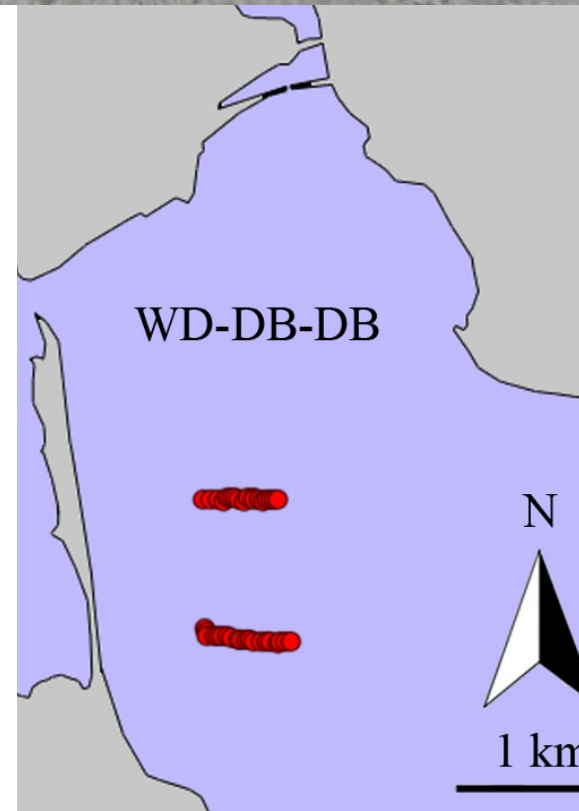
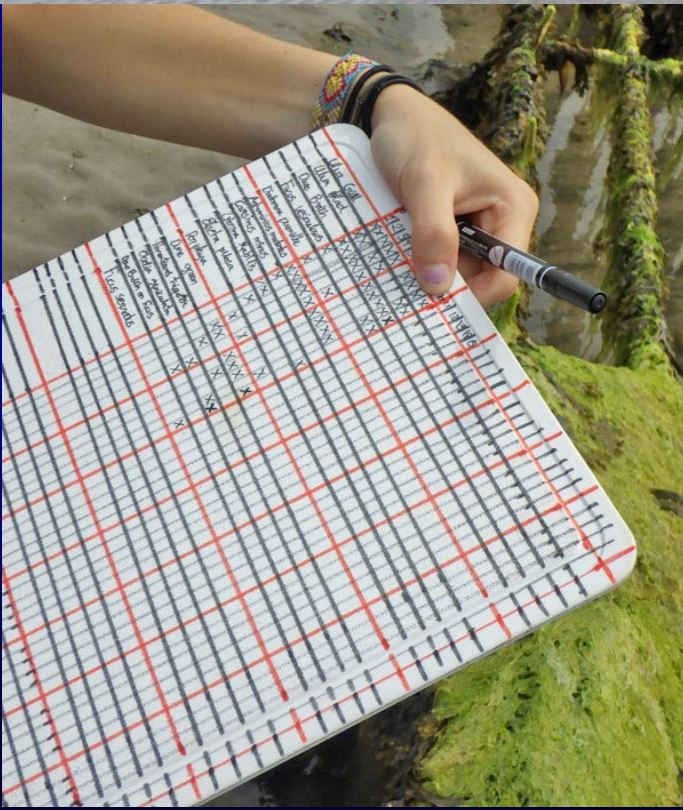


European trends: Invasive species associated with oyster production areas

Arjan Gittenberger

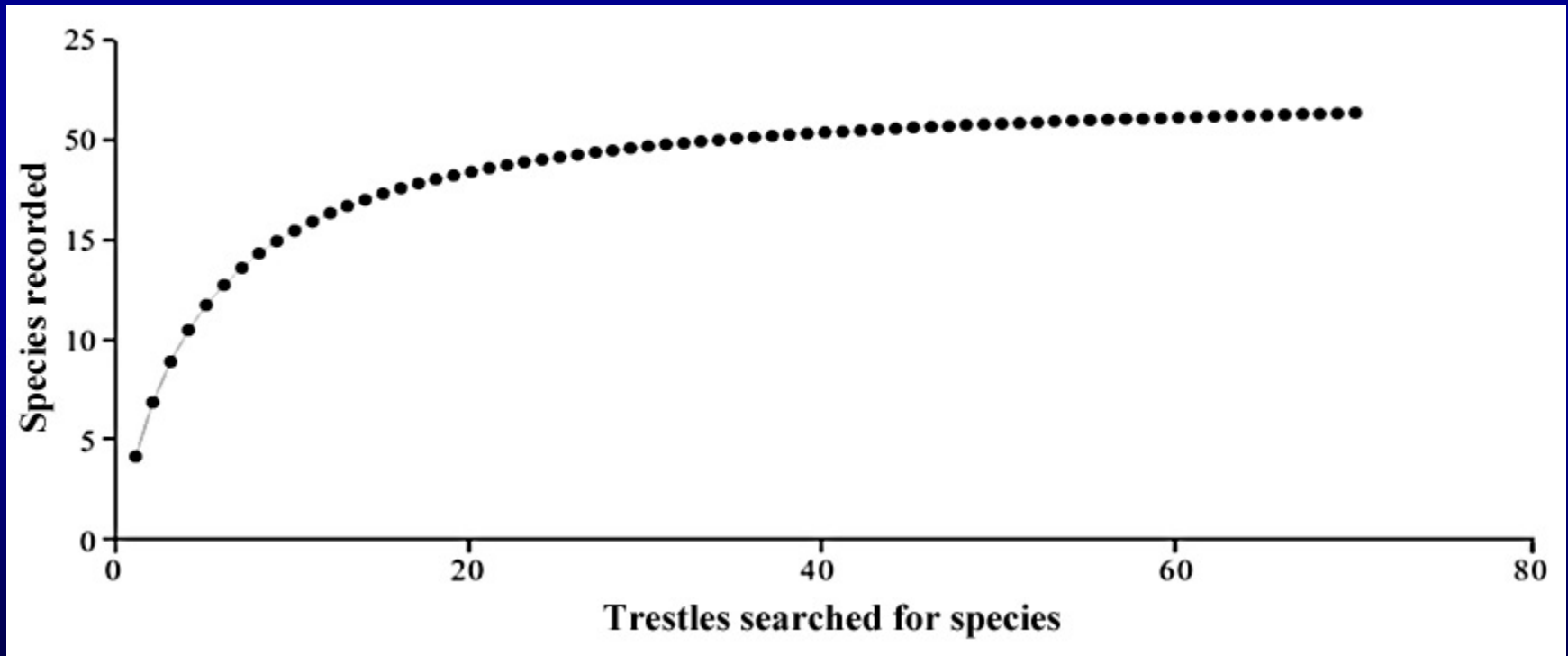


Dungarvan SASI 2021



Shellfish Associated Species Inventories (SASIs) since 2010

Additional samples are taken until a doubling of the research effort (number of trestles searched for species) is expected to yield less than 1 new species.



Dungarvan SASI 2021 most common species living on the bags with oysters on the trestles

Dungarvan Bay survey



Ireland's EU Structural and Investment Funds Programmes 2014 - 2020
Co-funded by the Irish Government and the European Union



An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine



EUROPEAN UNION
This measure is part-financed by the European Maritime and Fisheries Fund



Dynamena pumila



Idotea granulosa



Littorina littorea



Littorina fabalis



Austrominius modestus



Fucus serratus



Porphyra purpurea

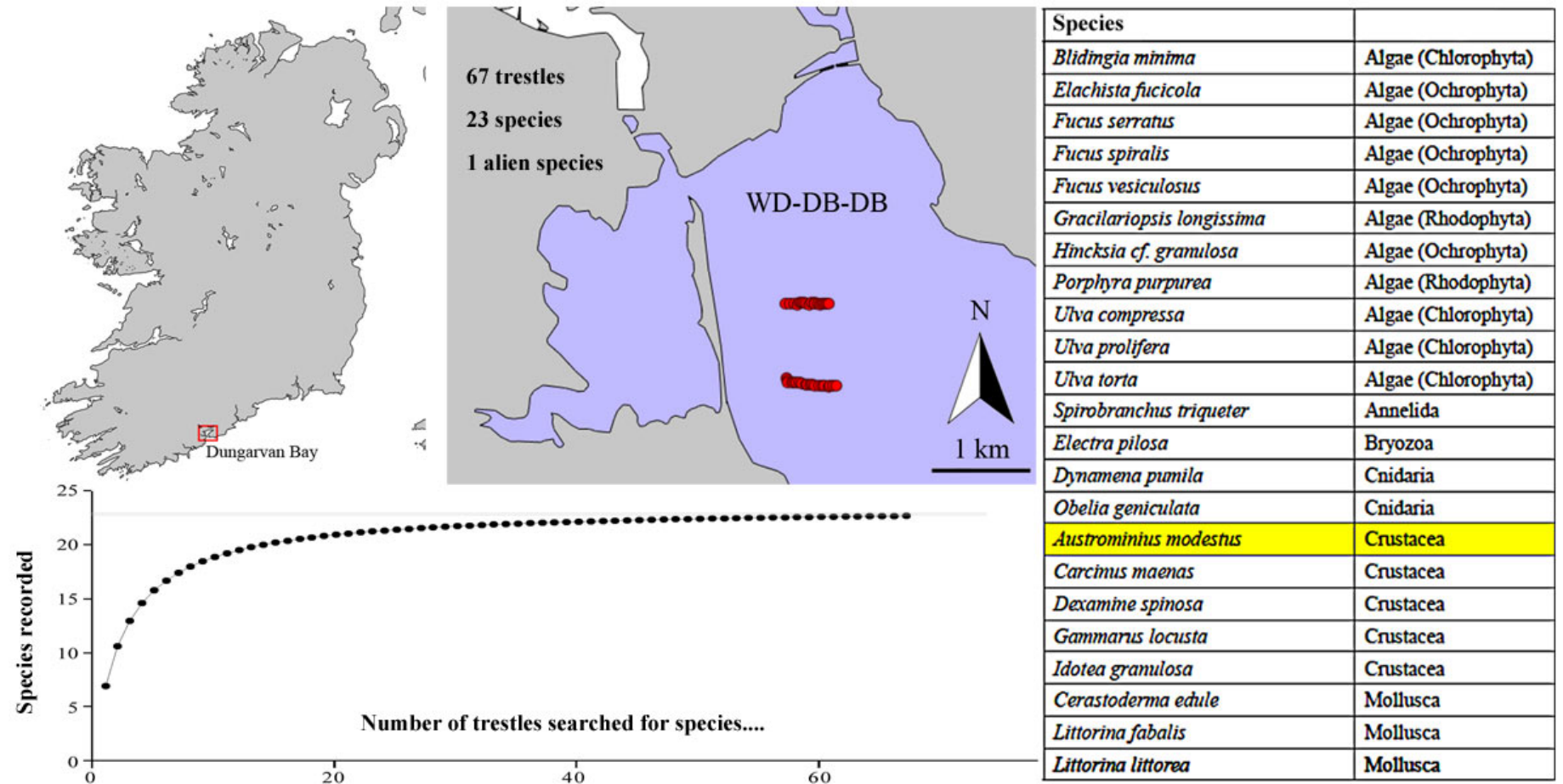


Electra pilosa

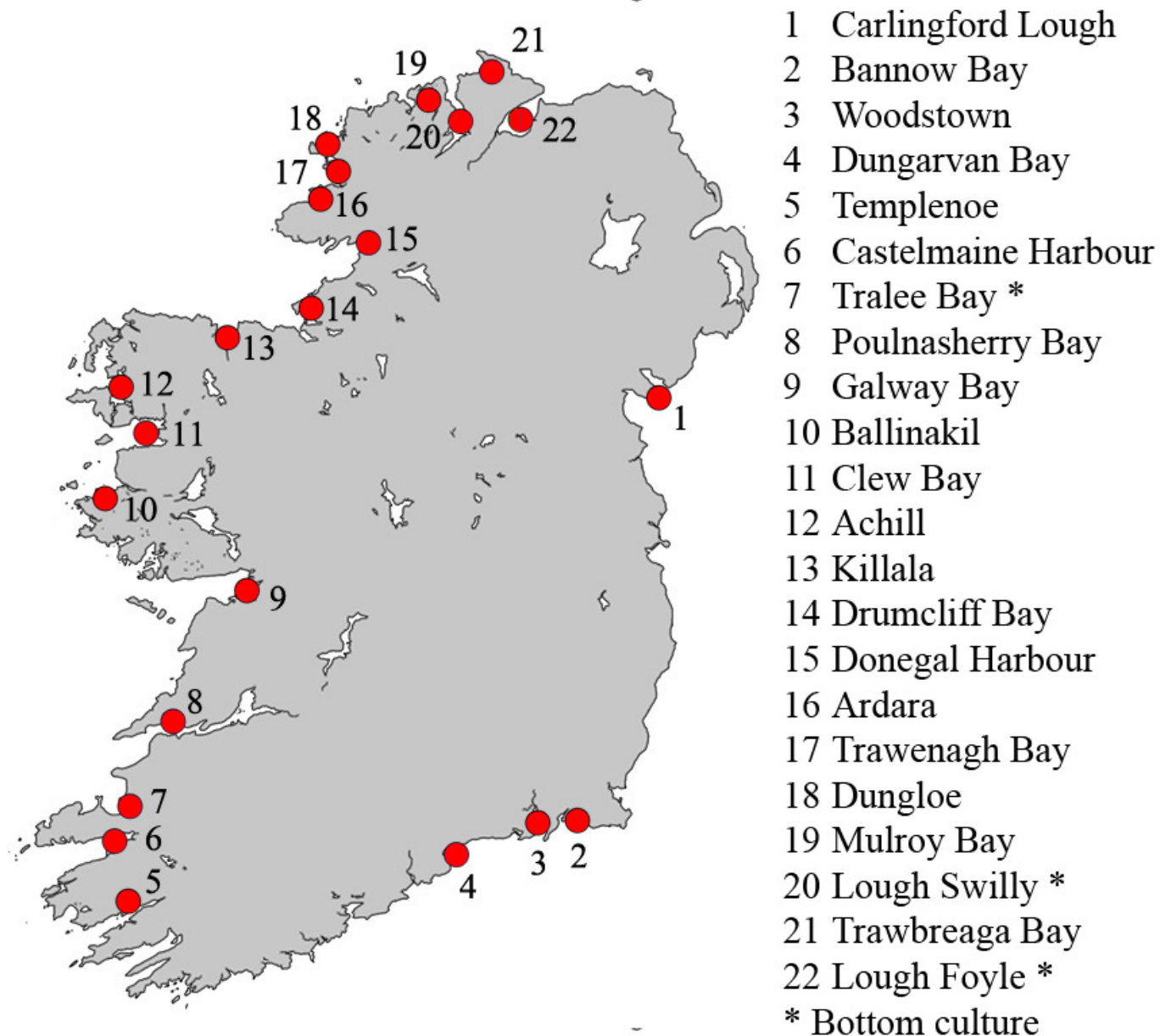
Dungarvan SASI 2021

- 67 trestles searched for species
- 23 species among which 1 alien species

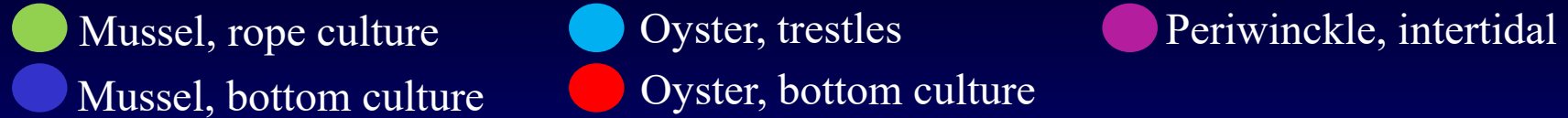
Results of the Shellfish Associated Species Survey (SASI) of the oyster trestles in Dungarvan Bay, July 2021



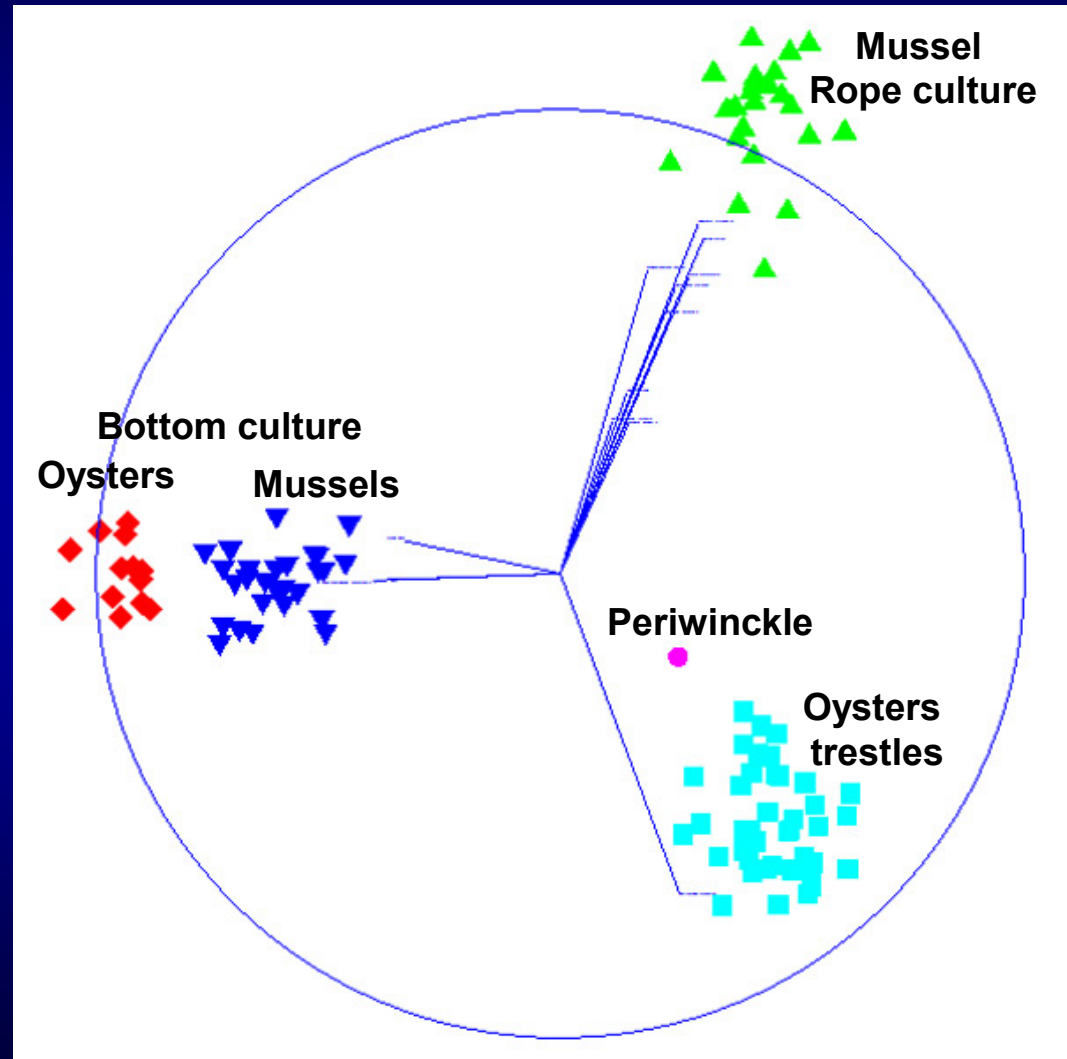
Oyster SASIs in Ireland since 2010



Shellfish species and “fishing” method in Ireland



- Each symbol represents one of Shellfish Associated Species Survey
- Species abundance = number of samples within a survey, in which a species was scored.
- MDS plots & CAP analyses based on species communities
- Blue lines indicate species correlations of > 0.4 : Potential “indicator” species for certain areas?



Shellfish species and “fishing” method in Ireland

● Mussel, rope culture

● Oyster, trestles

● Periwinkle, intertidal

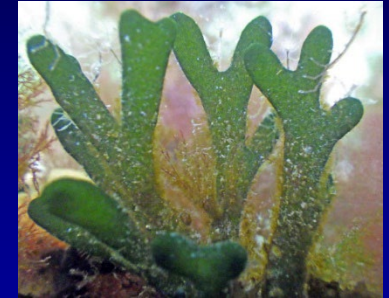
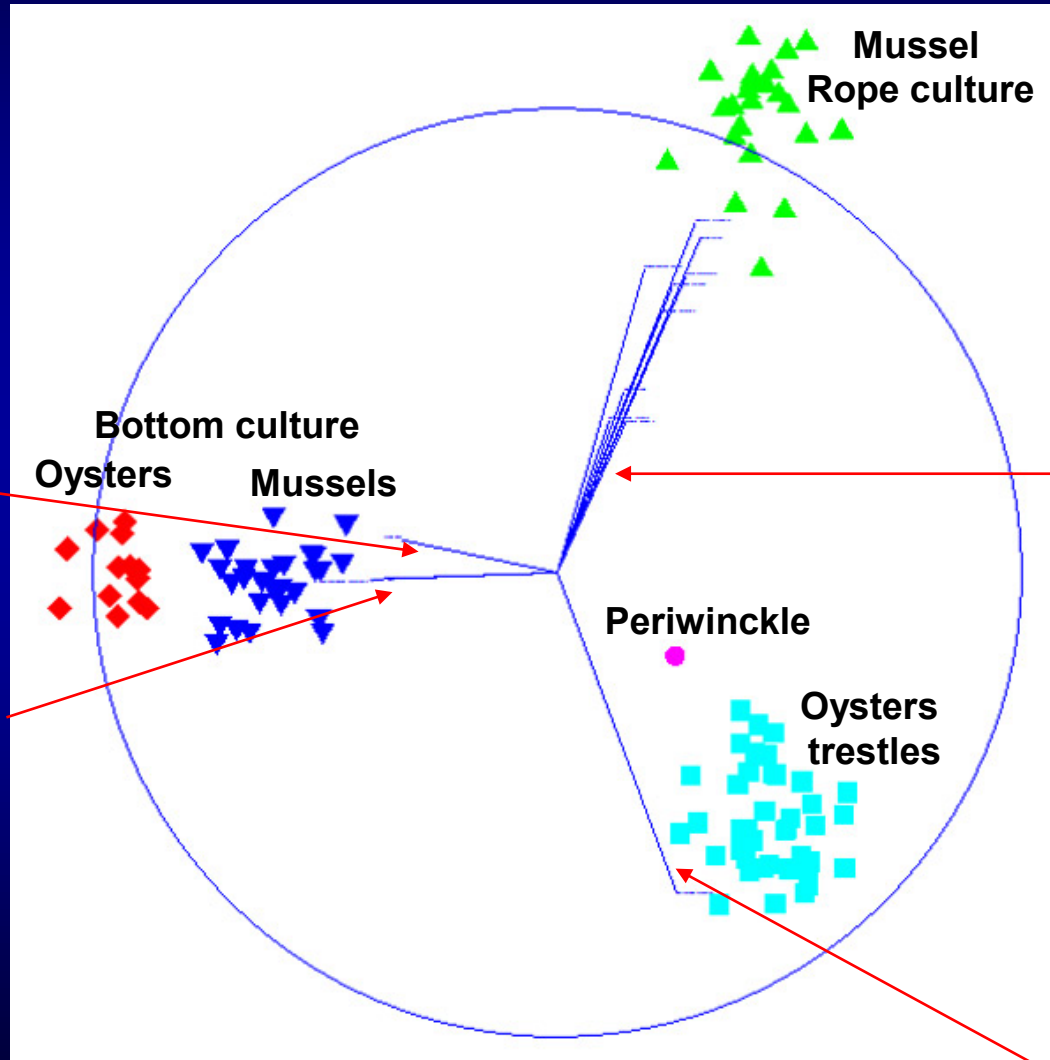
● Mussel, bottom culture

● Oyster, bottom culture



Styela clava

*Antithamnionella
spirographidis*



Diplosoma listerianum
Caprella mutica
Jassa marmorata
Codium fragile
Melanothamnus harveyi
Sargassum muticum
Colpomenia peregrina
Antithamnionella ternifolia
etc.



Austrominius modestus

SASIs since 2010 conducted in Ireland, United Kingdom, France, Sweden, Denmark and The Netherlands

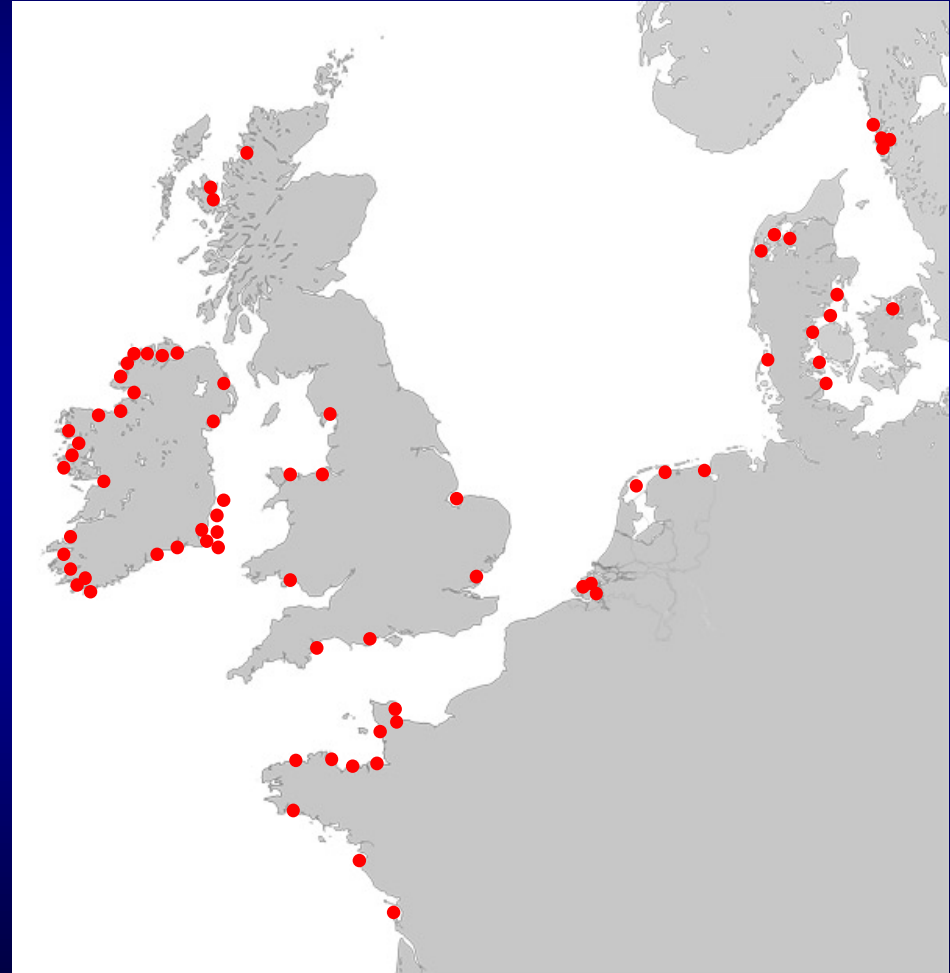
Over 21,000 samples with shellfish were searched for species

In total 751 species were found in association with the shellfish farmed/fished, among which about 80 alien species

In 188 Shellfish Associated Species Inventories

In 64 Shellfish production / fishing areas

In 38 Oyster production / fishing areas in NW Europe



SASIs since 2010 conducted in Ireland, United Kingdom, France, Sweden, Denmark and The Netherlands

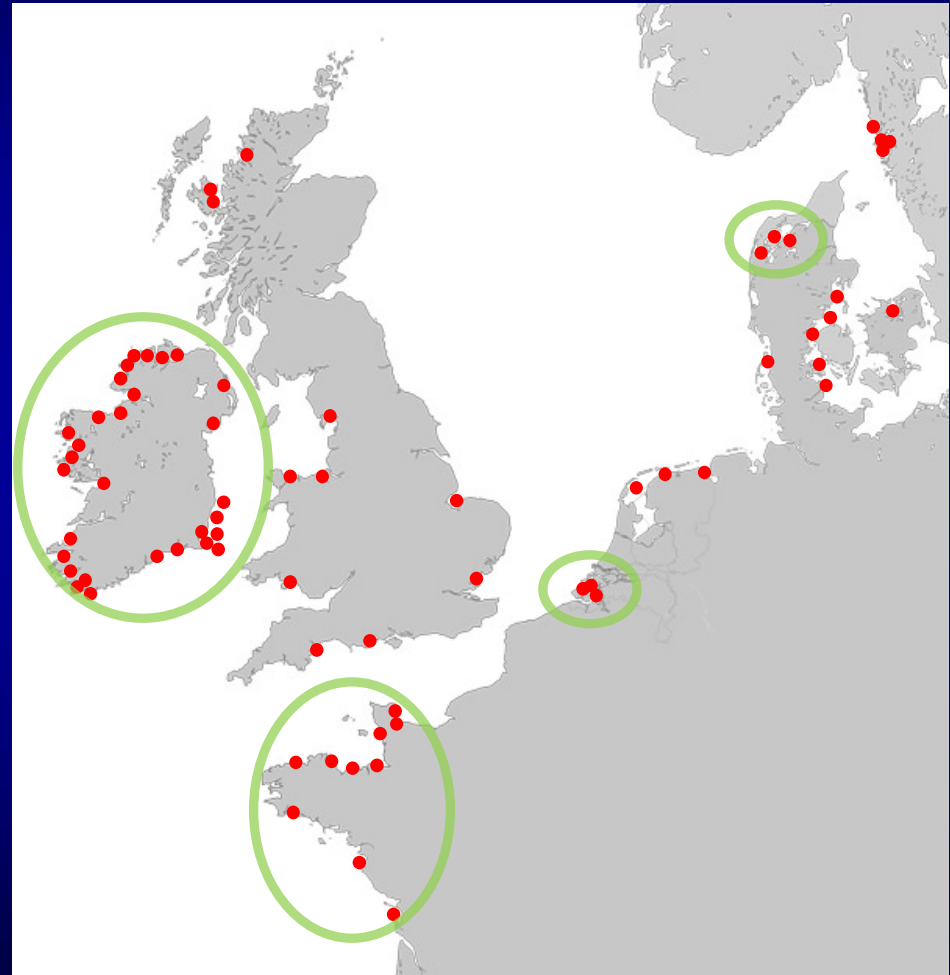
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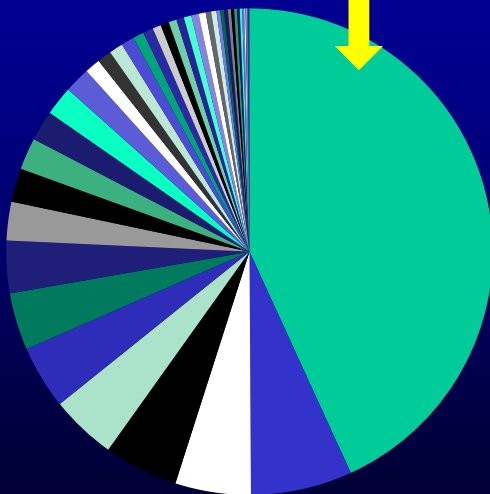
In 38 Oyster production / fishing areas in NW Europe



NW Europe

49 alien species in total associated with oysters

New Zealand barnacle
Austrominius modestus



■ <i>Austrominius modestus</i> (43,05%)	■ <i>Botrylloides violaceus</i> (6,72%)
■ <i>Styela clava</i> (5,01%)	■ <i>Crepidula fornicata</i> (4,92%)
■ <i>Sargassum muticum</i> (4,36%)	■ <i>Dasysiphonia japonica</i> (4,2%)
■ <i>Caulacanthus okamurae</i> (3,8%)	■ <i>Didemnum vexillum</i> (3,47%)
■ <i>Aplidium glabrum</i> (2,56%)	■ <i>Antithamnionella spirographidis</i> (2,23%)
■ <i>Melanothamnus harveyi</i> (2,11%)	■ <i>Hemigrapsus takanoi</i> (2,01%)
■ <i>Ulva australis</i> (1,94%)	■ <i>Ocinebrellus inornatus</i> (1,7%)
■ <i>Neodexiospira brasiliensis</i> (1,03%)	■ <i>Undaria pinnatifida</i> (0,94%)
■ <i>Agardhiella subulata</i> (0,92%)	■ <i>Perophora japonica</i> (0,87%)
■ <i>Diplosoma listerianum</i> (0,72%)	■ <i>Pacificincola perforata</i> (0,68%)
■ <i>Dasya sessilis</i> (0,56%)	■ <i>Grateloupia turuturu</i> (0,56%)
■ <i>Agarophyton vermiculophyllum</i> (0,53%)	■ <i>Asparagopsis armata</i> (0,5%)
■ <i>Vertebrata fruticulosa</i> (0,5%)	■ <i>Molgula manhattensis</i> (0,49%)
■ <i>Gelidium vagum</i> (0,47%)	■ <i>Mycale (Carmia) micracanthoxea</i> (0,36%)
■ <i>Antithamnionella ternifolia</i> (0,35%)	■ <i>Polysiphonia senticulosa</i> (0,25%)
■ <i>Haliclona (Soestella) xena</i> (0,25%)	■ <i>Tricellaria inopinata</i> (0,25%)
■ <i>Diadumene lineata</i> (0,21%)	■ <i>Bonnemaisonia hamifera</i> (0,2%)
■ <i>Ceramium sungminbooi</i> (0,2%)	■ <i>Fenestrulina delicia</i> (0,17%)
■ <i>Codium fragile</i> (0,16%)	■ <i>Ruditapes philippinarum</i> (0,14%)
■ <i>Palaemon macrodactylus</i> (0,08%)	■ <i>Colpomenia peregrina</i> (0,05%)
■ <i>Smittoidea prolifica</i> (0,05%)	■ <i>Diadumene cincta</i> (0,05%)
■ <i>Bugulina stolonifera</i> (0,03%)	■ <i>Caprella equilibra</i> (0,03%)
■ <i>Ammothea hilgendorfi</i> (0,01%)	■ <i>Amphibalanus amphitrite</i> (0,01%)
■ <i>cf. Ptilohyale littoralis</i> (0,01%)	■ <i>Teredo navalis</i> (0,01%)
■ <i>Sycon scaldiense</i> (0,01%)	

Oyster fisheries associated alien species in Ireland

26 alien species in total

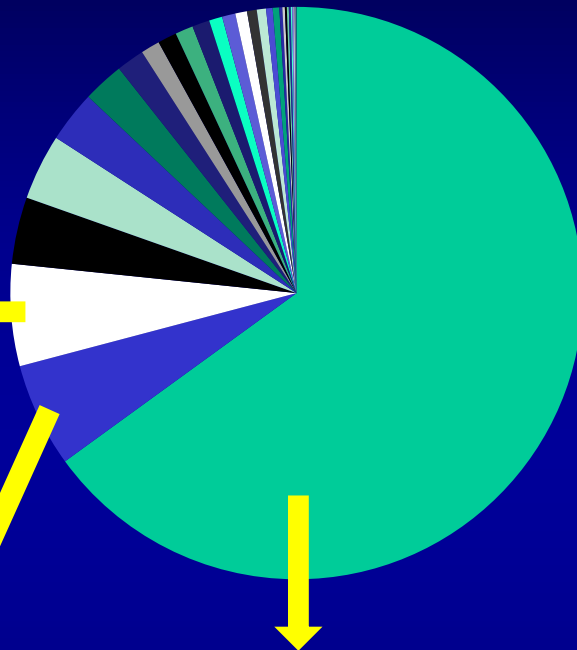


Botrylloides violaceus



Styela clava

Austrominius modestus



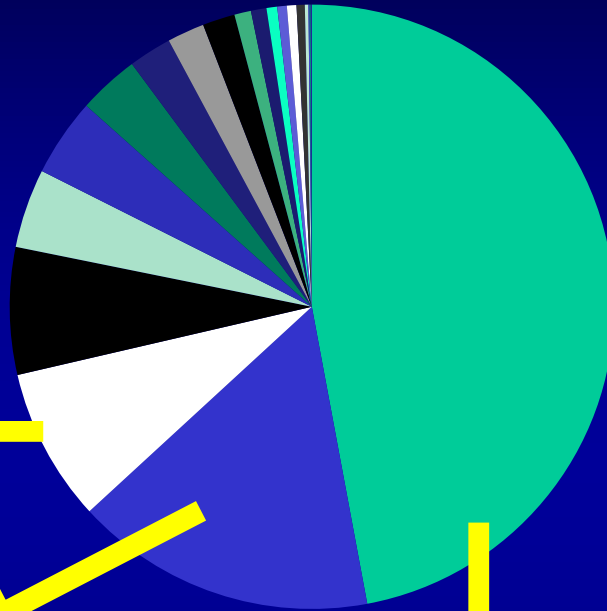
- *Austrominius modestus* (64.9%)
- *Styela clava* (5.88%)
- *Botrylloides violaceus* (5.74%)
- *Antithamnionella spirographidis* (3.77%)
- *Aplidium glabrum* (3.71%)
- *Didemnum vexillum* (2.9%)
- *Melanothamnus harveyi* (2.32%)
- *Dasysiphonia japonica* (1.57%)
- *Asparagopsis armata* (1.07%)
- *Vertebrata fruticulosa* (1.07%)
- *Ulva australis* (1.01%)
- *Agarophyton vermiculophyllum* (0.98%)
- *Sargassum muticum* (0.75%)
- *Mycale (Carmia) micracanthoxea* (0.75%)
- *Diplosoma listerianum* (0.66%)
- *Crepidula fornicata* (0.55%)
- *Antithamnionella ternifolia* (0.52%)
- *Bonnemaisonia hamifera* (0.37%)
- *Perophora japonica* (0.37%)
- *Fenestrulina delicia* (0.17%)
- *Codium fragile* (0.14%)
- *cf. Grateloupia turuturu* (0.11%)
- *cf. Neodexiospira brasiliensis* (0.11%)
- *Diadumene lineata* (0.11%)
- *cf. Agardhiella subulata* (0.08%)
- *Undaria pinnatifida* (0.08%)

Oyster fisheries associated alien species in France

20 alien species in total



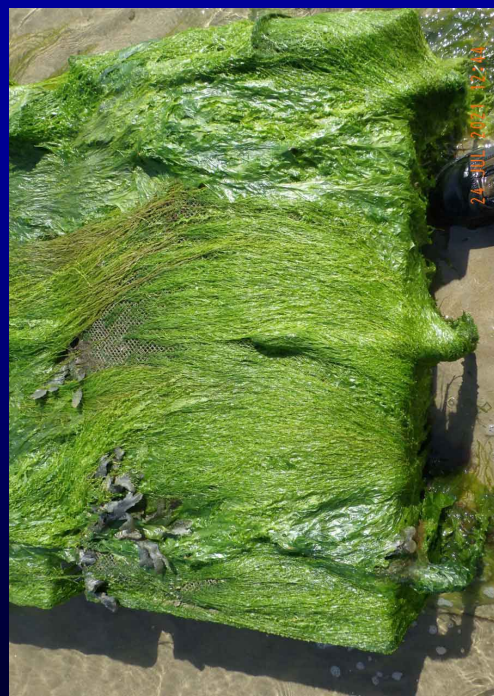
Botrylloides violaceus



Caulacanthus okamurae

Austrominius modestus

- *Austrominius modestus* (47,02%)
- *Caulacanthus okamurae* (16,09%)
- *Botrylloides violaceus* (8,2%)
- *Sargassum muticum* (6,8%)
- *Neodexiospira brasiliensis* (4,23%)
- *Dasysiphonia japonica* (4,17%)
- *Perophora japonica* (3,26%)
- *Melanothamnus harveyi* (2,3%)
- *Didemnum vexillum* (1,99%)
- *Aplidium glabrum* (1,73%)
- *Tricellaria inopinata* (0,89%)
- *Agardhiella subulata* (0,83%)
- *Diadumene lineata* (0,57%)
- *Antithamnionella ternifolia* (0,51%)
- *Diplosoma listerianum* (0,51%)
- *Ocinebrellus inornatus* (0,44%)
- *Ulva cf. pertusa* (0,19%)
- *Colpomenia peregrina* (0,06%)
- *Amphibalanus amphitrite* (0,06%)
- *cf. Ptilohyale littoralis* (0,06%)



Invasive species associated with oyster production areas

seaweed



sea-squirt



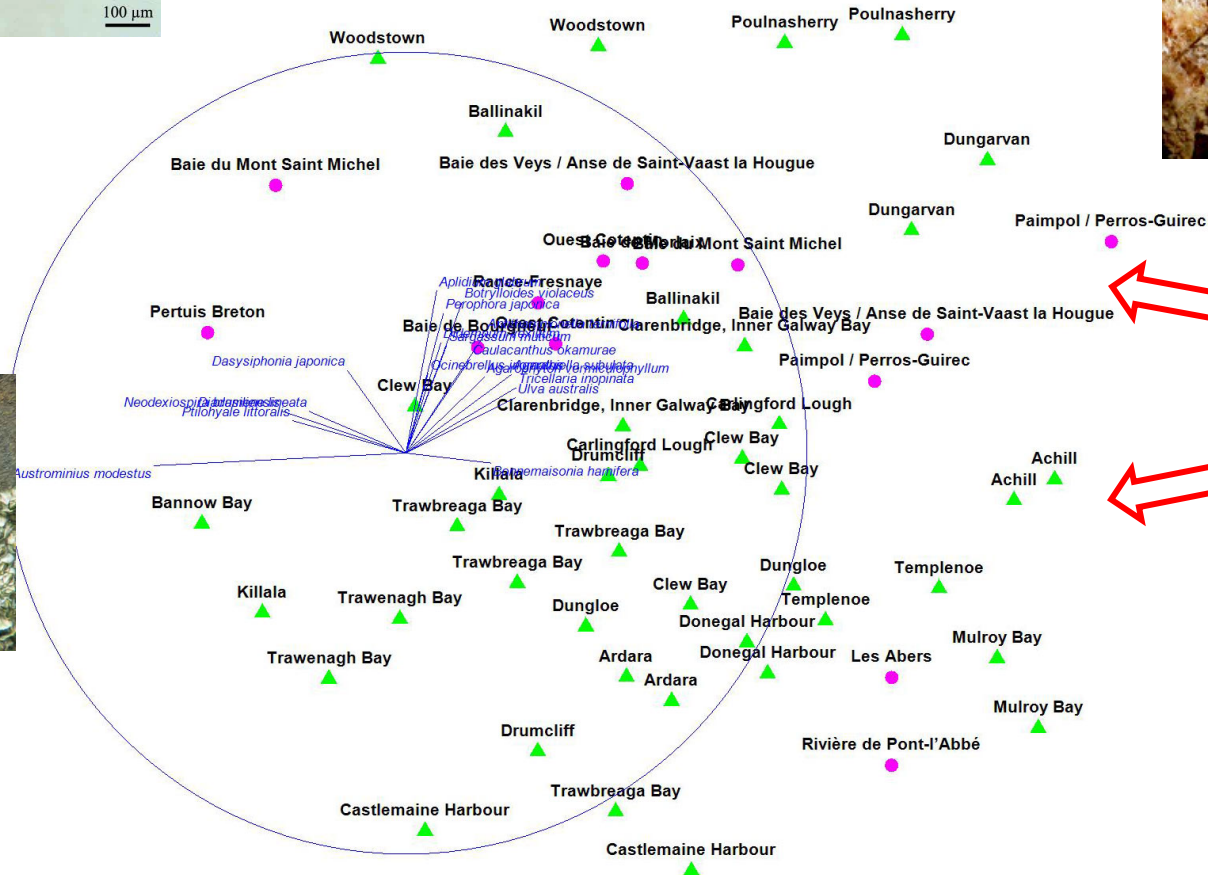
seaweed



bryozoan



barnacle



Dungarvan Galway Bay

Trawenagh Bay
Ardara
Donegal harbour

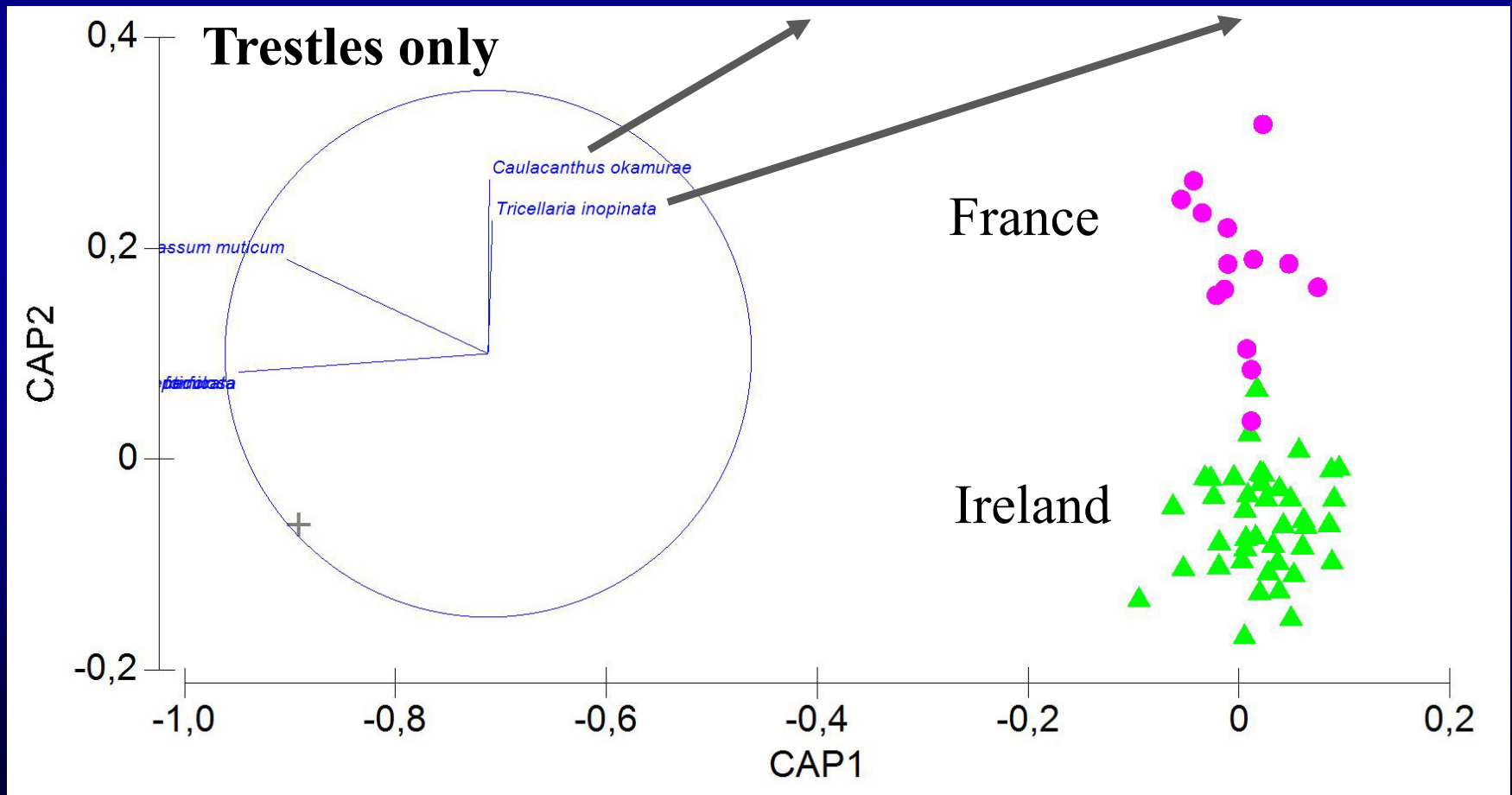
 France



Two alien species are typically associated with oyster production areas in France, and not in Ireland:

[1] *Caulacanthus okamurae*

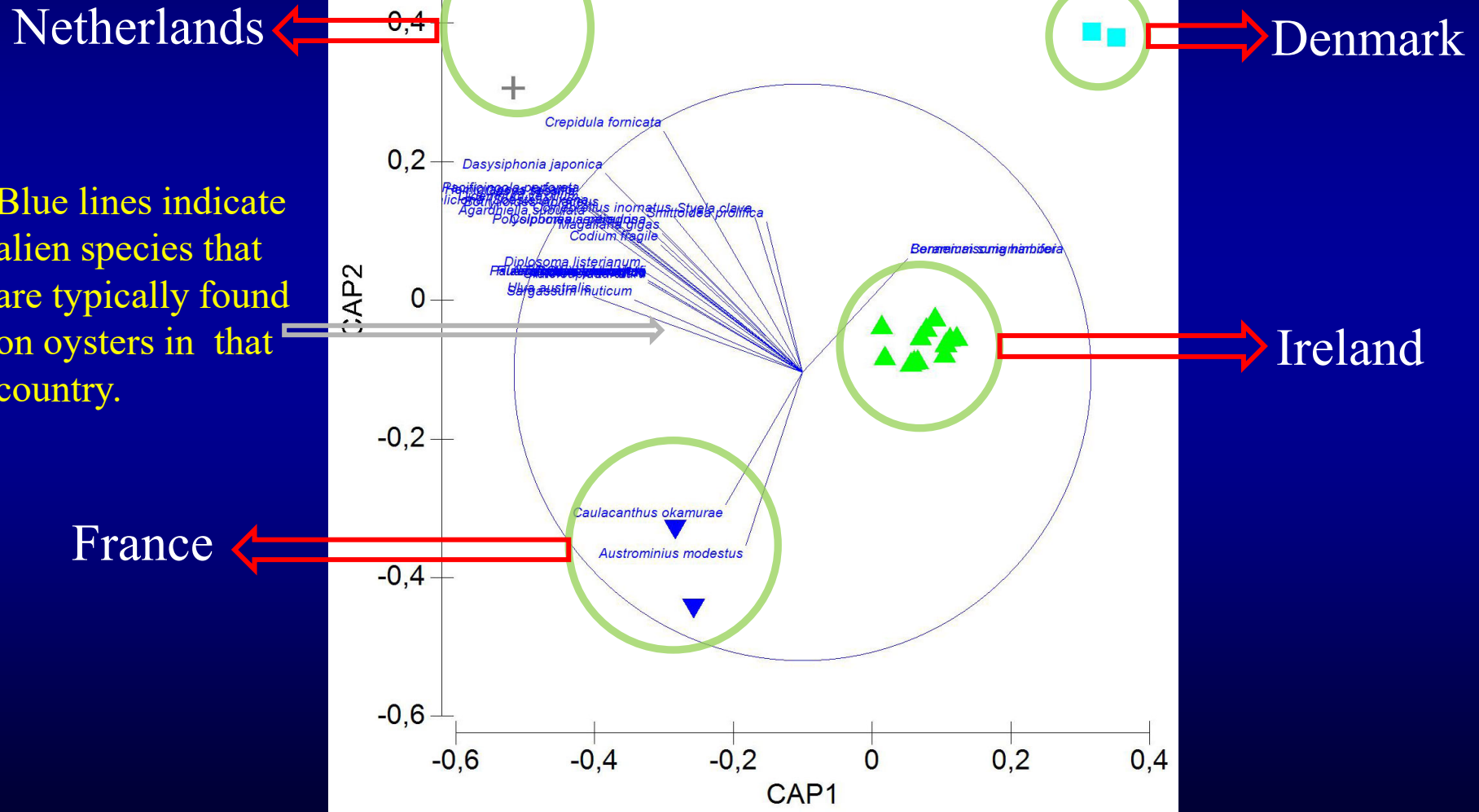
[2] *Tricellaria inopinata*



Okamura's Pom Pom Weed (*Caulacanthus okamurae*)



Alien species living among oysters on the bottom,
i.e. in areas with bottom culture / “wild fisheries”



Some conclusions...

- Alien species are found to be associated with specific shellfish species, e.g. mussels or oysters, and specific farming methods (habitats), e.g. rope culture, bottom culture, trestles, etc.
- Oyster production areas in NW Europe each have their own “unique” alien species associated to them.
- Risk of alien species being introduced with oyster transports, depends on export region, oyster size/age, and “farming” method.
- Okamura’s Pom Pom Weed (*Caulacanthus okamurae*), typically occurs in French oyster production areas but not in Ireland?

Not to forget...

- ... Pacific oyster drill *Ocenebrellus inornatus*
- ... Oyster herpes virus (OsHV-1)