Identifying stressors, related sectors, and the affected ecosystem components in the CCLME: a zoom in into **Invasive Alien Species**

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An Integrated Ecosystem Assessment (IEA) tool for evaluating Invasive Alien Species: ***ODEMM***

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An Integrated Ecosystem Assessment (IEA) tool for Invasive Alien Species: **ODEMM**

DPSIR framework: drivers, pressures, state, impact and response

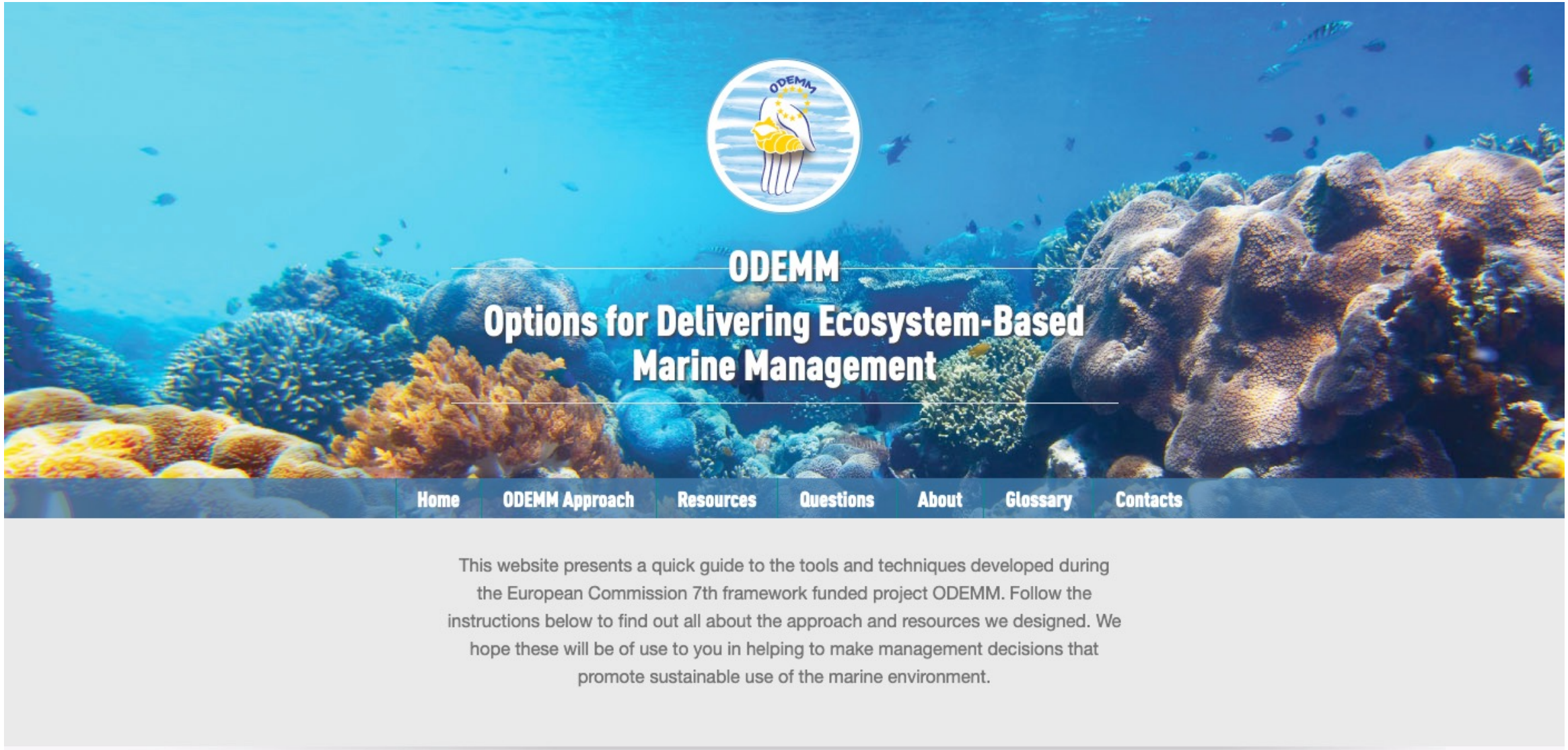
An Integrated Ecosystem Assessment (IEA) tool for Invasive Alien Species: **ODEMM**

DPSIR framework: drivers, pressures, state, impact, response

Disclaimer: I am not an ODEMM expert (but a user) nor on IAS (but there are in the audience)

What is **ODEMM**?

www.odemm.com



What is **ODEMM**?

Options for Delivering Ecosystem Based Marine Management

- **Goal:** Maps Sectors, Pressures and Ecological Characteristics
  - DPSIR framework: drivers, pressures, state, impact and response.
- **How**: Panel Assessment (can include stakeholders)
  - Three steps: (1) establish links, (2) score them and (3) review
- **Useful to** Filter – Prioritise
- **Aim:** distil complexity into interpretable graphs and tools

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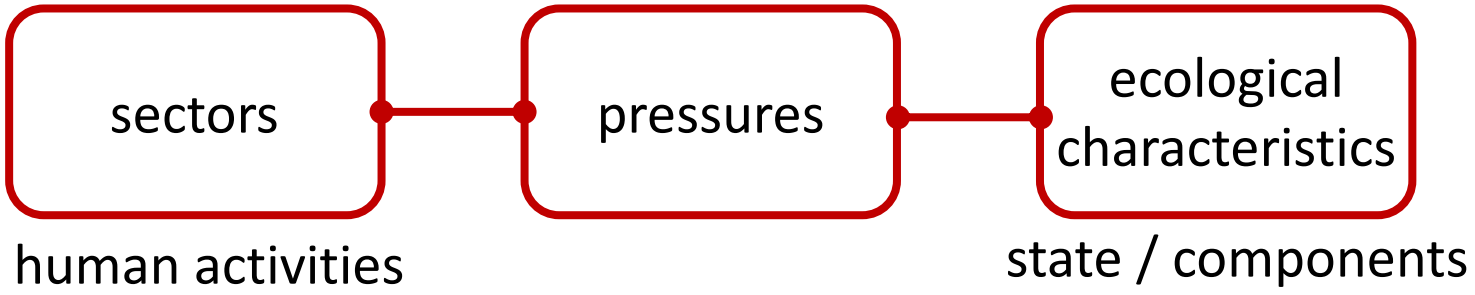
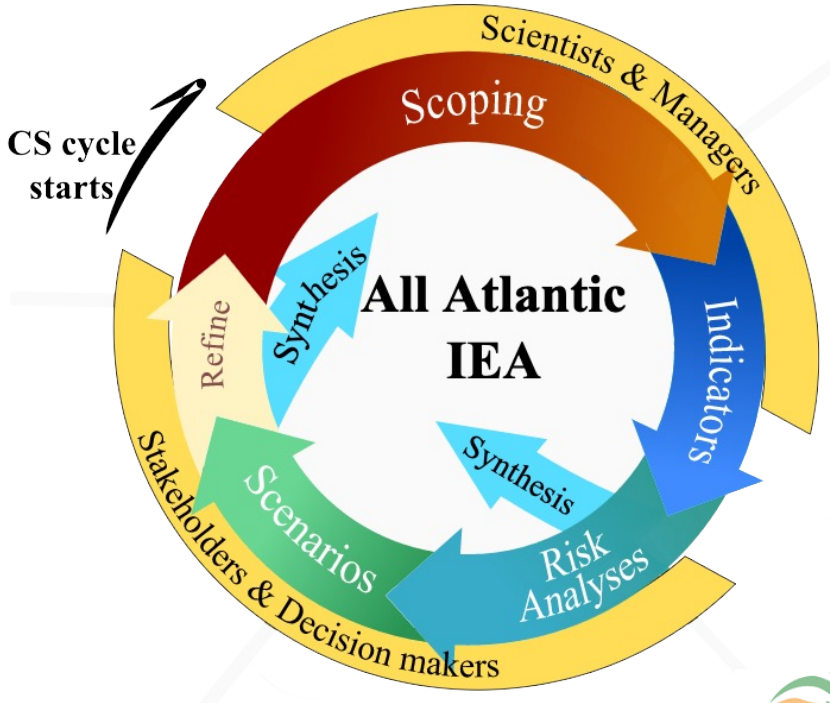
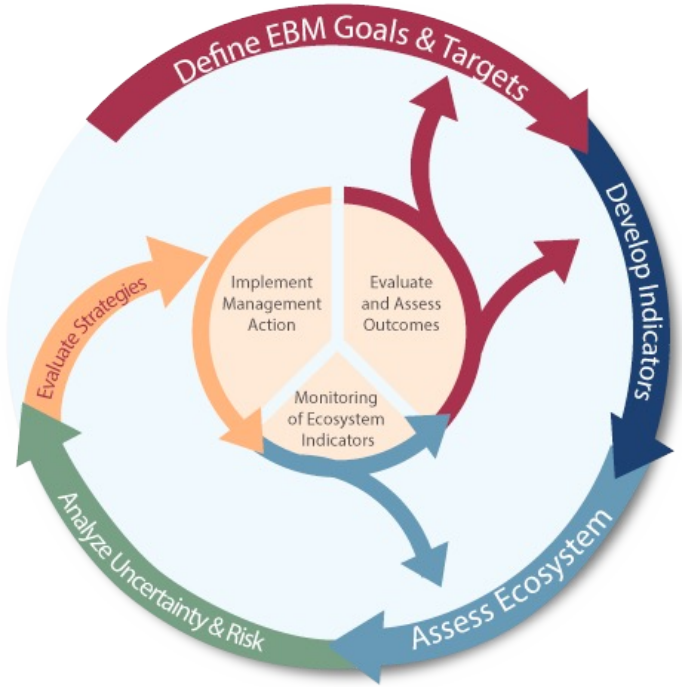


ODEMM in the **IEA cycle**

ODEMM is an Integrated Ecosystem Assessment (IEA) tool, presenting the first stage of scoping for IEA.





MISSION ATLANTIC

Levin *et al.* (2009) PLoS Biol

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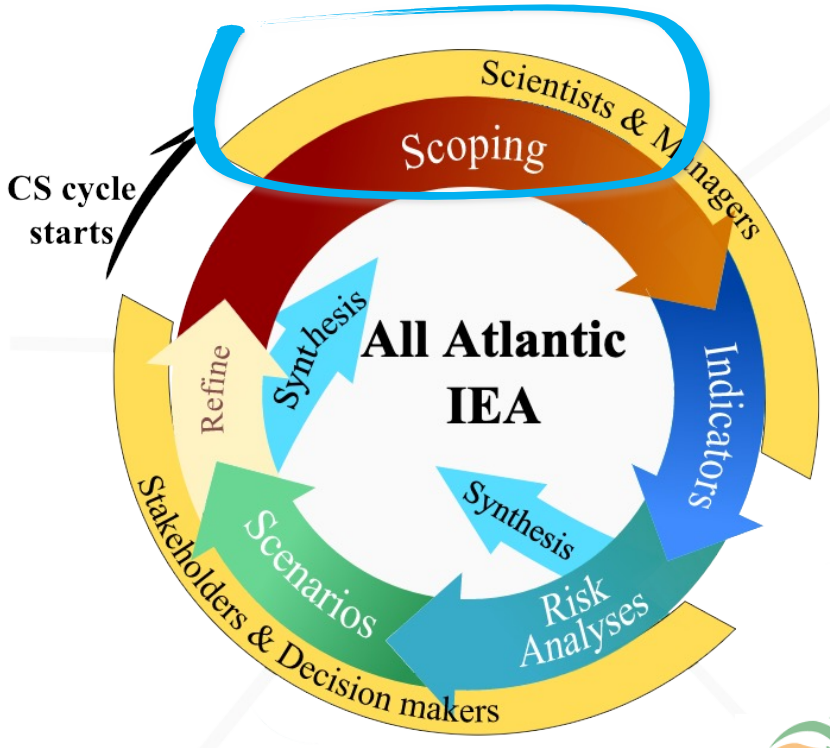

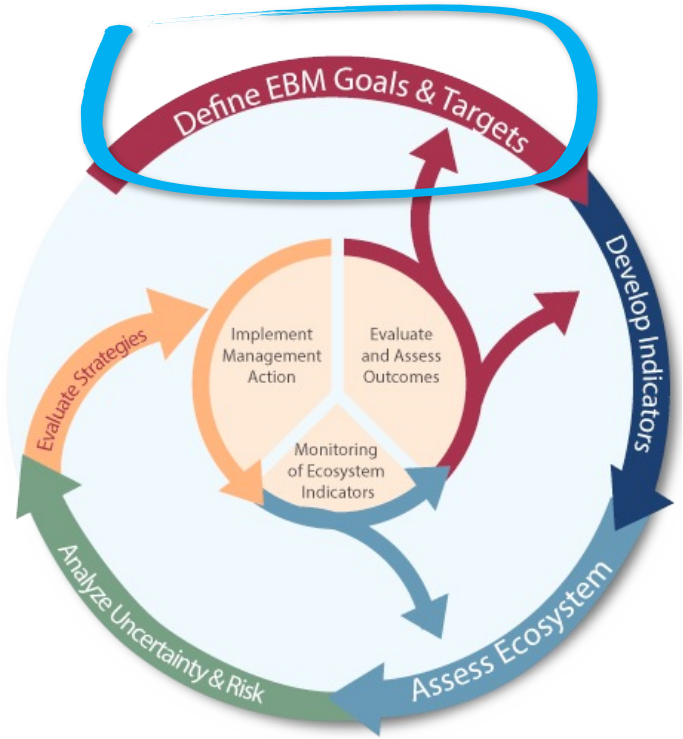

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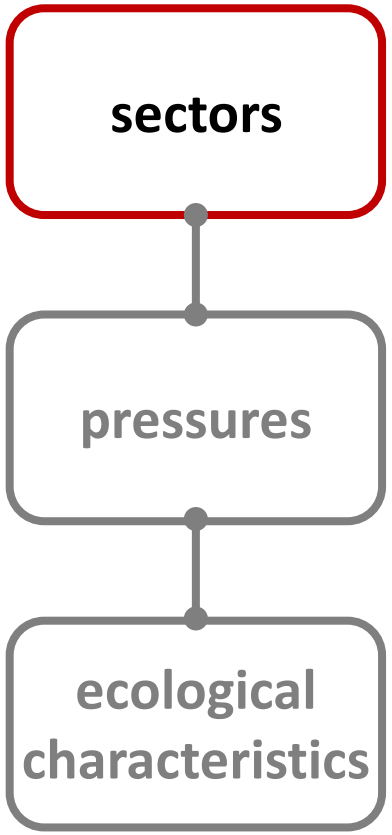
ODEMM **into greater detail**

Three-step process

1. Identify linkages
2. Score linkages
3. Analyse

pressure pathways or linkage chains

a. Linkage chain



- Aggregates
- Agriculture
- Coastal infrastructure
- Desalination
- Fishing
- Harvesting/collecting
- Land-based industry
- Military
- Navigational dredging
- Oil and gas (non-renewables)
- ~~Nuclear energy~~
- Renewable energy
- Research
- Shipping
- Telecommunications
- Tourism/recreation
- Waste Water treatment

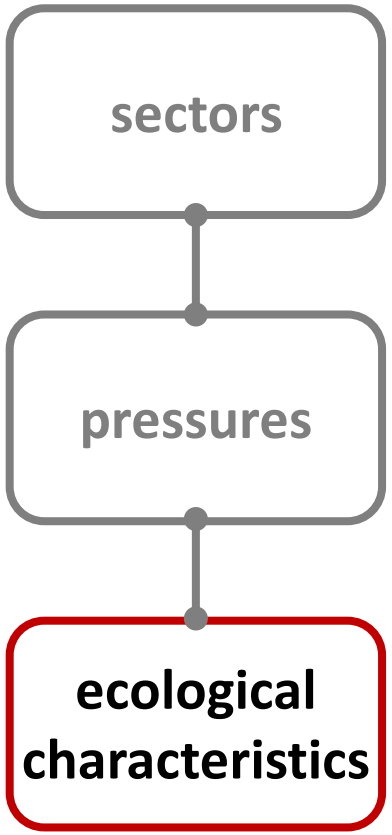
Sector	Description
Aggregates	Inorganic mine and particulate waste, maerl, rock/minerals (coastal quarrying), sand/gravel (aggregates).
Agriculture	Agricultural wastes, coastal farming, coastal forestry, land/waterfront run-off.
Aquaculture	Fin-fish, shellfish, macro-algae
Coastal Infrastructure	Artificial reefs, barrage, beach replenishment, communication infrastructure on the shoreline, construction phase, culverting lagoons, dock/port facilities, groynes, land claim, marinas, oil & gas infrastructure found on the coast rather in the marine environment (e.g. shore pipelines), urban dwellings (i.e. housing and other buildings).
Desalination	Operational (effluent discharge, abstraction of water)
Fishing	Benthic trawls and dredging, netting (e.g. fixed nets), pelagic trawls, potting/creeling, suction (hydraulic dredging).
Harvesting/Collecting	Bait digging, seaweed and saltmarsh vegetation harvesting, bird egg collecting, shellfish hand collecting, peels (boulder turning), curios (trampling)
Land-based Industry	Industrial effluent discharge, industrial/urban emissions (air), particulate waste.
Military	Military (ships, munitions).
Navigational Dredging	Capital dredging, maintenance dredging, removal of substrate, spoil dumping.
Non-renewables (Oil & Gas)	Oil and gas power stations, thermal discharge (cooling water), water resources (abstraction).
Nuclear Energy	Power stations (land-based) - construction (jetties and intake wells - habitat change, sealing, increased turbidity, noise), abstraction of water, thermal discharge of cooling water, contamination, etc.
Renewable Energy	Renewable (tide/wave/wind) power stations.
Research	marine archaeology, activities undertaken as part of marine research (e.g. survey cruises, grab sampling, trawls etc).
Shipping	Litter and debris, mooring/beaching/launching, shipping, shipping wastes.
Telecommunications	Communication cables.
Tourism/Recreation	Angling, boating/yachting, diving/dive site, public beach, tourist resort, water sports.
Waste Water Treatment	Sewage discharge, thermal discharge

Linkage chain

- Sealing
- Siltation/Smothering
- Abrasion
- Selective extraction of non-living resources
- Underwater noise
- Harvesting/collecting
- Marine litter
- Thermal regime changes
- Salinity regime changes
- Contaminants
- Organic matter
- Introduction of non indigenous sp.
- Selective extraction of sps.
- By-catch
- Incidental loss of sps.
- Barriers
- Change in wave exposure
- Water current changes
- PH changes
- Electromagnetic changes

Type	Pressure	Description
Physical Loss	**Substrate Loss (Sealing)**	Sealing by permanent construction (e.g. coastal defences, wind turbines) or change in substrate type due to loss of key characteristic features (physical and/ or biological). Natural substrate loss and replacement by a different kind of substrate. Loss of seal haul-out sites. Loss of roosting/nesting/foraging areas of bird. Loss of nursery grounds for fish.
Physical damage	**Changes in siltation/ Smothering**	Change in the concentration and/or distribution of suspended sediments in the water column from runoff, dredging etc. or smothering by man-made structures or disposal of materials to the seafloor.
	Abrasion	Physical interaction of human activities with the seafloor and with seabed fauna/flora causing physical damage and/or mortality (e.g. from trawling or anchoring), excluding death or injury due to collision. Abrasion may cause damage to spawning grounds.
	Selective Extraction of Non-living Resources	Sand & gravel (aggregates) extraction, or removal of surface substrates for exploration of subsoil.
Other physical disturbance	**Underwater noise**	Underwater sound from anthropogenic sources (e.g. shipping, fishing, geological investigations, harbour operations).
	Marine Litter	Marine litter originates from numerous sources and consists of different materials including metal, glass, rubber, wood, cloth and plastics (including microparticles of plastics).
Interference with hydrological processes	**Thermal regime changes**	Change in temperature (average, range and variability) due to outfalls/industry
Interference with chemical composition of water	**Salinity regime changes**	Change in salinity (average, range and variability) due to constructions affecting water flow.
Contamination by hazardous substances	**Introduction of Contaminating compounds**	Introduction of pesticides, antifoulants, pharmaceuticals, heavy metals and hydrocarbons into marine waters.
Nutrient and organic matter enrichment	**Input of Organic Matter (including N&P)**	Organic enrichment e.g. from industrial and sewage effluent input and/or fertilisers, and other nitrogen & phosphorous rich substances into rivers and coastal areas. Include organic discards e.g. from aquaculture or fishing discards
Biological disturbance	**Introduction of non-indigenous spp and translocations**	Introduction of non-indigenous species and translocations of species by the activities of a particular sector (e.g. through shipping or aquaculture
	Selective extraction of species	**Targeted** extraction of species.
	By-catch	Unwanted/illegal catch (that ends up in the net/on board)
	Inicidental Loss of spp. Death or injury by collision	Collateral damage of all species (e.g. collisions with ships/ gear). Entanglement in fishing and aquaculture nettings.
	Barrier to species movement	Preventing the natural movement of motile marine fauna along a key route of travel (e.g. migration or foraging routes) due to barrages, causeways, **wind turbines**, weirs and other man-made installations and structures.
Interference with hydrological processes	**Change in wave exposure**	Changes to natural sea level regime (average, range and variability) due to barrages or other structures. Change in the size, number, distribution and/or periodicity of waves along a coast due to installation of structures.
	Water current changes	Change in currents (speed, direction, and variability) due to barrages or other man-made structures.
Interference with chemical composition of water	**pH changes**	Change in pH (average, range or variability) due runoff from land-based industry and agriculture, aquaculture activities or point-source discharges. Here, pH changes exclude ocean acidification (i.e. the reduction in pH of the ocean over an extended period, typically decades or longer, caused primarily by the uptake of anthropogenic carbon dioxide from the atmosphere)
	Electromagnetic changes	Change in the amount and/or distribution and/or periodicity of electromagnetic energy emitted in a marine area (e.g. **from electrical sources such as underwater cables**).

a. Linkage chain



- Fish: pelagic, demersal, deep-sea
- Elasmobranchs: pelagic, demersal, deep-sea
- Cephalopods
- Reptiles
- Seabirds
- Marine mammals
- Littoral: rock, sediment
- mangroves
- salt marshes
- Shallow: rock, sediment
- Shelf: rock, sediment
- Slope: rock, sediment
- Deep-sea: rock, sediment
- Pelagic: coastal, shelf, oceanic

SPECIES GROUPS CONSIDERED INDEPENDENTLY OF BENTHIC HABITATS	
Fish	Pelagic, Demersal, Deep-Sea
Elasmobranchs	Pelagic, Demersal, Deep-Sea
Cephalopods	All
Reptiles	All
Marine Birds	All
Marine Mammals	Pinnipeds, Toothed and Baleen Whales

HABITATS ARE CONSIDERED INCLUDING ALL FAUNA NOT SPECIFICALLY INCLUDED SEPARATELY ABOVE		
Ecological Characteristic	**Description**	
Littoral rock & biogenic reef	Littoral	
Littoral sediment		
Mangroves	Mangroves wooded habitats consisting of trees and shrubs that grow in coastal saline or brackish water (coastal intertidal zone)	Could be considered under littoral, but participants felt as unique habitats should be considered separately
Saltmarshes	rdin	Could be considered under littoral, but participants felt as unique habitats should be considered separately
Shallow sublittoral rock & biogenic reef	Shallow (less than 50 m)	
Shallow sublittoral sediment		
Shallow sublittoral mud		
Shelf rock & biogenic reef	Shelf (50 – 199 m)	
Shelf sediment		
Slope rock & biogenic reef	Slope (200 – 749 m)	
Slope sediment		
Deep Sea rock & biogenic reef	(greater than 750 m)	
Deep Sea sediment		
Coastal Pelagic	(Water Framework Directive transitional water boundary out to the 50 m contour)	
Shelf Pelagic	Coastal water body outer limit to 200 m depth	
Oceanic Pelagic	Greater than 200 m depth	

b. Scoring

Three-step process

a. Identify linkages
b. Score linkages
   1. Spatial extent (overlap)
   2. Frequency of occurrence
   3. Degree of Impact (severity/magnitude)
c. Analyse

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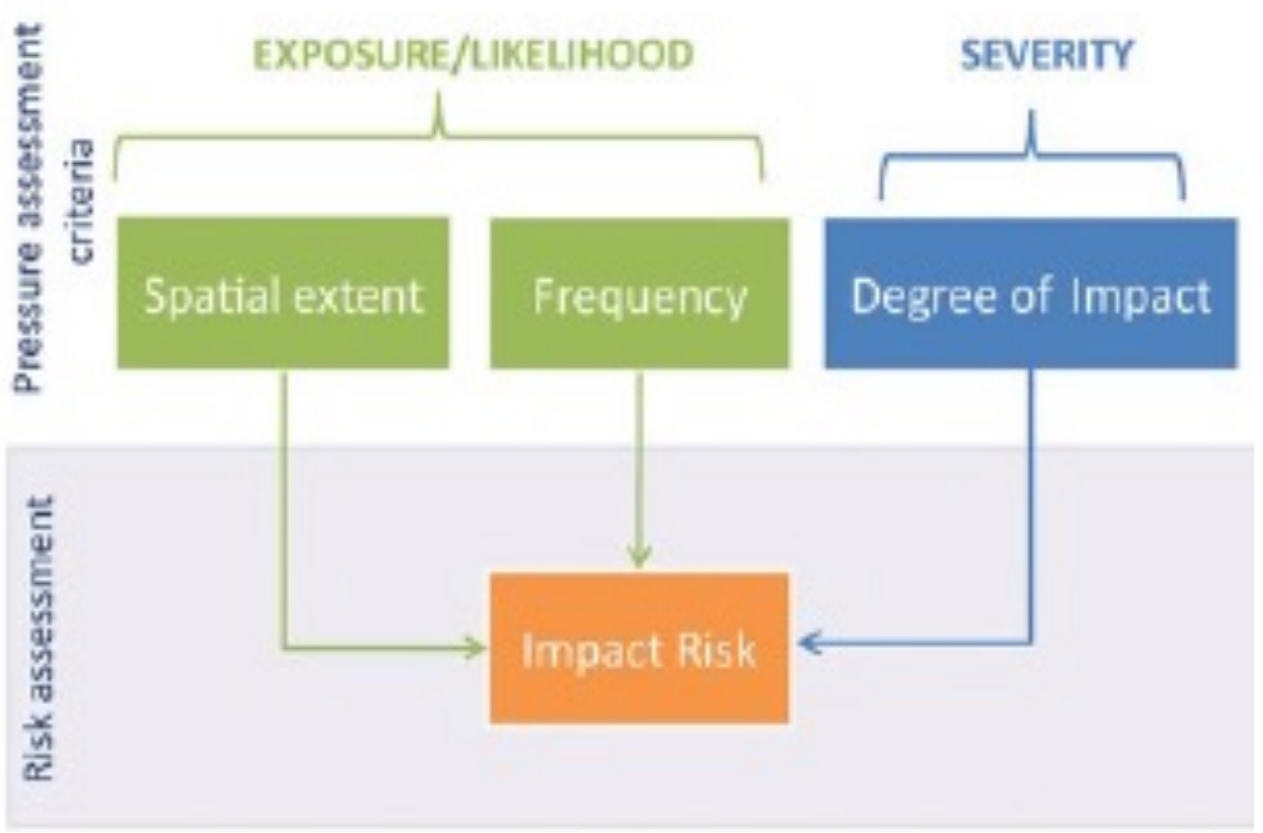
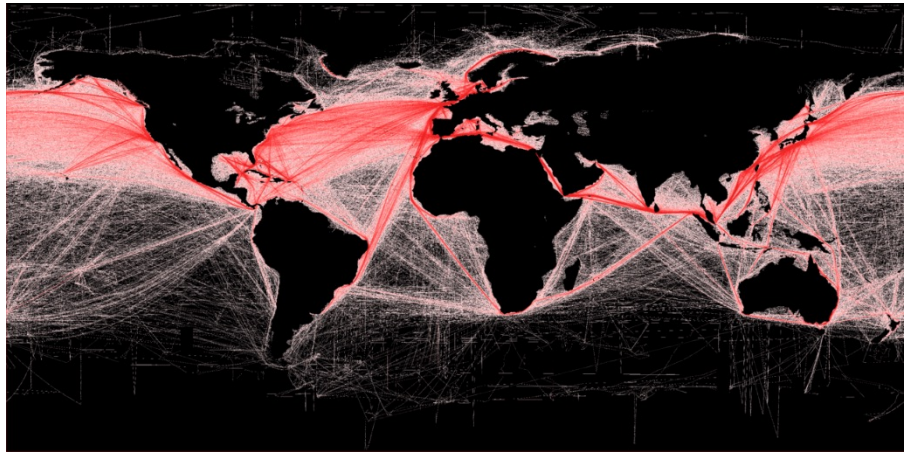
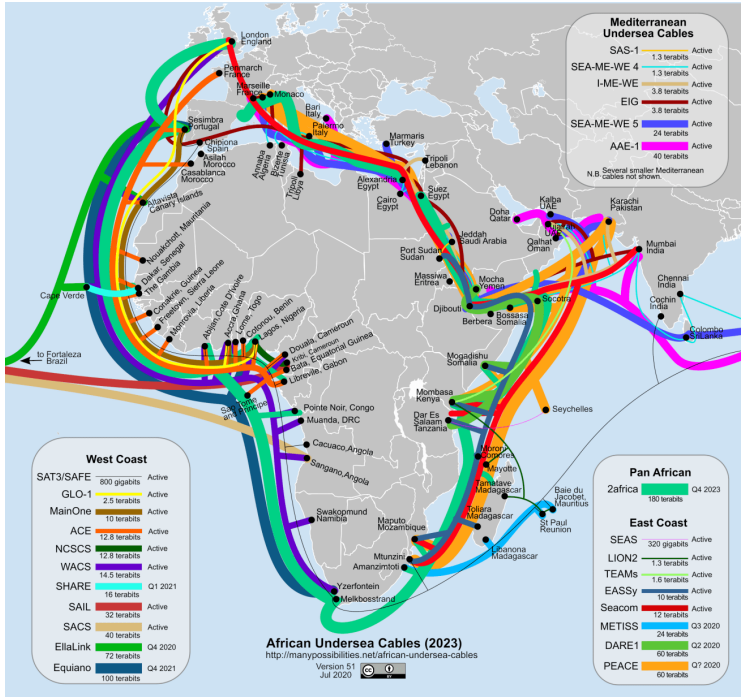


Spatial extent

1. **Spatial extent** (overlap): site (<5%), local (<50%), widespread even or patchy (>50%)
2. **Frequency** of occurrence: rare (1 month), occasional (4), common (8), persistent (12)
3. Degree of **impact** (severity magnitude): low, chronic, acute



shipping routes



cables (telecommunications)

Frequency

1. **Spatial extent** (overlap): site (<5%), local (<50%), widespread even or patchy (>50%)
2. **Frequency** of occurrence: rare (1 month), occasional (4), common (8), persistent (12)
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fishing bans

Degree of Impact

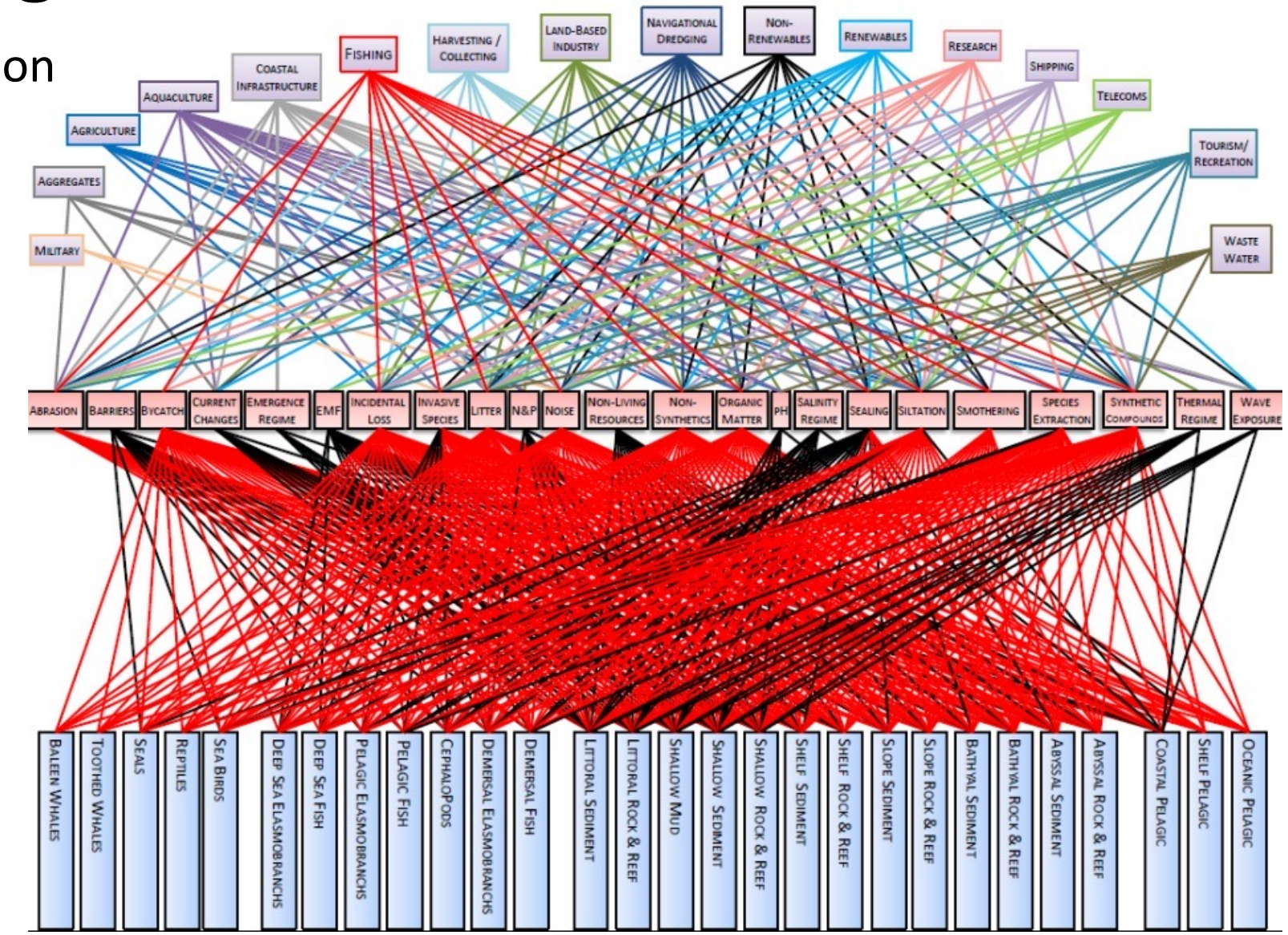
1. **Spatial extent** (overlap): site (<5%), local (<50%), widespread even or patchy (>50%)
2. **Frequency** of occurrence: rare (1 month), occasional (4), common (8), persistent (12)
3. Degree of **impact** (severity magnitude): low, chronic, acute

fishing bans

death (acute)

RESULT: **horrendograms!**

no matter which representation



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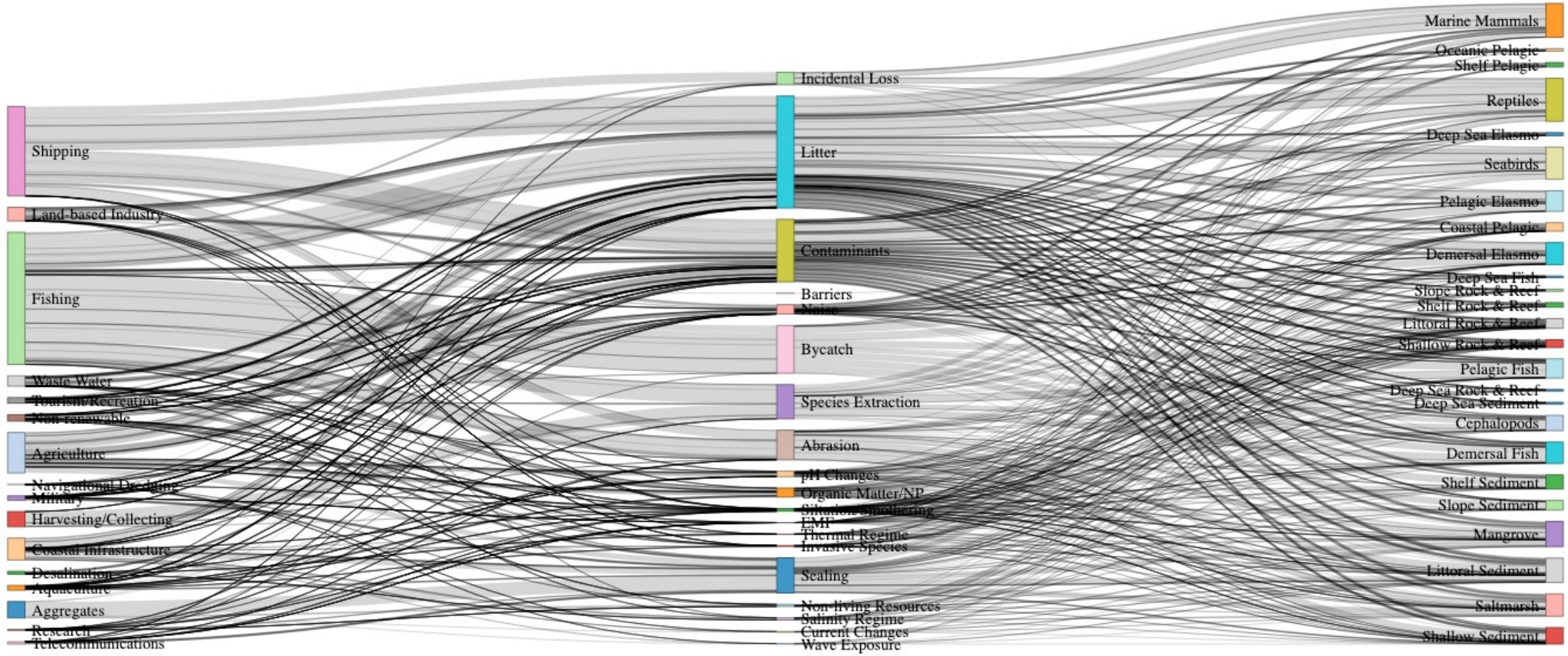

https://rpubs.com/edraro/sankey

RESULT: **horrendograms!**

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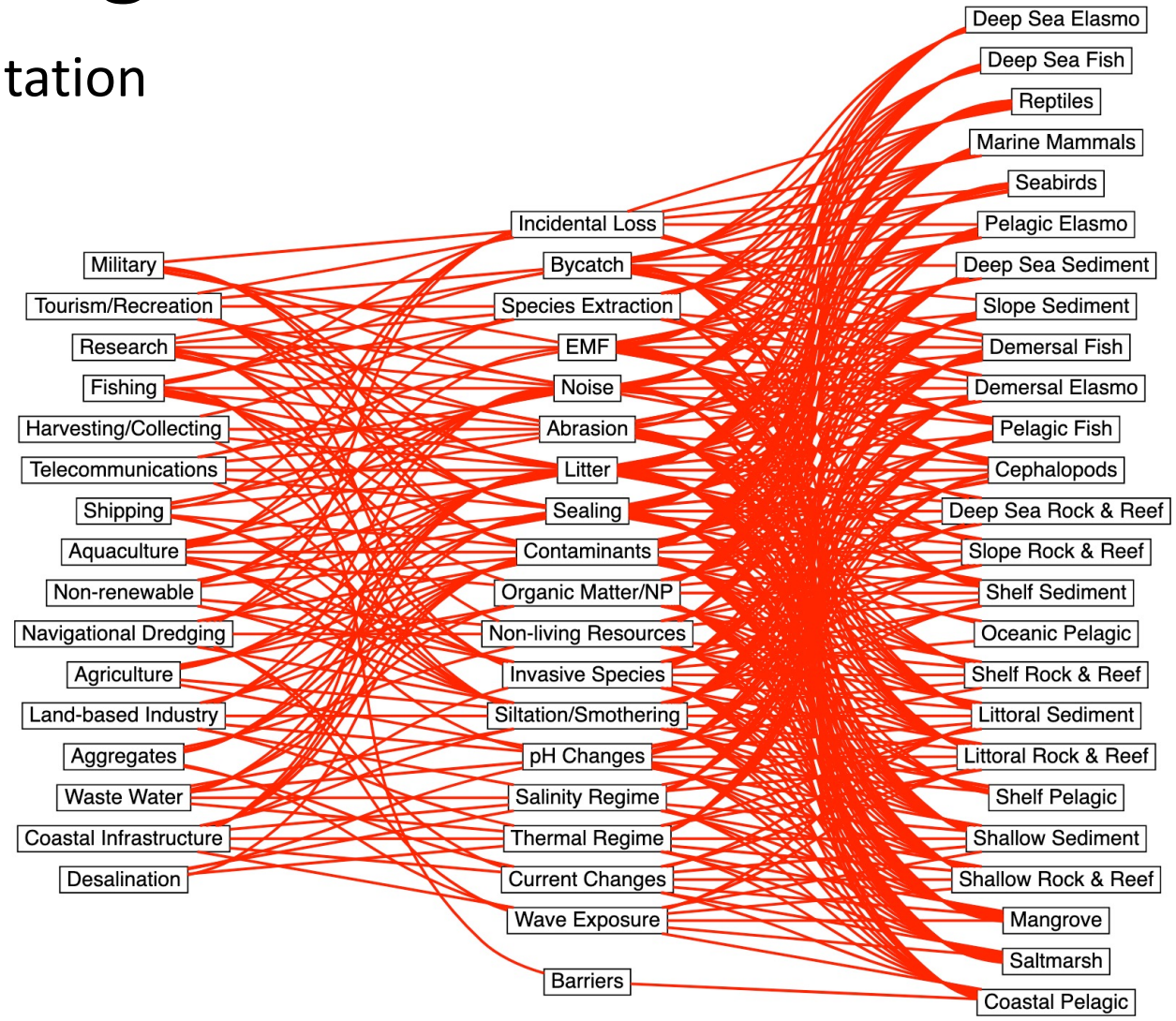

https://edraro.shinyapps.io/plots_ODEMM/

RESULT: **horrendograms!**

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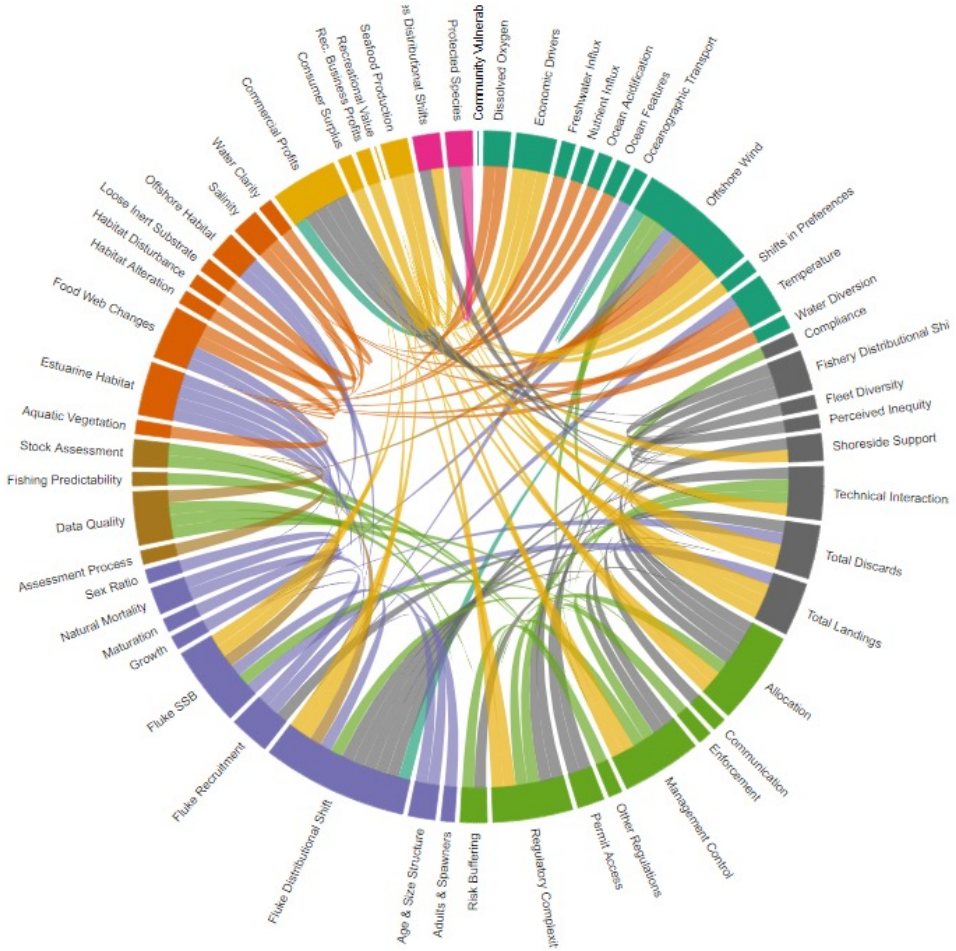

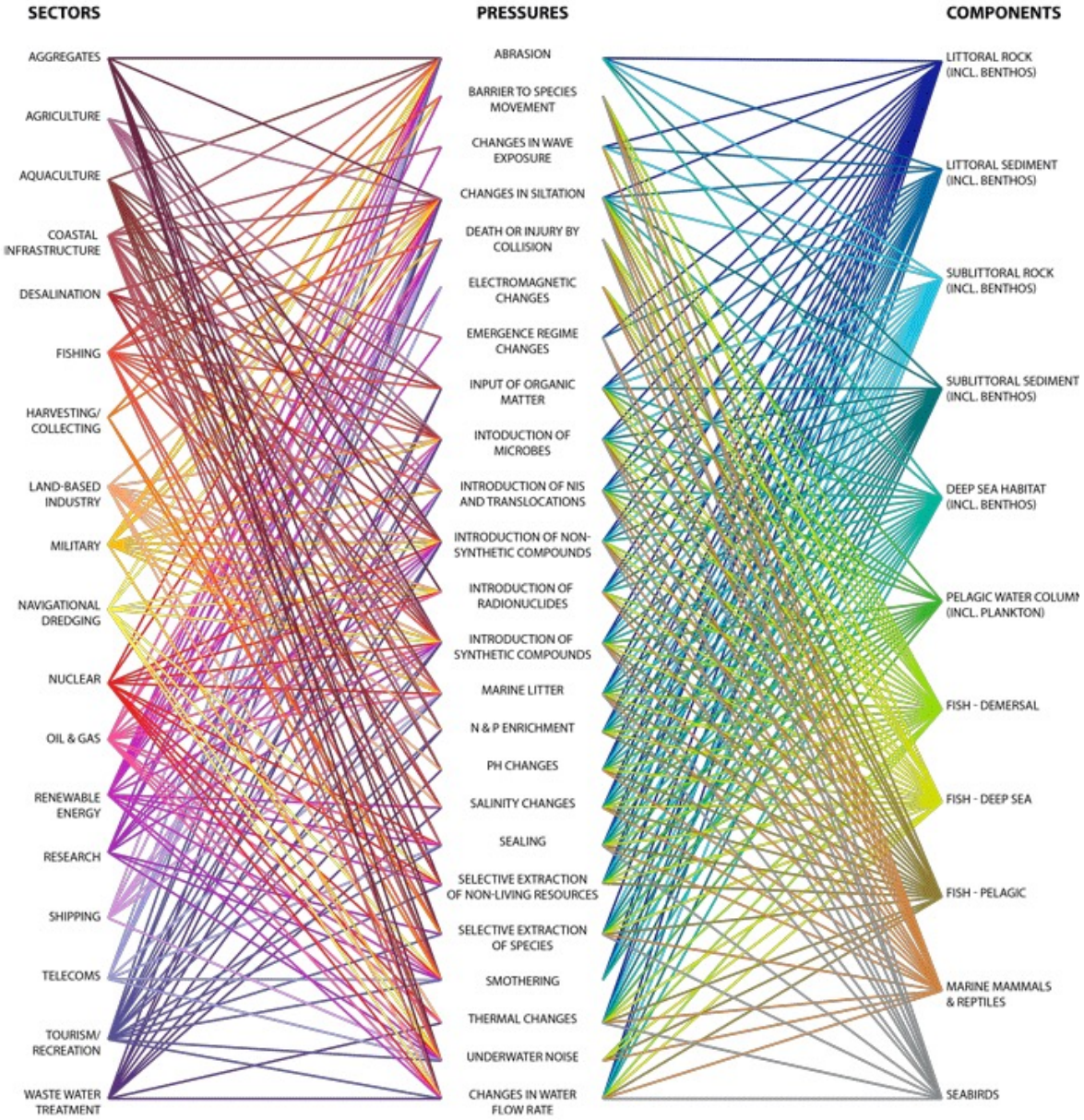

horrendograms!

Three-step process

a. Identify linkages

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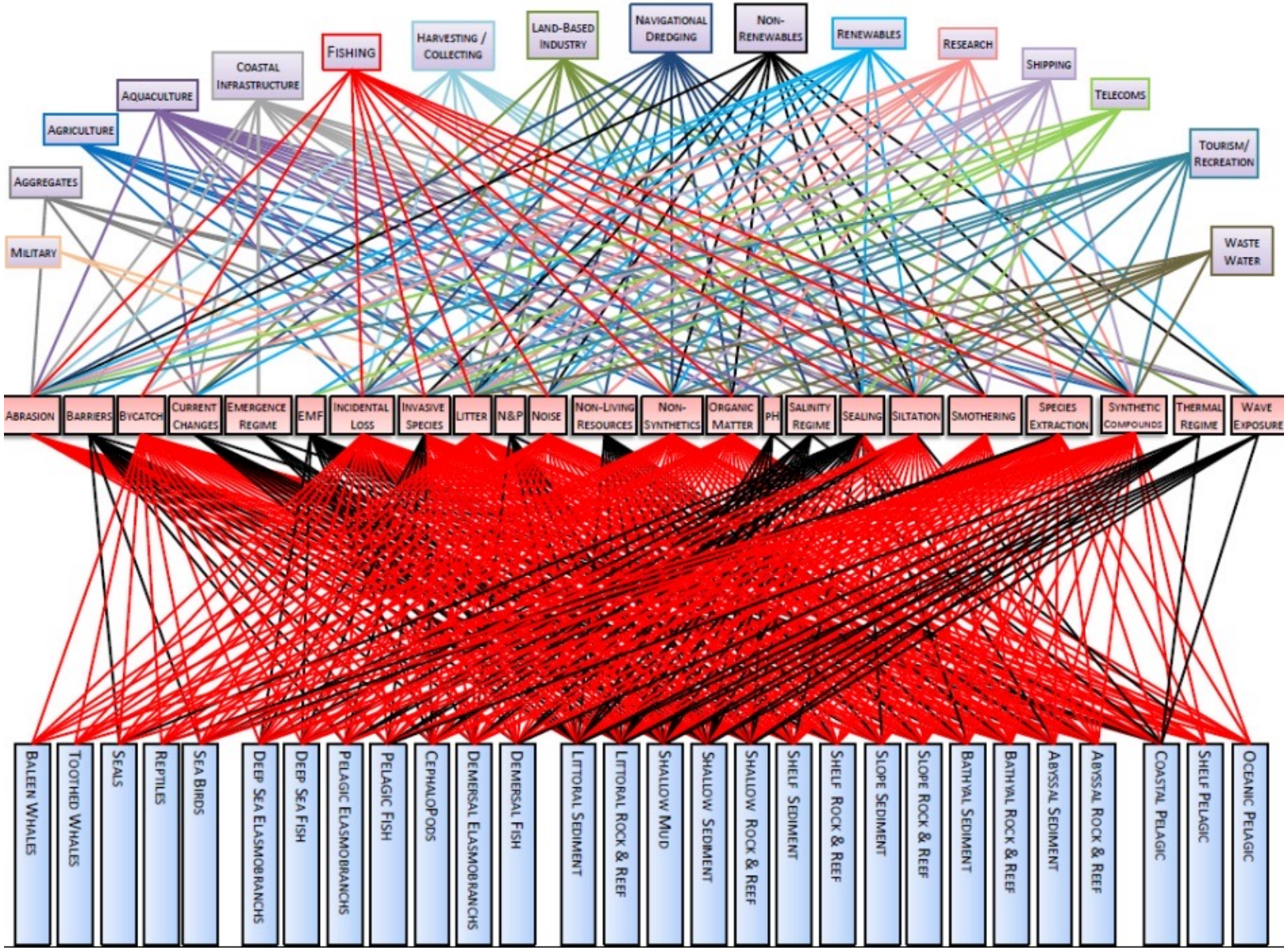
c. Analyse



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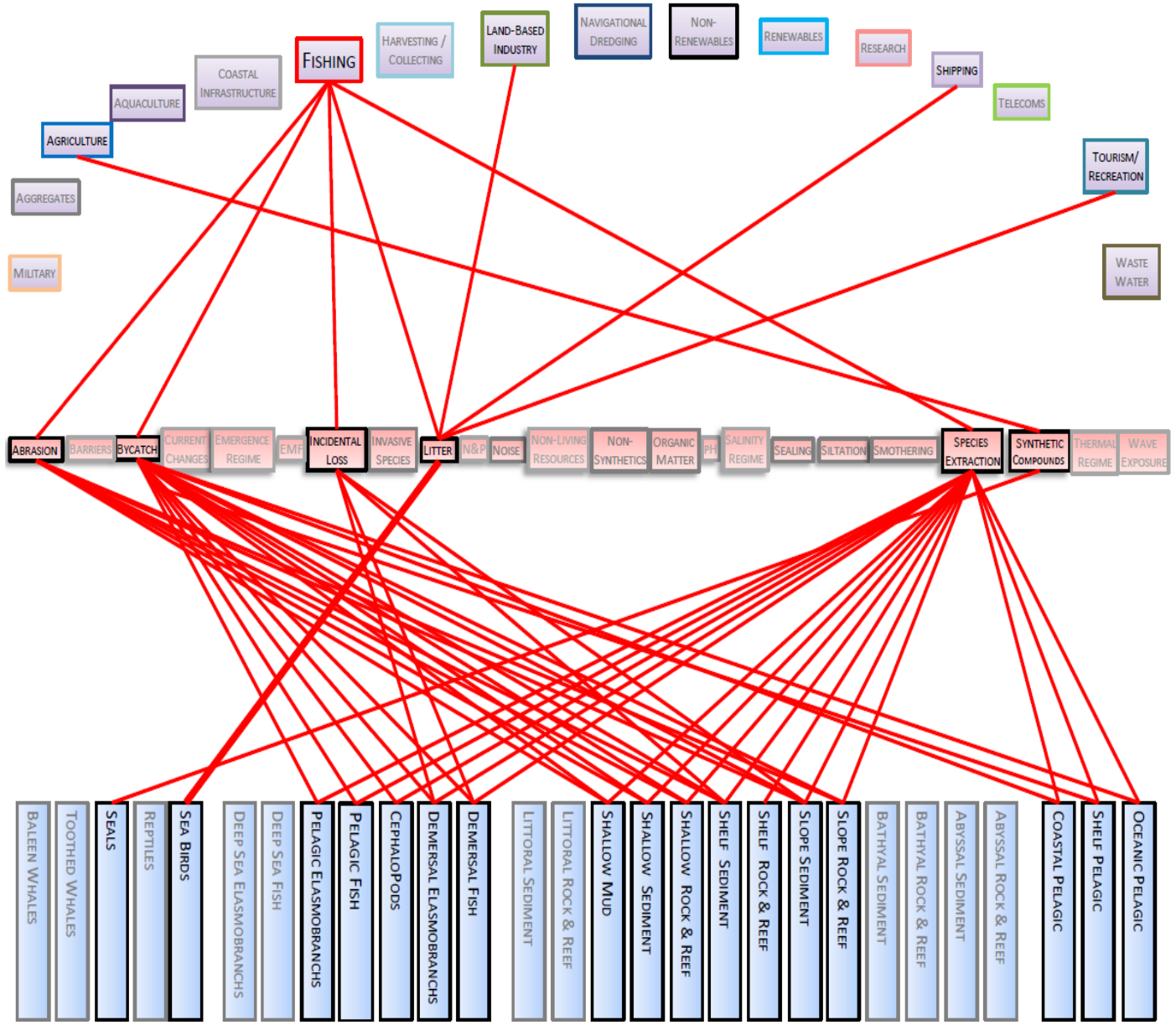
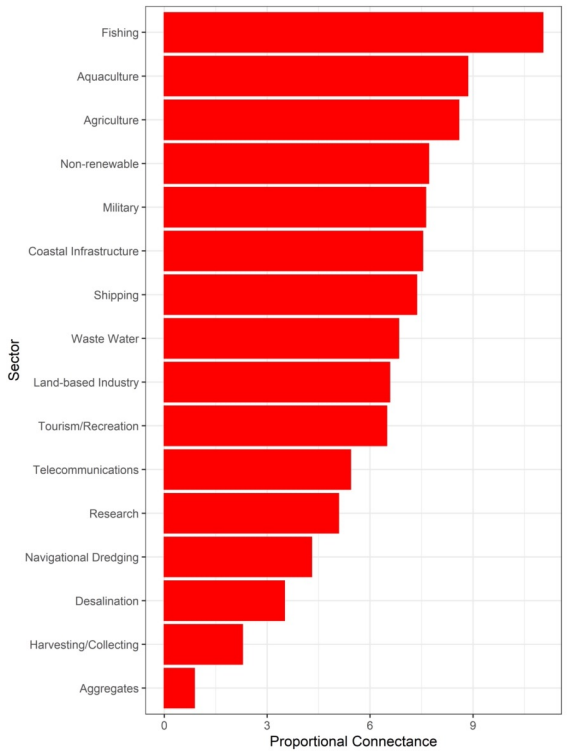
1874 links

59 links

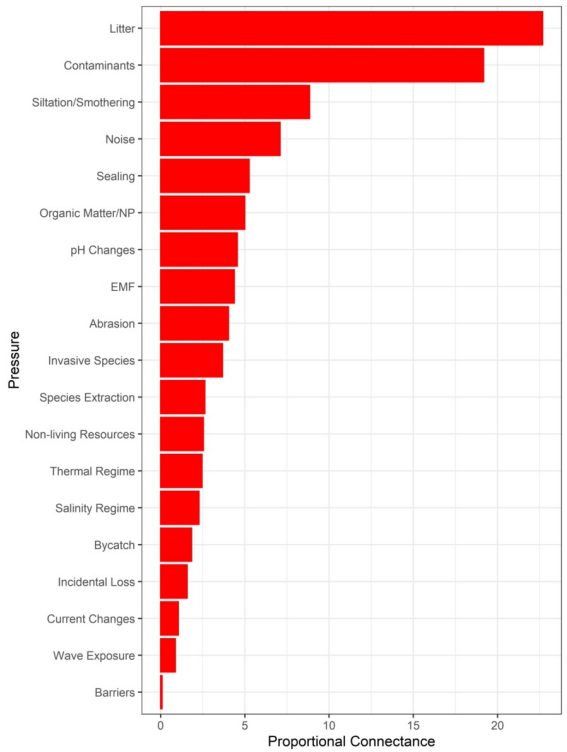


CONNECTANCE

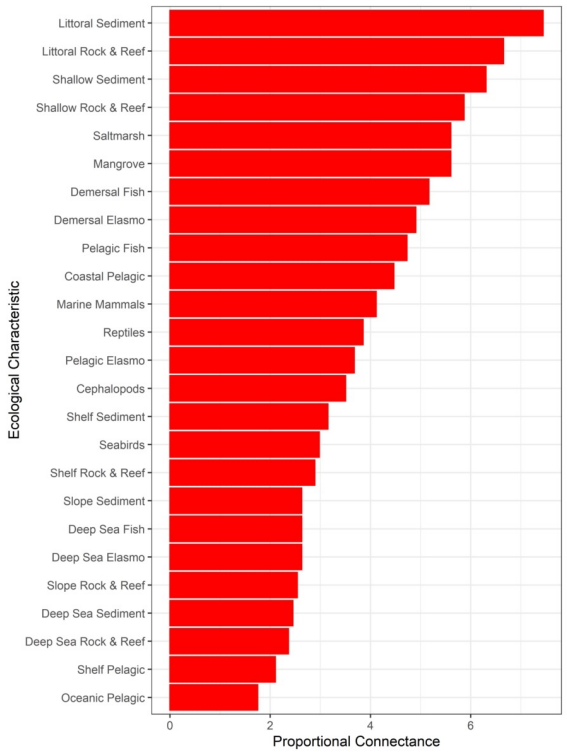
sectors



pressures



ecological charac.



SECTORS

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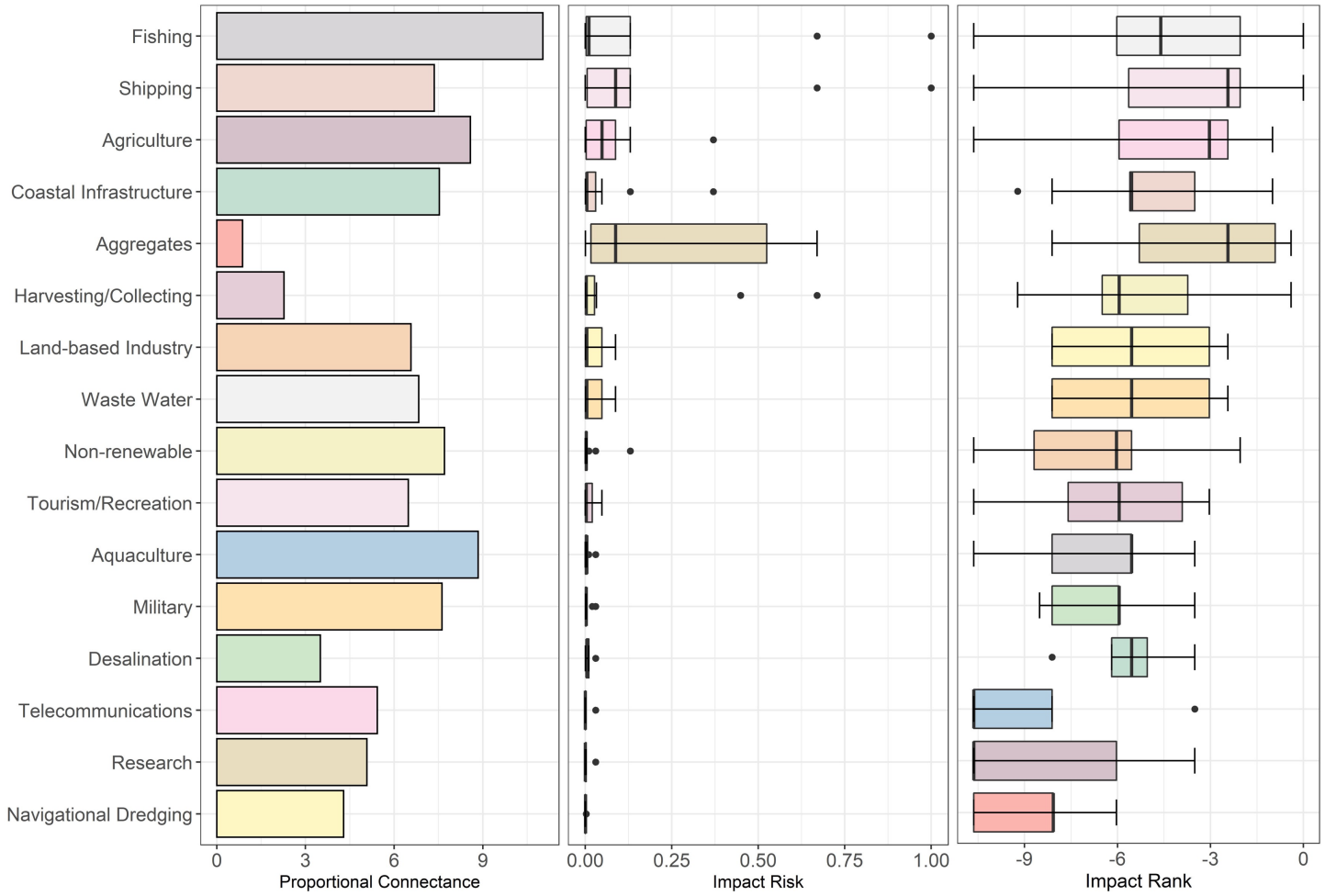

PRESSURES

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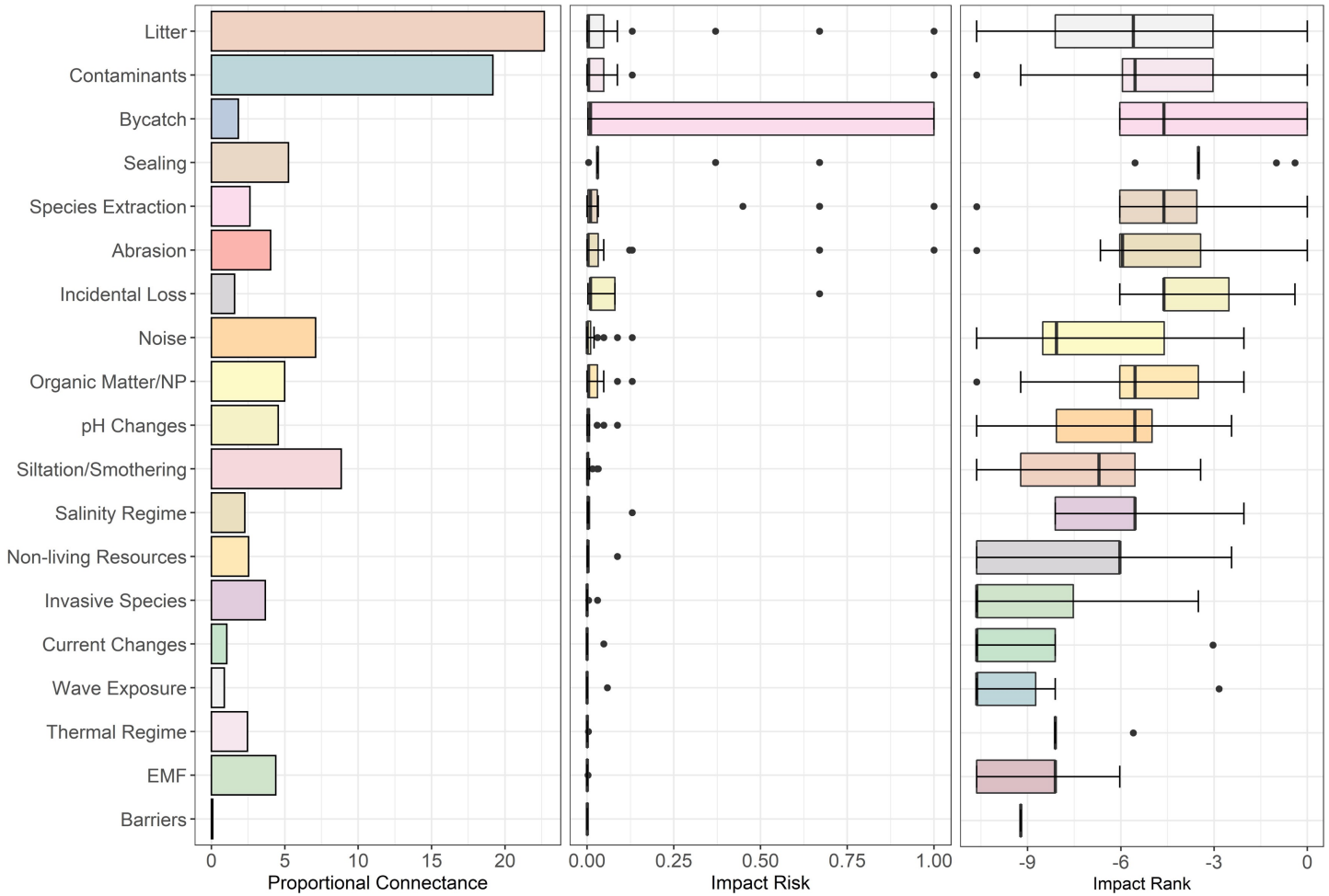

ECOLOGICAL CHARACTERISTICS

Three-step process

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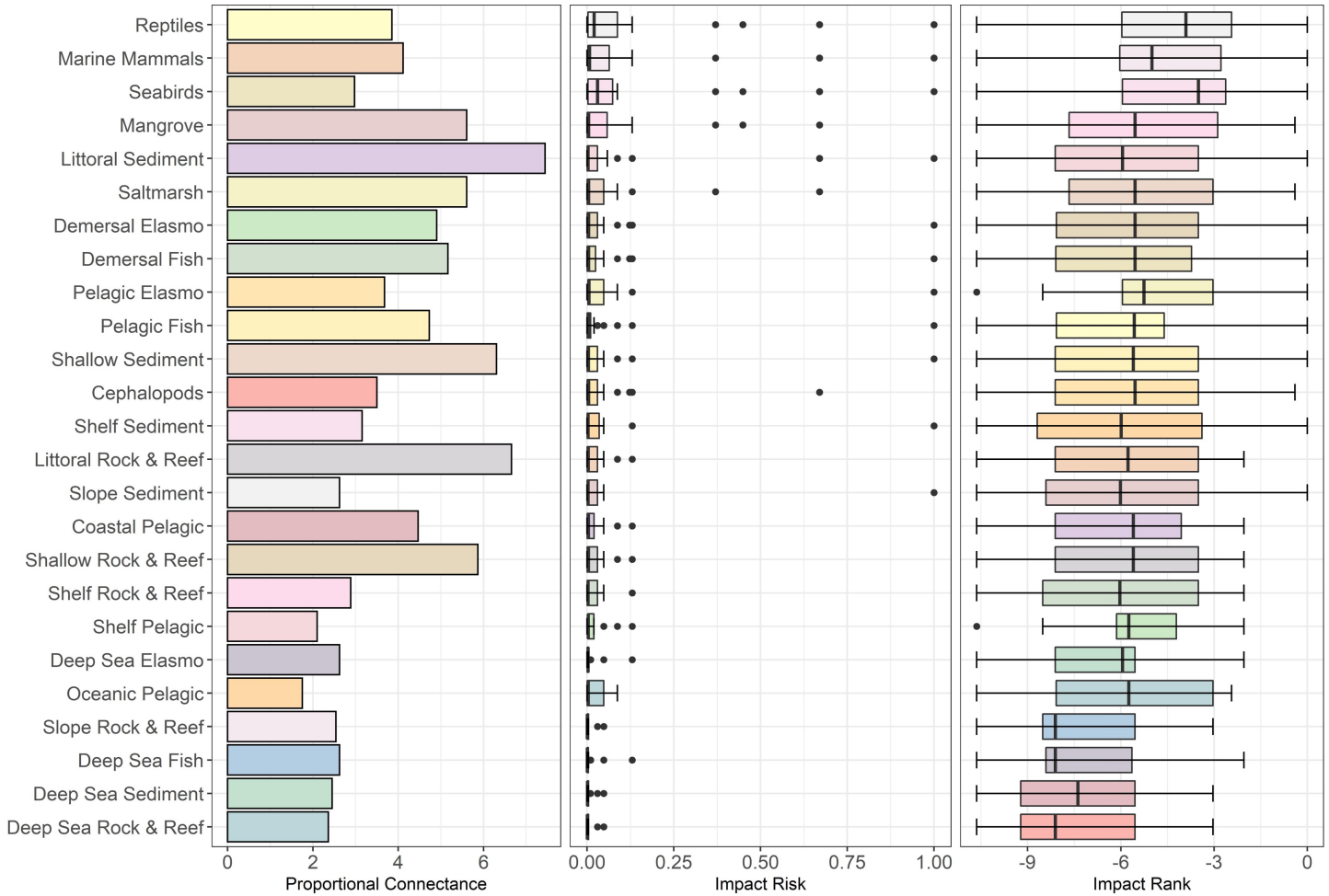
b. Score linkages

c. Analyse



ECOLOGICAL CHARACTERISTICS

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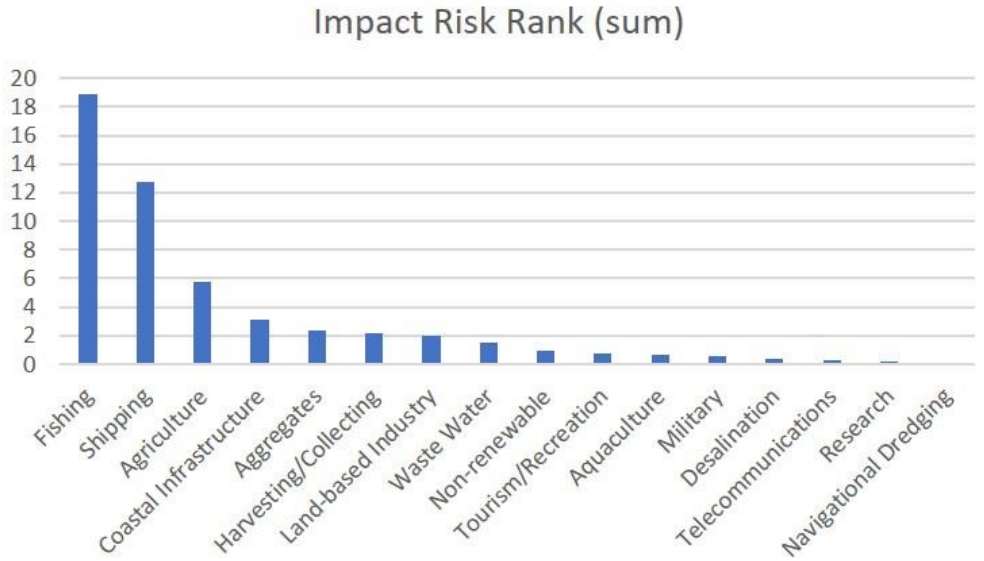
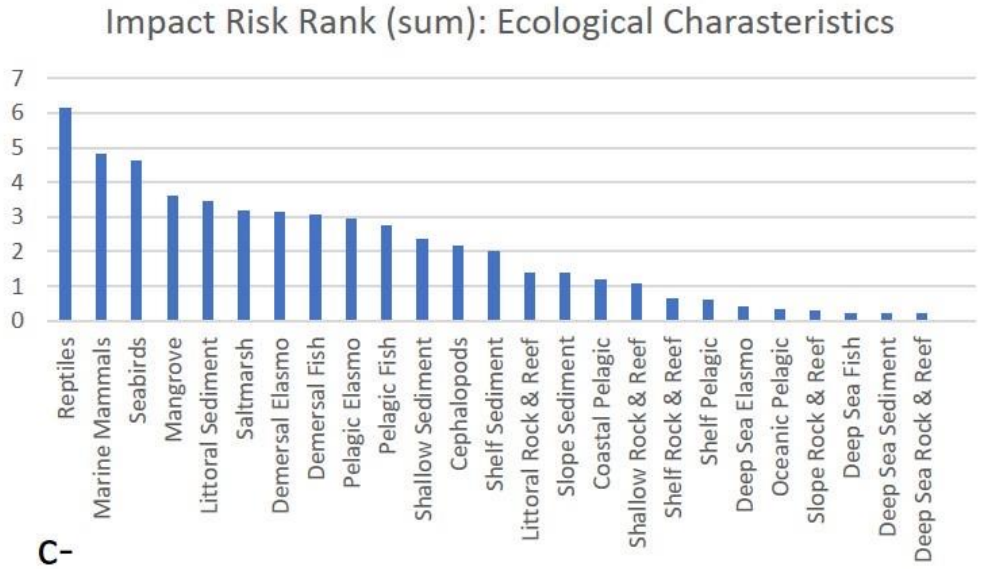
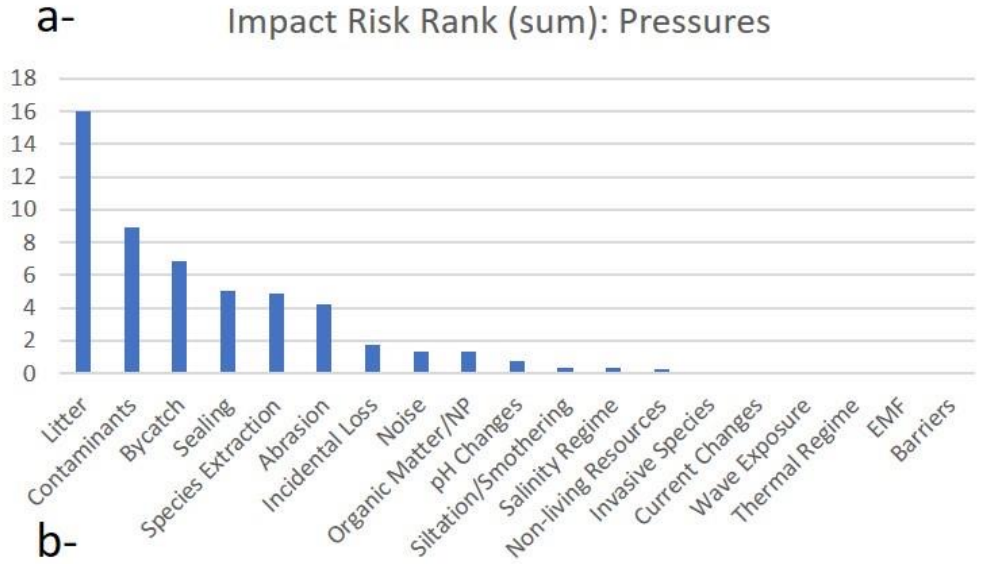


a-



c-



b-

ODEMM **strengths / weaknesses**

Utility:

- Useful for management action
- Forces to consider everything regardless of your expertise and/or data availability
- Data gaps

Limitations:

- Currently, it does not include climate change
- Direct links only

ODEMM **spin-offs…**

International Council for the Exploration of the Sea

ICES CIEM

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ABOUT ICES SCIENCE DATA

- Latest advice
- Ecosystem overviews
- Fisheries overviews
- ICES ecoregions and advisory areas

NEW ECOSYSTEM OVERVIEW FOR THE CENTRAL ARCTIC OCEAN

ICES

network of scientists

- 2000 active scientists
- 20 member countries
- 150+ expert groups

advice provider

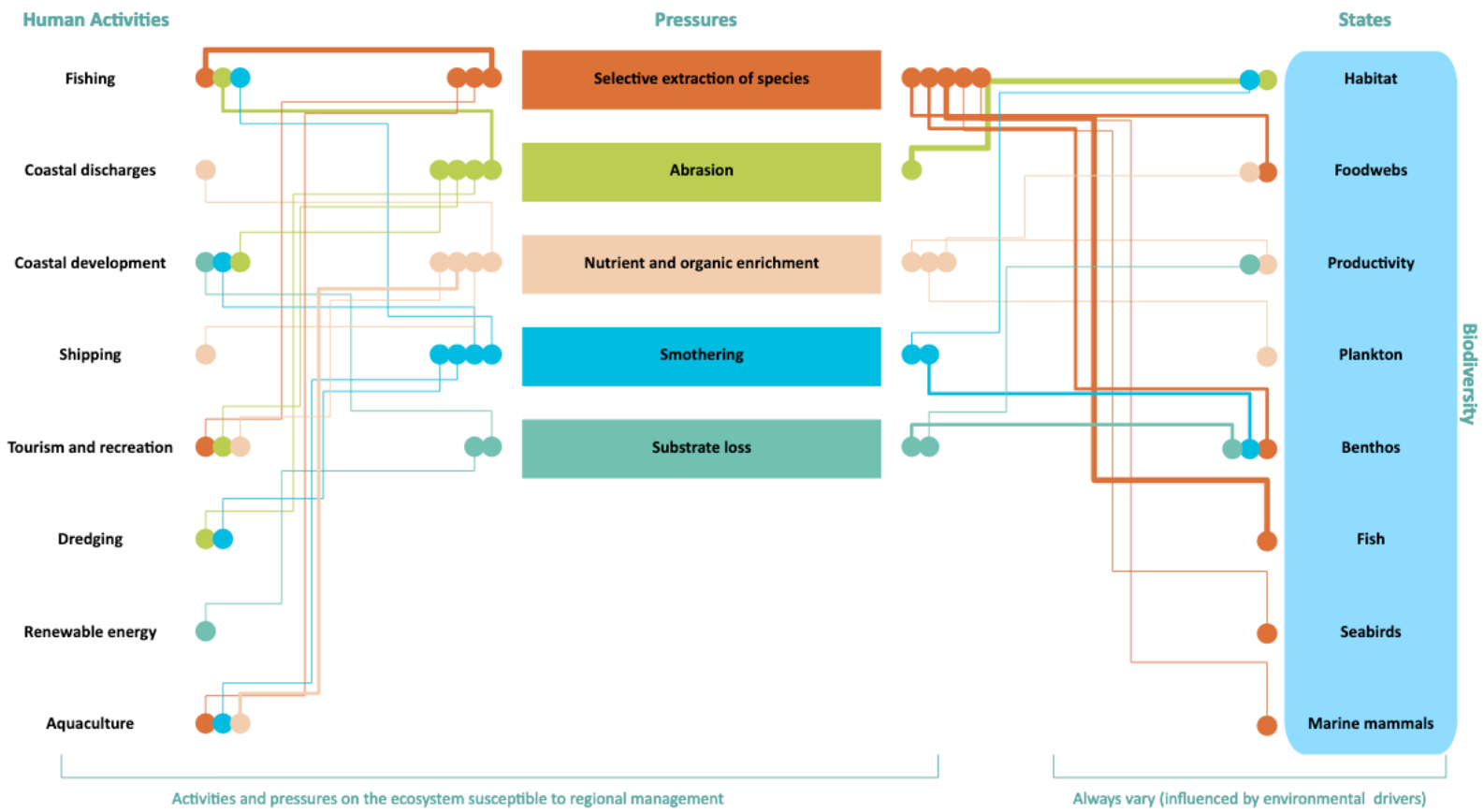
ICES **ecoregions**

ICES Ecosystem Overviews

https://www.ices.dk/advice/ESD/Pages/default.aspx

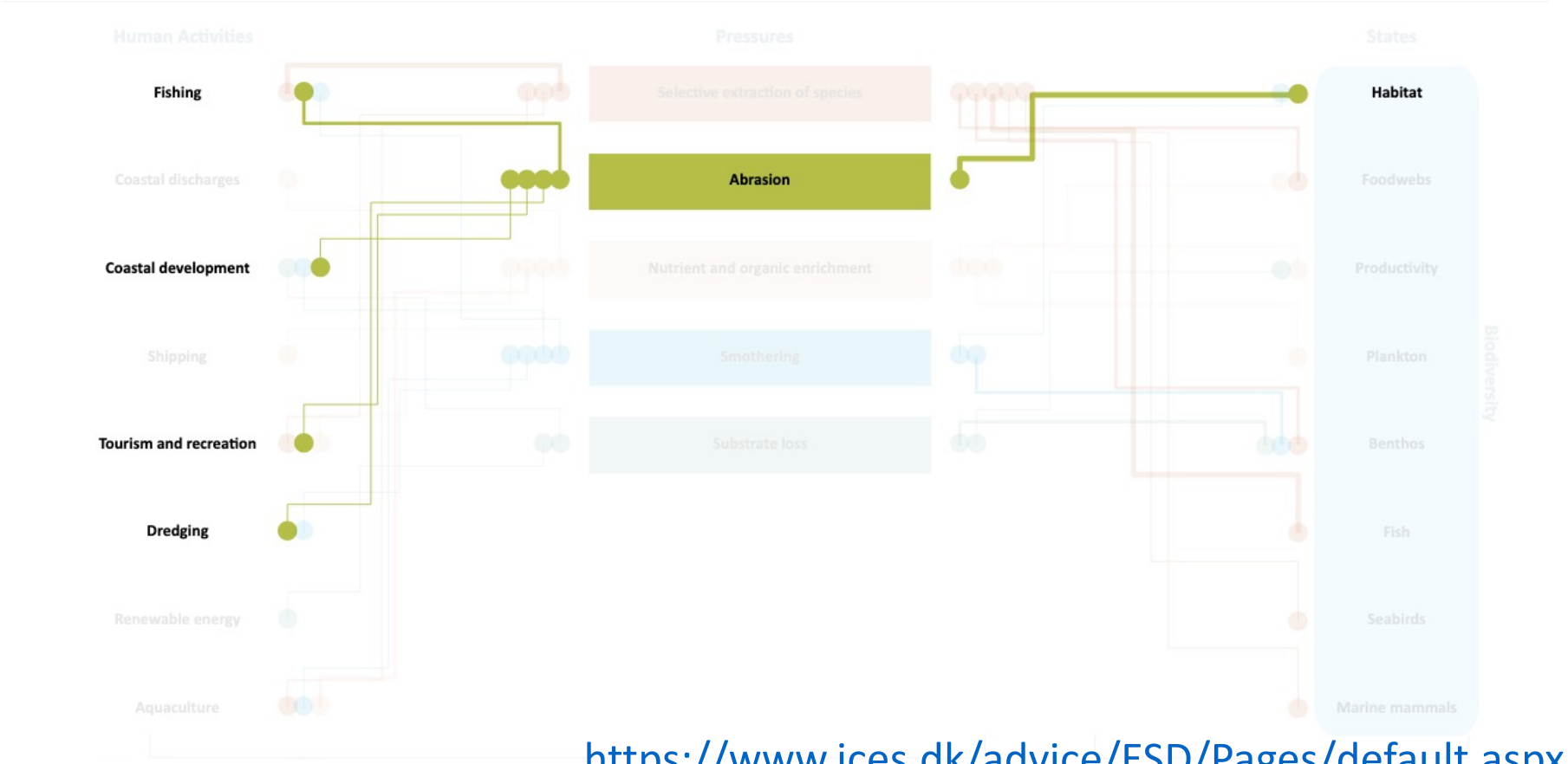
ICES **wire diagrams**

ICES Ecosystem Overviews



ICES **wire diagrams**

ICES Ecosystem Overviews



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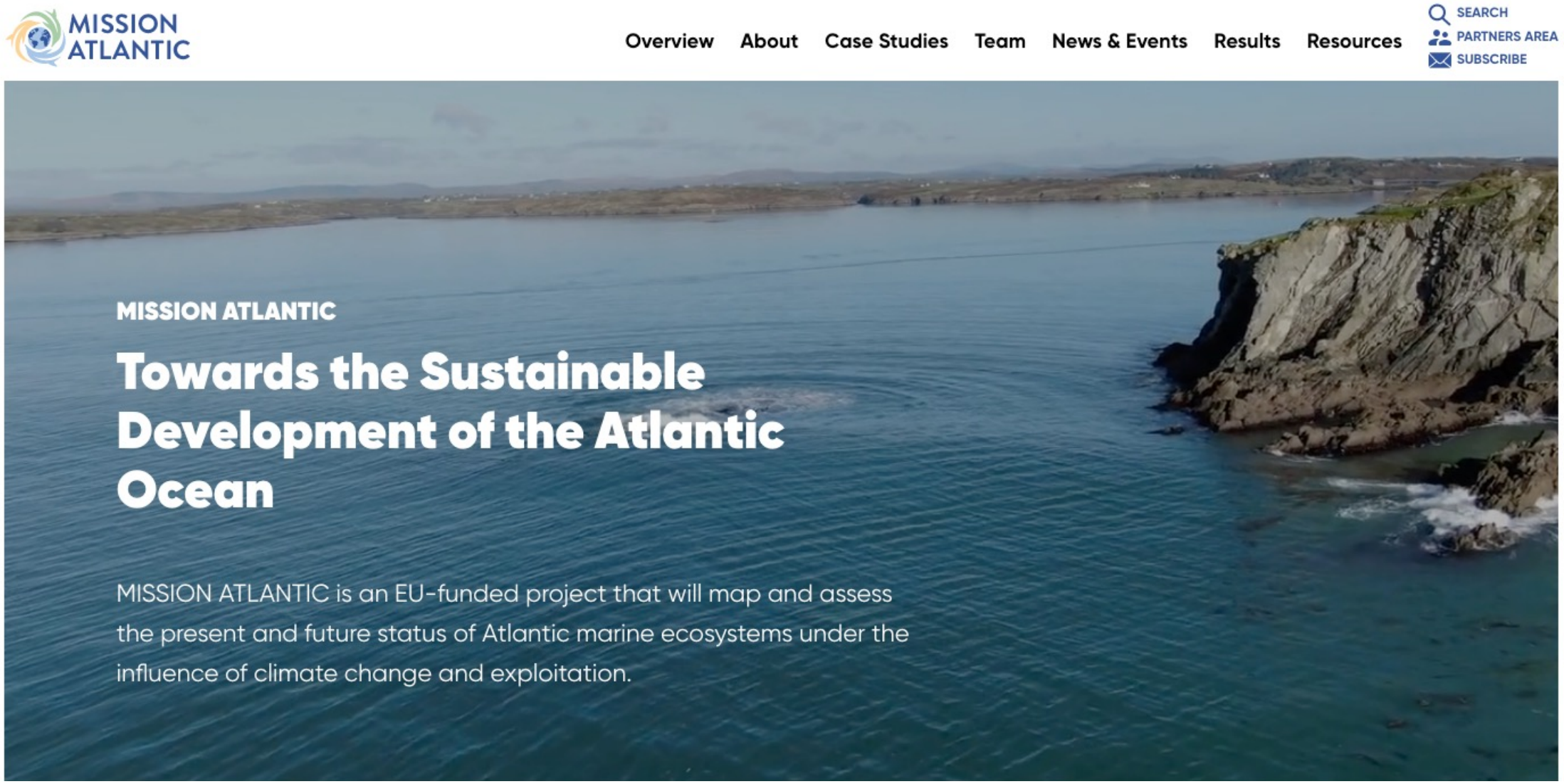
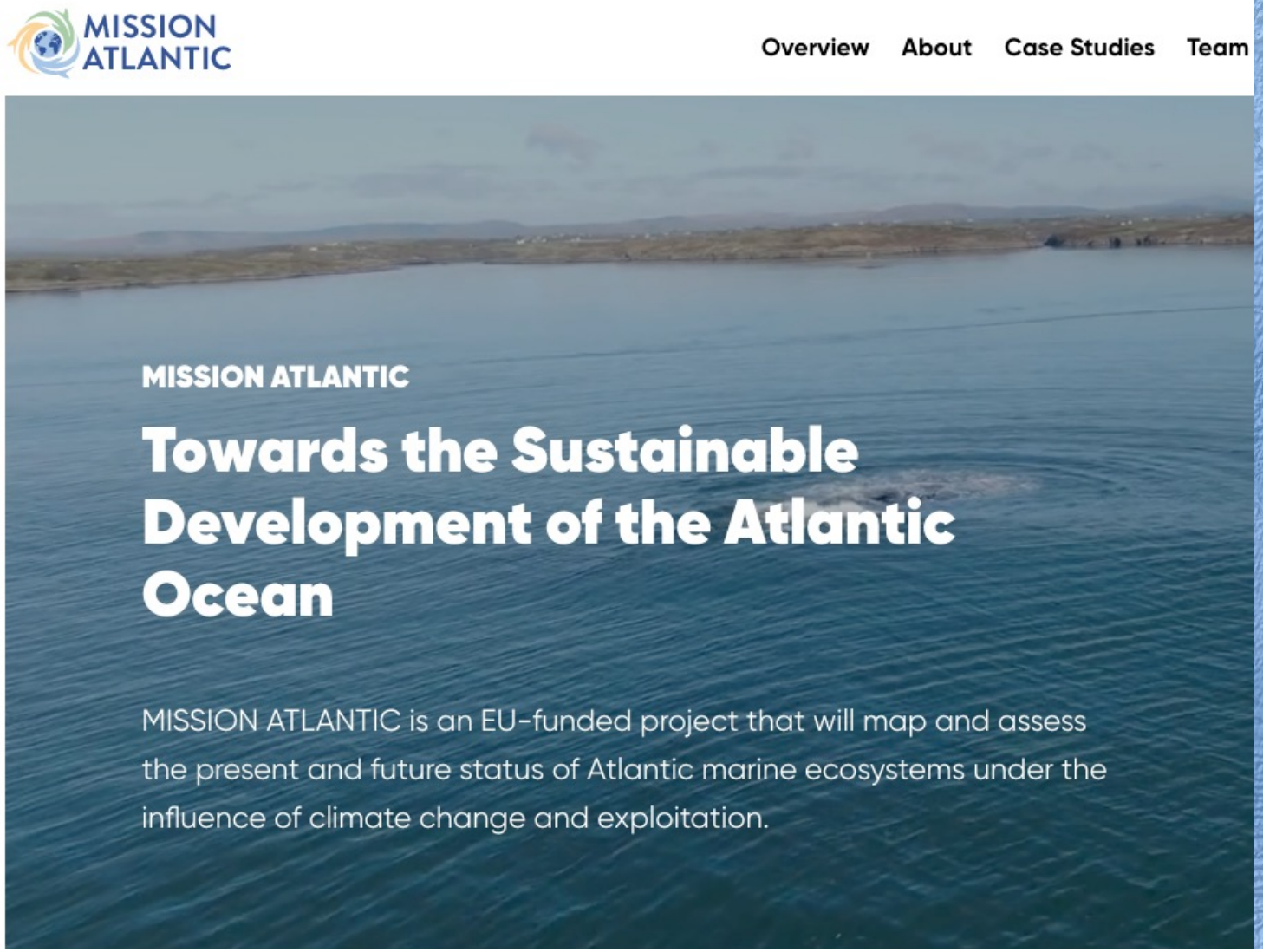
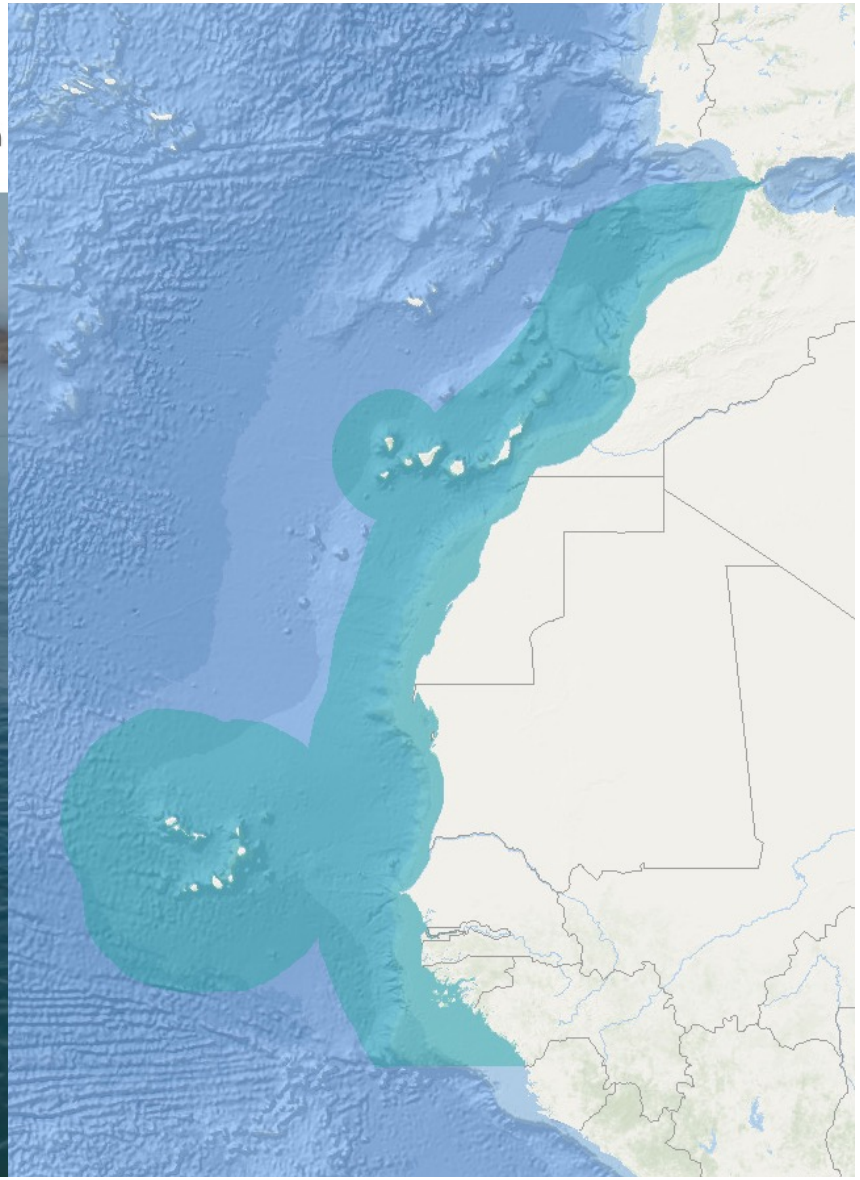
ODEMM **spin-offs…**



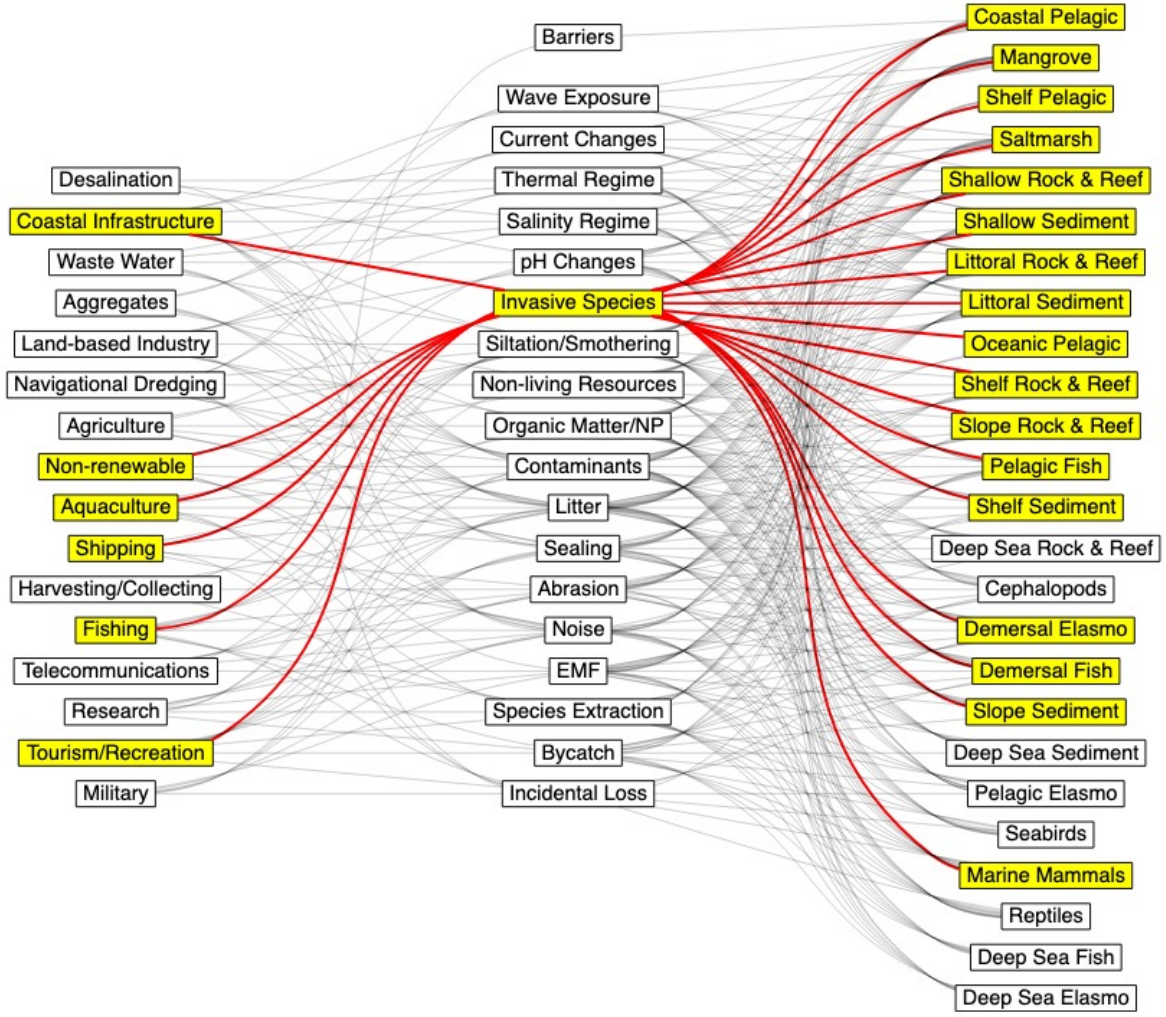
ODEMM **spin-offs…**

CCLME ODEMM





Invasive Alien Species



https://edraro.shinyapps.io/plots_ODEMM/

Thanks!

EU H2020 project

International Council for the Exploration of the Sea

Debbi Pedreschi

ICES IEA Chair

Invasive Alien Species

Do you find it useful?

- Would it be interesting to re-evaluate it focussing on IAS?
- Include climate change? Maybe by create various scenarios?
- …