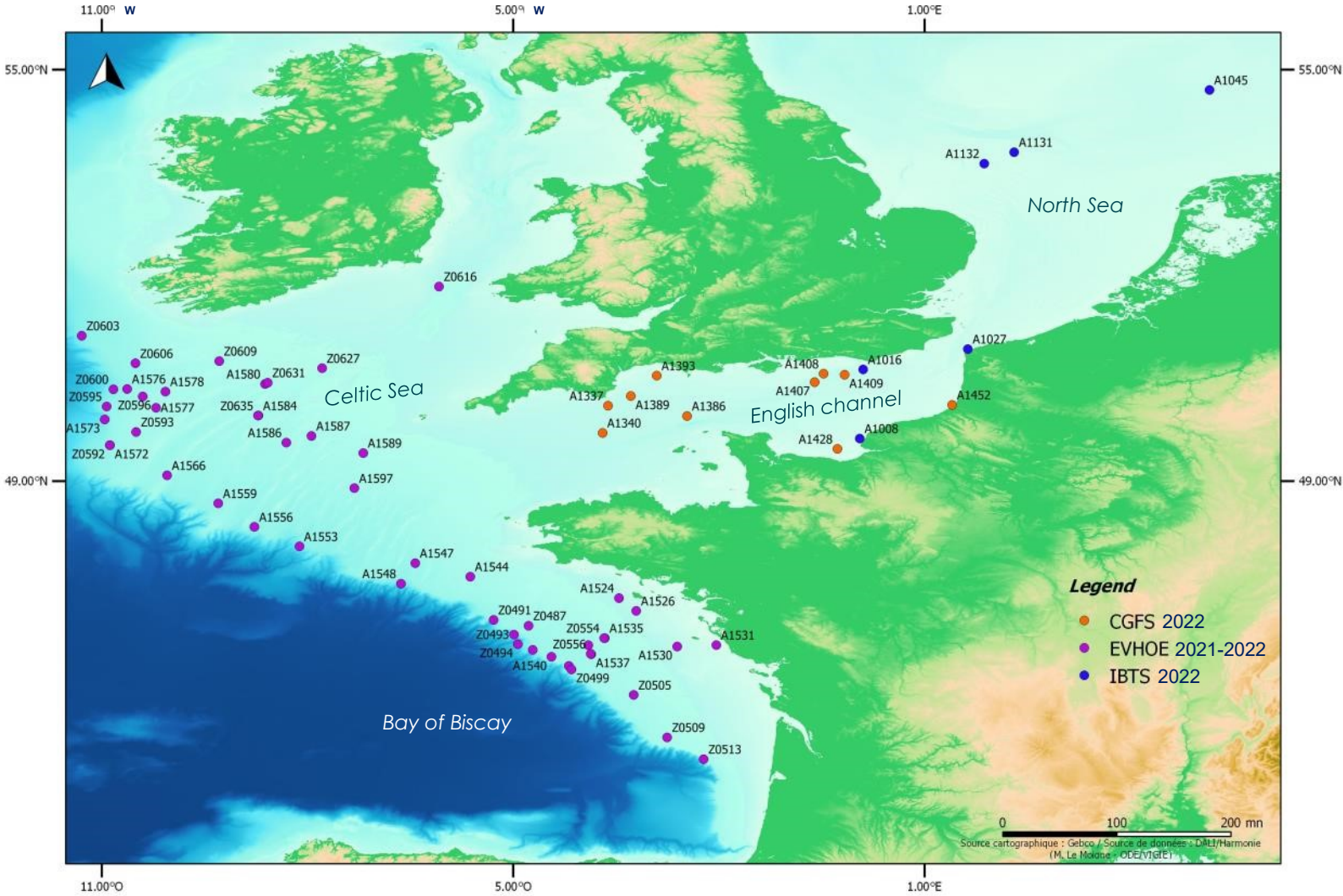


- 2020
- 2021
- 2022
- 2023





# FR: Fishing Bottom Trawl Surveys



## Annual assessments (DCF & MSFD)

Commercial fish species

Marine mammals and birds

Zooplankton

Marine Litter

# UK Investigation - Results



CEND 15 / 22 Litter sample

Taxa list

		Column Labels ▾	
		244 Trawl C - 19	244 Trawl C - 20
Taxon ID			
Abludomelita obtusata	Abl obt		
Achelia echinata	Ach ech		
Actinaria sp. A	Act		
Actinaria sp. B	Act B		
Aequipecten opercularis juv.	Aeq ope		
Aetea	Aetea		
Alcyonidium diaphanum	Alc dia		P
Alcyonidium gelatinosum	Alc gel		
Alcyonidium parasiticum	Alc par		
Alcyonium digitatum	Alc dig	P	
Ampharetidae dam.	Amp dam		
Amphiblestrum	Amphiblestrum		
Amphiblestrum flemingii	Amp fle	P	P
Amphiblestrum solidum	Amp sol		
Amphisbetia operculata	Amp ope		
Anomiidae juv.	Ano juv.		6
Aora typica	Aor typ		
Aoridae female	Aor female		
Arachnidium fibrosum	Ara fib		
Asciacea juv.	Asc juv.		
Asciella aspersa	Asc asp		1
Asciella scabra	Asc sca		
Astroidea juv.	Ast juv.		
Atylus falcatus	Aty fal		
Atylus swammerdamei	Aty swa		
Austrominius modestus	Aus mod		
Balanus crenatus	Bal cre		
Balanus juv.	Bal juv.		
Balanus perforatus	Bal per		
Bathyporeia	Bathyporeia		
Bicellariella ciliata	Bic cil		
Bopyridae	Bopyridae		
Botryllis schlosseri	Bot sch		
Bougainvilliidae	Bougain		
Buccinum undatum egg cases	Buc und eggs.	P	
Bufo	Bufo		



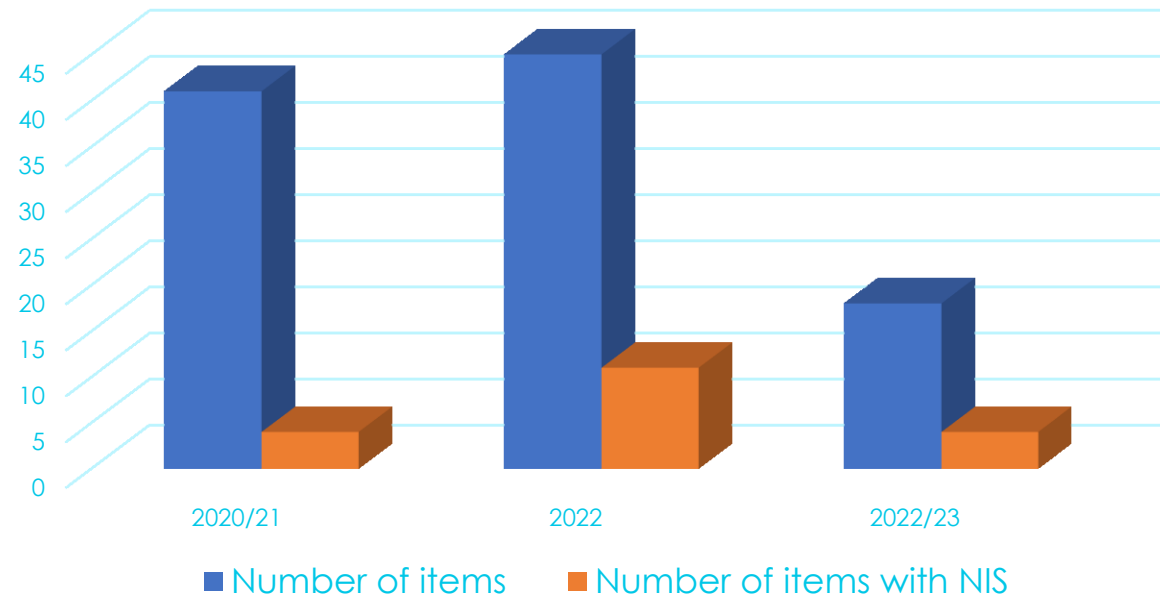
# UK results – Sampling effort

UK Marine Non-Indigenous Species Priority List (updated 2020)

Species	List	AphiaID
<i>Acartia tonsa</i>	Present	345943
<i>Agarophyton vermiculophyllum</i>	Present	1327786
<i>Arcuatula senhousia</i>	Present (new addition)	505946
<i>Alexandrium catenella</i>	Horizon	231873
<i>Amphibalanus amphitrite</i>	Present	421137
<i>Amphibalanus reticulatus</i>	Horizon	421140
<i>Asparagopsis armata</i>	Present	144438
<i>Asterias amurensis</i>	Horizon	254497
<i>Asterocarpa humilis</i>	Present	250047
<i>Boccardia proboscidea</i>	Present (new addition)	327249
<i>Bonnemaisonia hamifera</i>	Present	144442
<i>Botryocladia wrightii</i>	Present (new addition)	1313615
<i>Caprella mutica</i>	Present	146768
<i>Caulacanthus okamurae</i>	Present	496188
<i>Caulerpa racemosa</i>	Horizon	144472
<i>Caulerpa taxifolia</i>	Horizon	144476
<i>Celtodoryx ciocalyptoides</i>	Horizon	559274
<i>Cephalothrix simula</i>	Present (new addition)	573293
<i>Ciona savignyi</i>	Horizon (new addition)	250202

54 species - 28 sessile

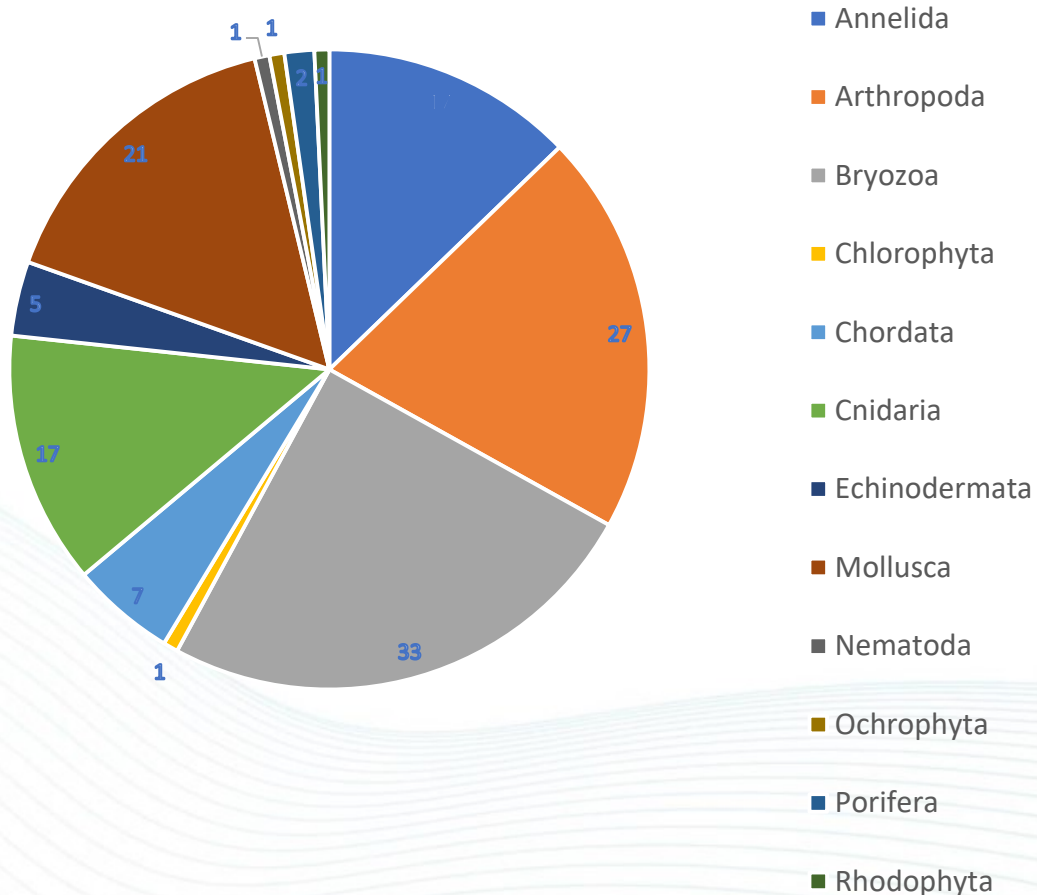
Number of litter items collected across three surveys



Identification of NIS

# UK results – Sampling effort

Number of taxa per Phylum



133 taxa, divided into 12 phyla / 21 classes.

87 identified to species level.

Top 3 phyla (species richness):

- Bryozoa (25%)
- Arthropoda (20%)
- Mollusca (16%)



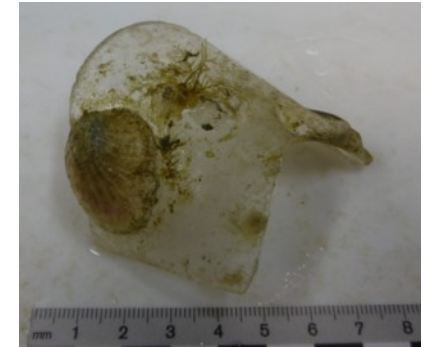
# UK results – Non-Indigenous Species



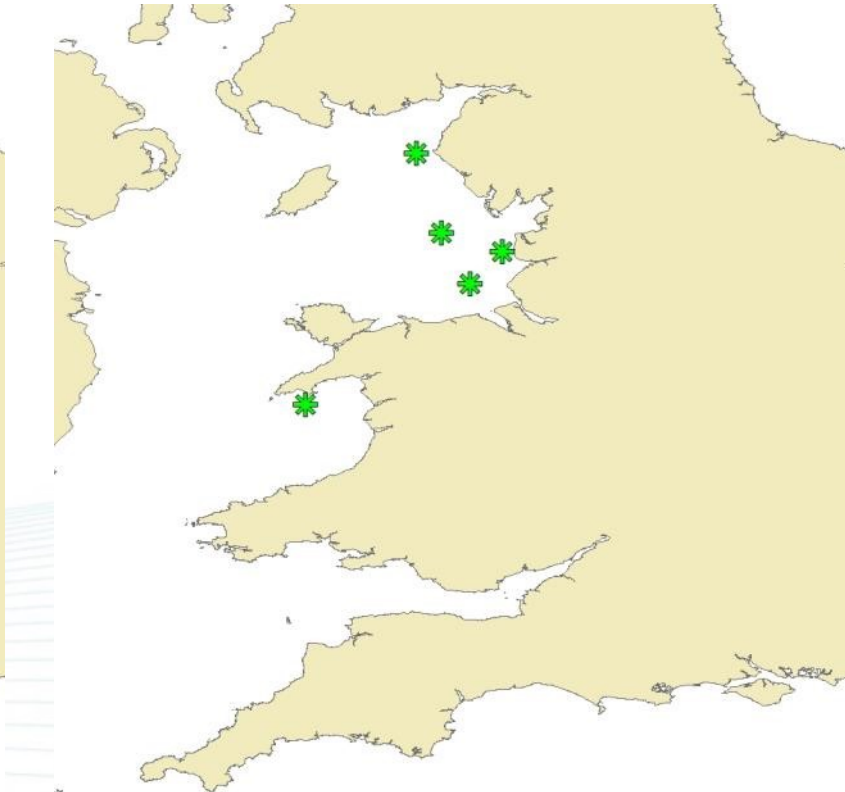
*Solidobalanus fallax*



*Austrominius modestus*



*Crepidula fornicata*



# UK results – Investigation of patterns

Taxon ID		Column Labels	
		244 Trawl C - 19	244 Trawl C - 20
Abludomelita obtusata	Abl obt		
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Amphiblestrum	Amphiblestrum		
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Bathyporeia	Bathyporeia		
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Bopyridae	Bopyridae		
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Bougainvilliidae	Bougain		
Buccinum undatum egg cases	Buc und eggs.	P	
Bumelia squarrosa	Buc sui		

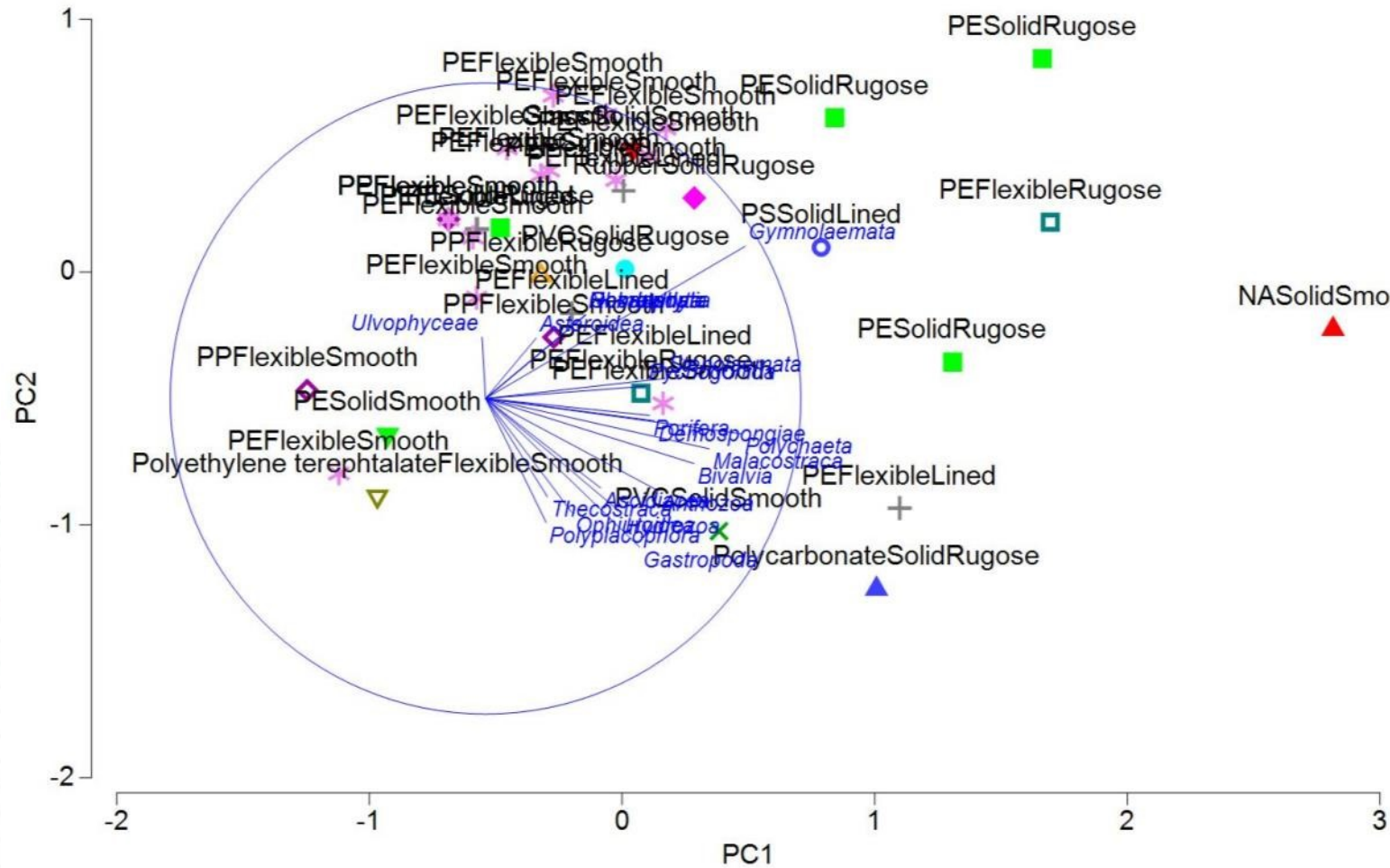
Taxa: Abundance

Litter code	Expanded name
GLSS	Glass / Smooth / Solid
PCRS	Polycarbonate / Rugose / Solid
PELF	Polyethylene / Lined / Flexible
PERF	Polyethylene / Rugose / Flexible
PERS	Polyethylene / Rugose / Solid
PESF	Polyethylene / Smooth / Flexible
PESS	Polyethylene / Smooth / Solid
PISS*	Pipe / Smooth / Solid
PPRF	Polypropylene / Rugose / Flexible
PPSF	Polypropylene / Smooth / Flexible
PSLS	Polystyrene / Lined / Solid
PTSF	Polyethylene terephthalate / Smooth / Flexible
PVRS	Polyvinyl chloride / Rugose / Solid
PVSS	Polyvinyl chloride / Smooth / Solid
RURS	Rubber / Rugose / Solid

Litter characterisation



# UK results – PCA



41 samples: 17 Classes

Litter code	Expanded name
GLSS	Glass / Smooth / Solid
PCRS	Polycarbonate / Rugose / Solid
PELF	Polyethylene / Lined / Flexible
PERF	Polyethylene / Rugose / Flexible
PERS	Polyethylene / Rugose / Solid
PESF	Polyethylene / Smooth / Flexible
PESS	Polyethylene / Smooth / Solid
PISS*	Pipe / Smooth / Solid
PPRF	Polypropylene / Rugose / Flexible
PPSF	Polypropylene / Smooth / Flexible
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PTSF	Polyethylene terephthalate / Smooth / Flexible
PVRS	Polyvinyl chloride / Rugose / Solid
PVSS	Polyvinyl chloride / Smooth / Solid
RURS	Rubber / Rugose / Solid



# FR results – Sampling effort

PVC glove – North Sea – January 2022



*Austrominius modestus* (NIS)

Gastropod eggs

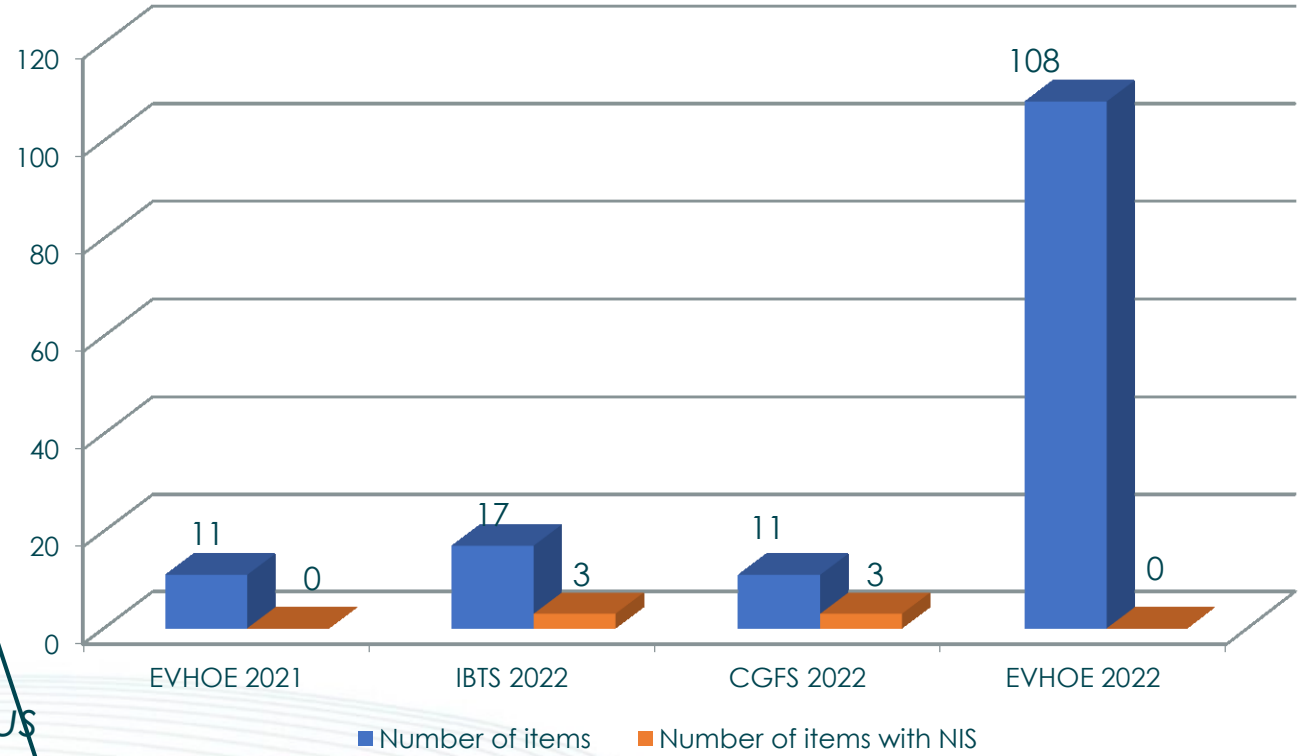
*Crepidula fornicata* (NIS)

*Spirobranchus triqueter*

*Spirobranchus lamarcki*

**145 taxa – 128 identified to species level**

Number of litter items collected across four surveys  
153 litter items, including 6 with NIS



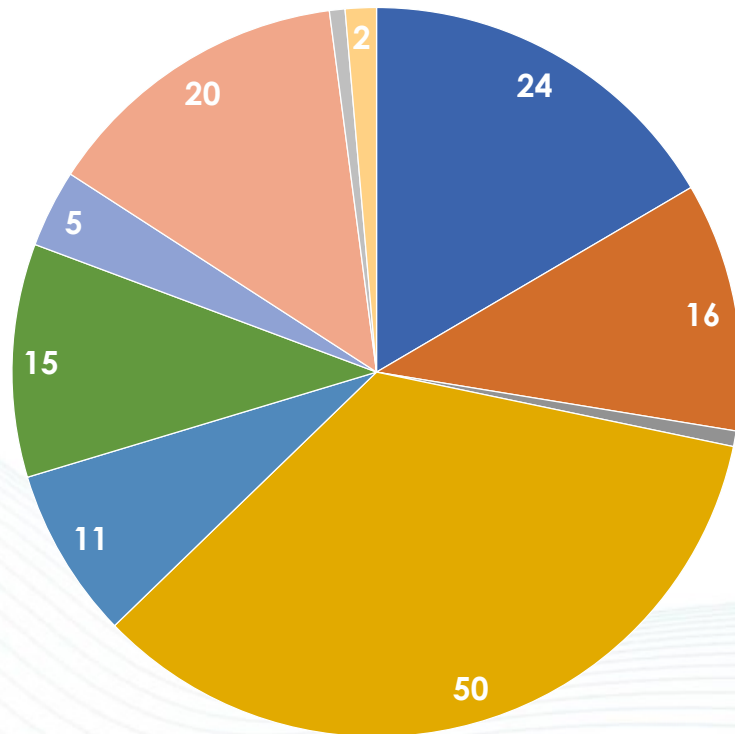
Identification of NIS





# FR results – Sampling effort

Number of taxa per phylum



- Annelida
- Arthropoda
- Brachiopoda
- Bryozoa
- Chordata
- Cnidaria
- Echinodermata
- Mollusca
- Nemertea
- Porifera

145 taxa, divided into 10 phyla /17 classes.

128 identified to species level.

Top 3 phyla (species richness):

- Bryozoa (34%)
- Annelida (17%)
- Mollusca (14%)

# FR results – Non-Indigenous species

The exact same three as in UK samples!

*Solidobalanus fallax*



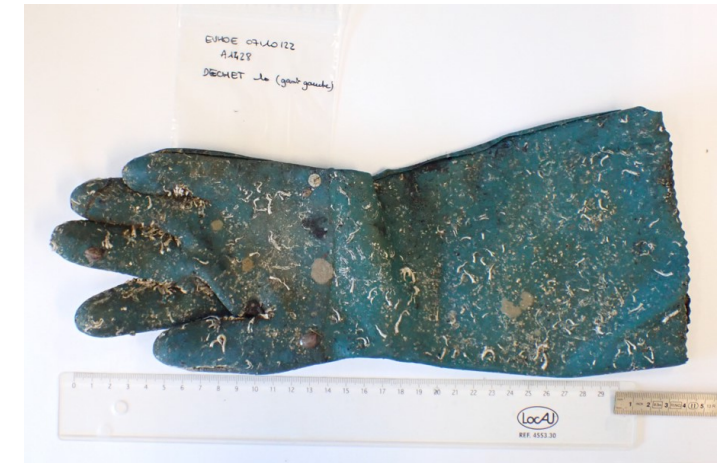
Found on plastic sheeting (PPRF)  
1 individual

*Austrominius modestus*  
Modest barnacle



Found on a PVC glove and rubber ring (PESF + PPSF)  
9 individuals

*Crepidula fornicata*  
Slipper limpet



Found exclusively on 3 different PVC SF (fishing) gloves  
12 individuals

# FR results – Non-Indigenous species

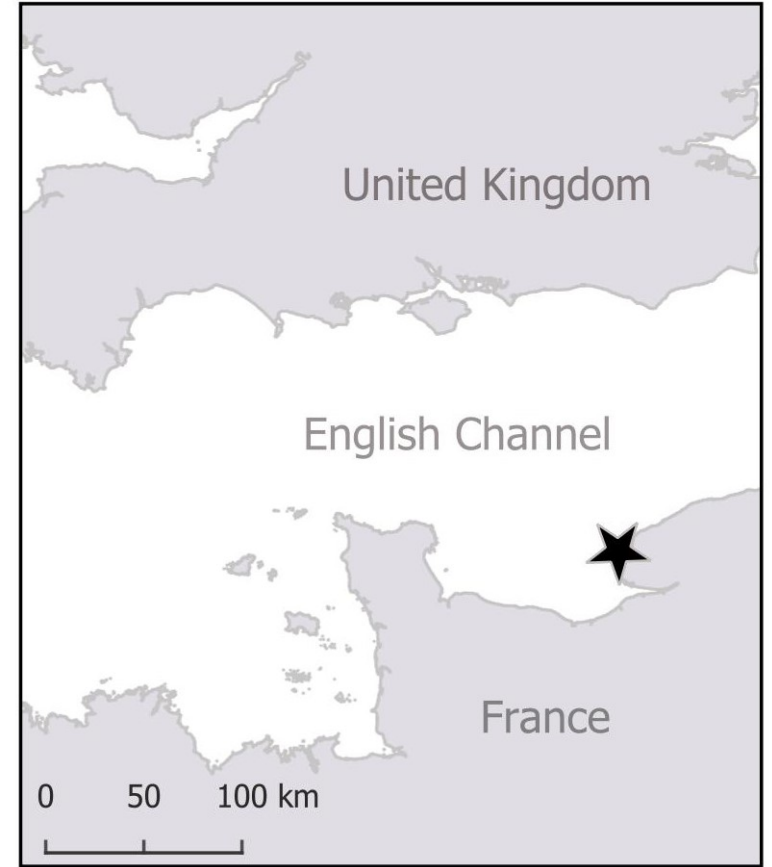
*Crepidula fornicata*



*Solidobalanus fallax*



*Austrominius modestus*



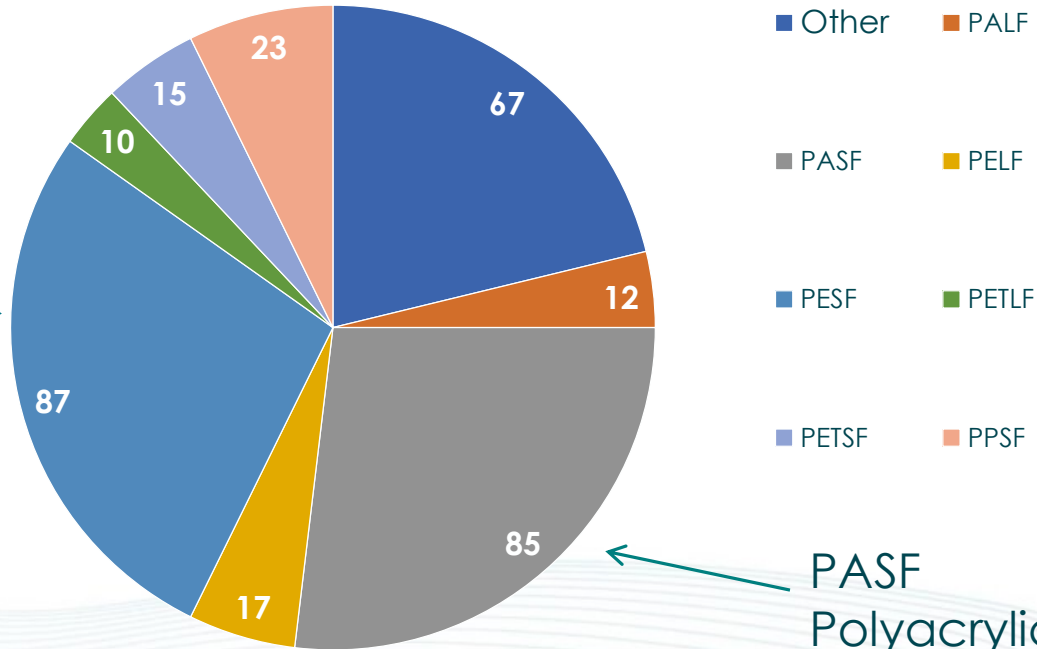
Map projection: Lambert 93

# FR results – Investigation of patterns

A majority of fishing debris (hake longlines)

Litter analysis – 316 samples run through the ATR-FTIR

### Number of plastic debris analysed



“Other” category very diverse:  
67 samples --> 35 different plastics

PESF  
Polyethylene  
Smooth Flexible  
(fishing lines & ropes,  
but also food wrappers)

PASF  
Polyacrylic Smooth Flexible  
(fishing lines & ropes, but also foodwrappers)



# Bryozoans like glass



November 2021 – North Bay of Biscay  
Trawl # ZO556

*Pyripora catenularia*  
*Haplopoma impressum*  
*Annectocyma major*  
*Oncousoecia dilatans*  
*Ammatophora nodulosa*  
*Diplosolen obelia*  
Plagioeciidae



*Escharella ventricosa*  
*Chorizopora brongniartii*  
*Crisia denticulata*  
*Tubulipora liliacea*  
*Cellepora pumicosa*

# Preliminary Discussion Points

1. NIS low proportion of litter fouling communities...however
2. Sometimes found in high abundance (i.e. *Solidoballanus fallax*)
3. Same three NIS found in UK/FR samples
3. All items with NIS found in very coastal trawl sites: either 1) recent sinking or 2) collected in water column by trawl
4. Litter items mostly from fishing activity (but skewed by large number of samples from North Bay of Biscay)

# Advance Research

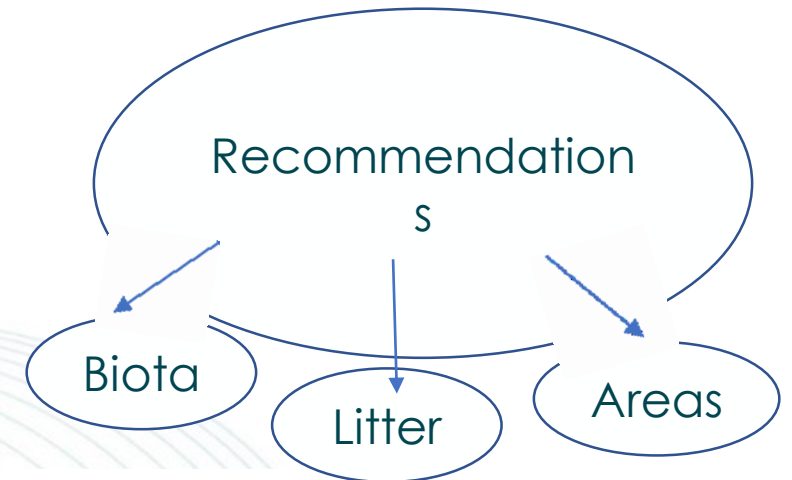
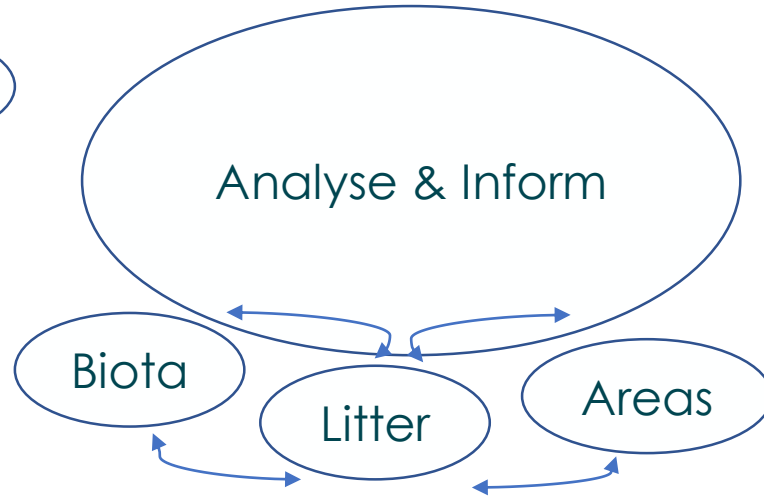
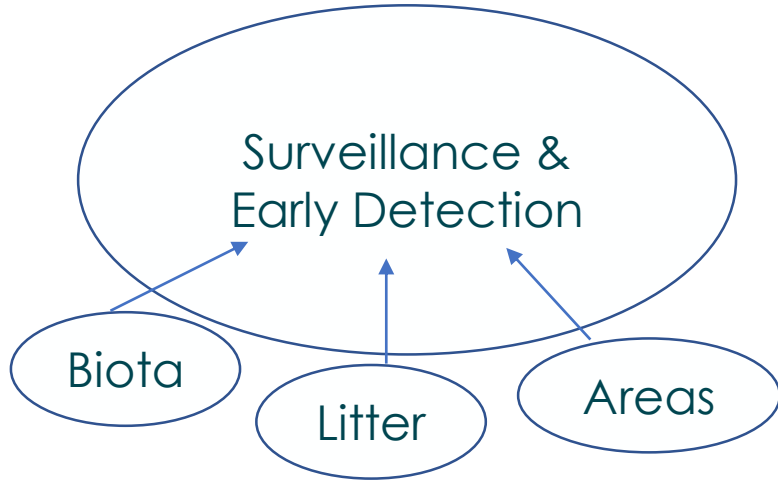
## ➤ Identify knowledge gaps

Research Avenues*	Preliminary Results
Assess whether litter is facilitating NIS	Some species
Assess scale of the problem	Early indications (UK)
What areas are at risk?	Limited knowledge
What species facilitated by what litter	First indications
Correlation / pattern ?	No clear evidence. More testing needed

\*Adapted from: Rech et al. (2016) Marine litter as a vector for non-native species: What we need to know. *Mar. Poll. Bull.* 113: 40 – 43.



# ➤ Application of our data



The Great Britain Invasive Non-Native Species Strategy

2023 to 2030

# Next Steps

## Pool Cefas & Ifremer results

1. Compare litter items & plastic types to fouling communities
2. Drift models?
3. Sediment Characterization?
3. Effects of Climate Change?

**Publish!**

# Thank you for listening

