Cumulative effects in Integrated Ecosystem Assessments

Debbi Pedreschi
debbi.pedreschi@marine.ie

Denise O'Sullivan, Christina O'Donnell, Paul Bouch, *Debbi Pedreschi & Dave Reid

Marine Institute
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Image by Jacob Bentley

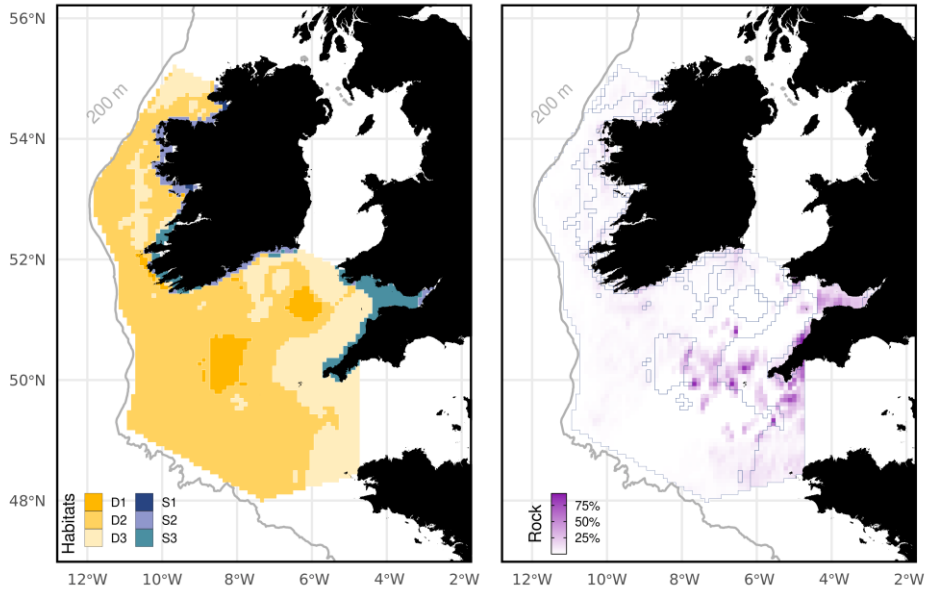
The Celtic Sea Example

Using ecosystem-based management approaches and an **Integrated Ecosystem Assessment (IEA)** Framework to synthesise the knowledge and provide tools to support marine resource managers and policy makers.

*Debbi Pedreschi *, Christie O'Donnell, Fiona Culhane, Dave Reid (Marine Institute)*

Jed Kempf (University College Cork)

Jack Laverick, Douglas Speirs, Mike Heath (University of Strathclyde)



Achieving Good Environmental Status (GES) for maintaining ecosystem services by assessing integrated impacts of cumulative pressures.

*Debbi Pedreschi *, Christie O'Donnell, Dave Reid (Marine Institute)*

Ecosystem Based Management (EBM)

EBM mandate

- European Union (EU) Marine Strategy Framework Directive (MSFD)
- Australia's Oceans Policy
- Canadian Oceans Act
- Oceans Act of 2000
- Norwegian Cross Sector Management Plans
- South African National Water Act
- More....

No universally agreed definition.

Chat GPT tells us:

*Ecosystem-based management (EBM) is an approach to natural resource management that focuses on the **conservation and sustainable use of entire ecosystems**, rather than just individual species or specific resources. It takes into account the **complex interactions and interdependencies** between different **species, habitats, and human activities** within an ecosystem. The primary goal of ecosystem-based management is to maintain the **health, resilience, and functionality of ecosystems while also meeting the needs of society**.*

Sustainability

Holistic Perspective

Multi-disciplinarity

Adaptive Management

Cross-Sector Integration

Precautionary Principle

Conservation Targets

Objectives

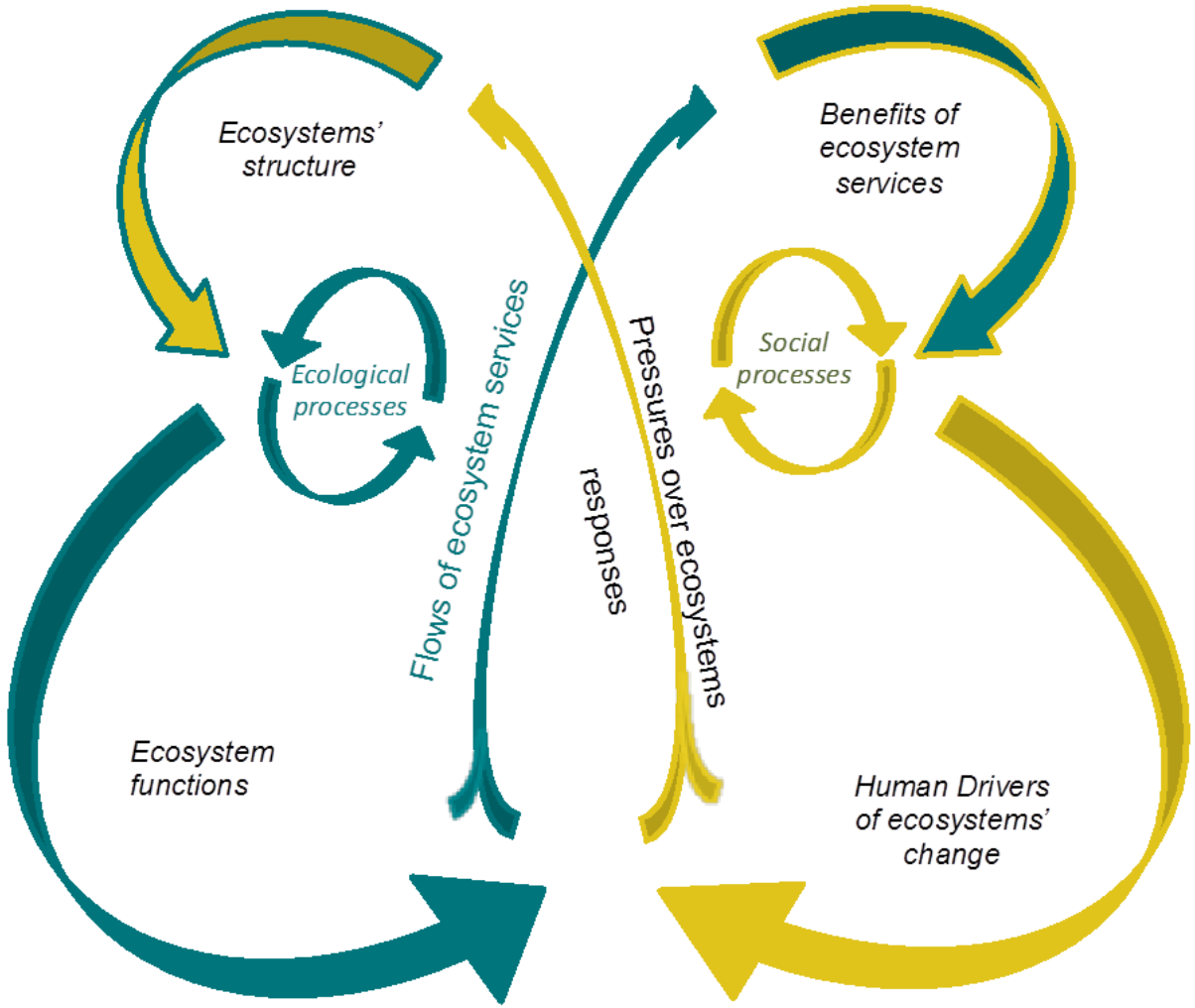
Stakeholder Engagement

Useful/ Applied

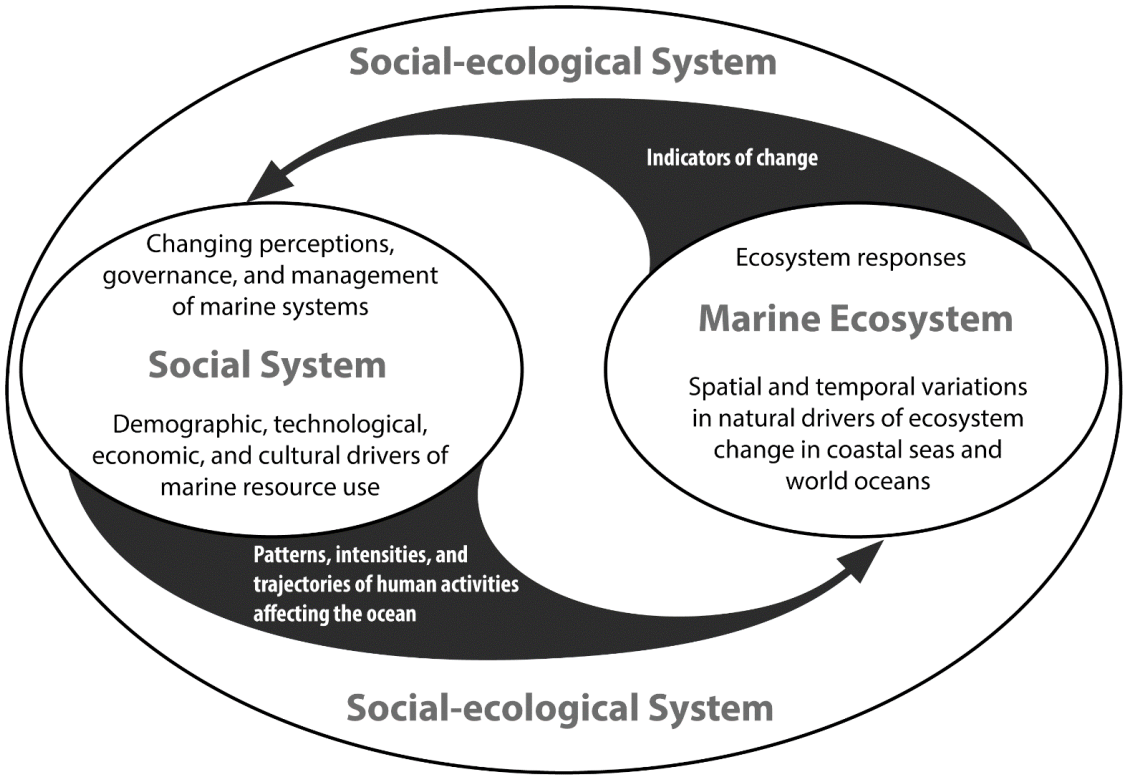
Trade-offs

Resilience

EBM is a WHOLE systems approach...

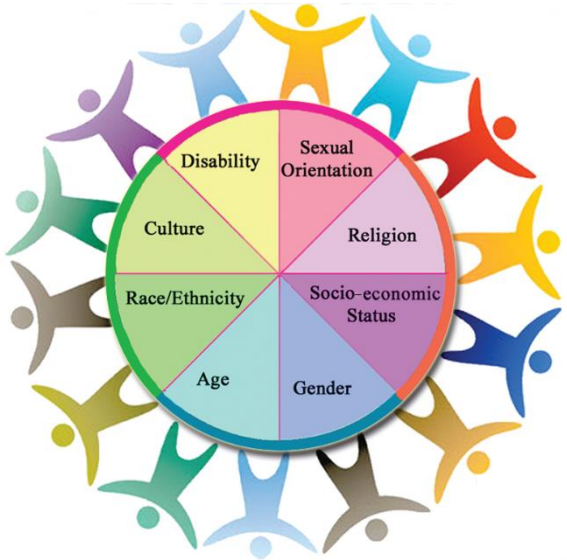


From AQUACROSS



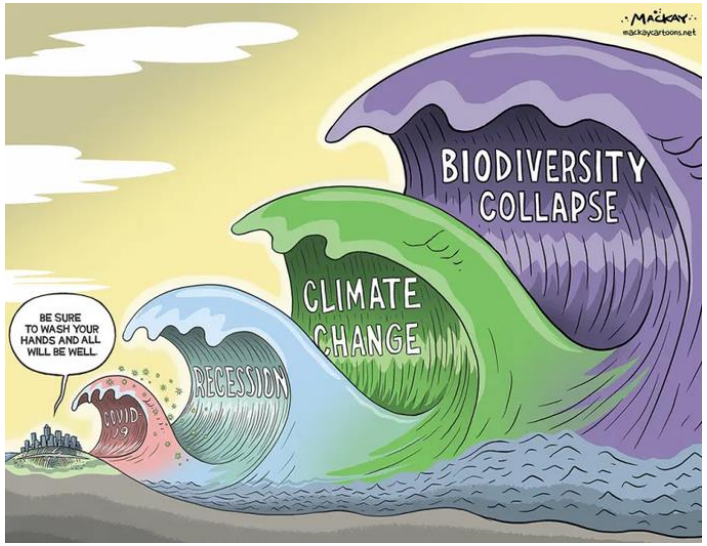
Máñez et al. 2014 https://doi.org/10.1371/journal.pone.0101466

And society is diverse....



...with diverse perspectives

And nothing is static....



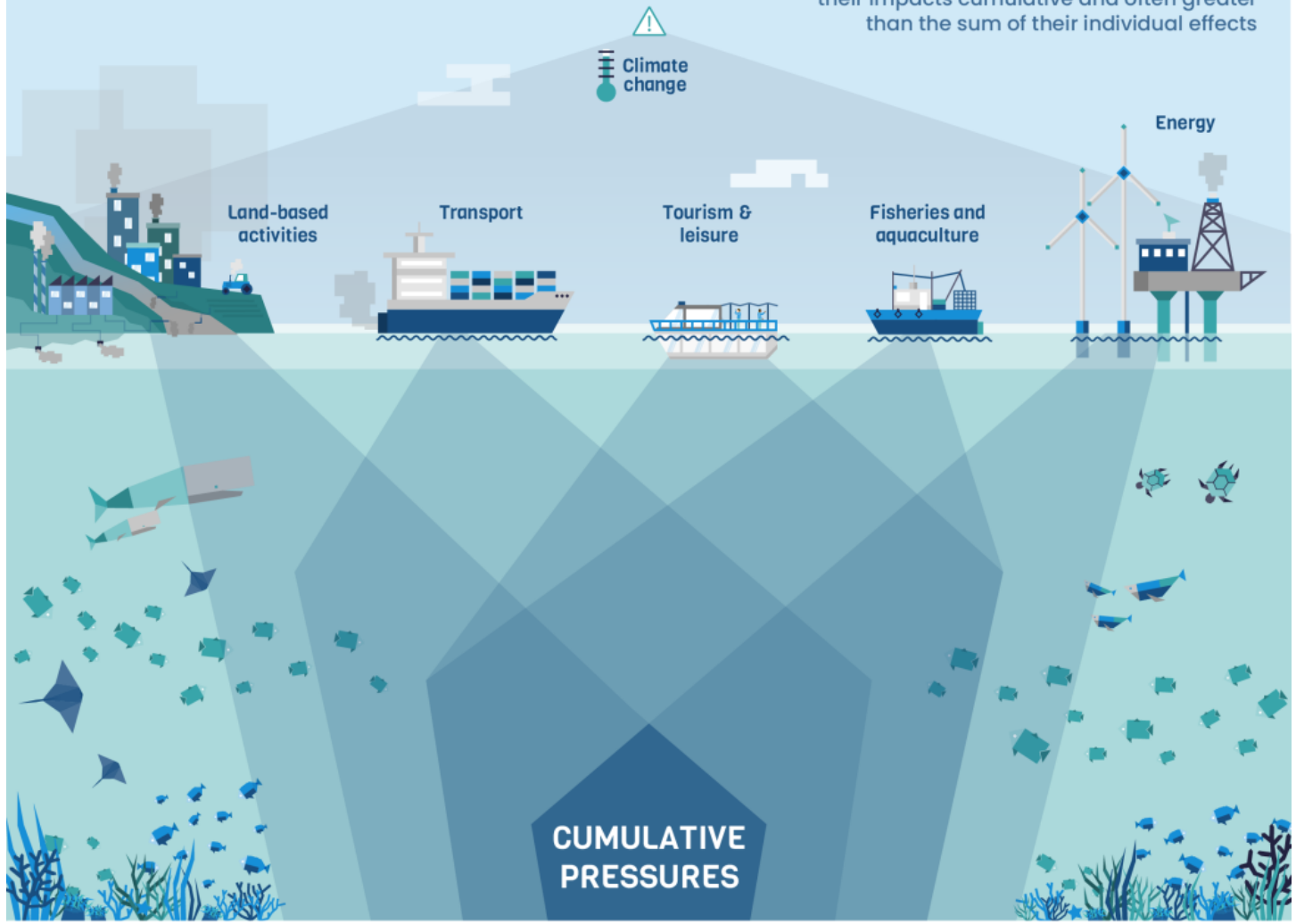
And everything is urgent....

GES4SEAS

CUMULATIVE PRESSURES

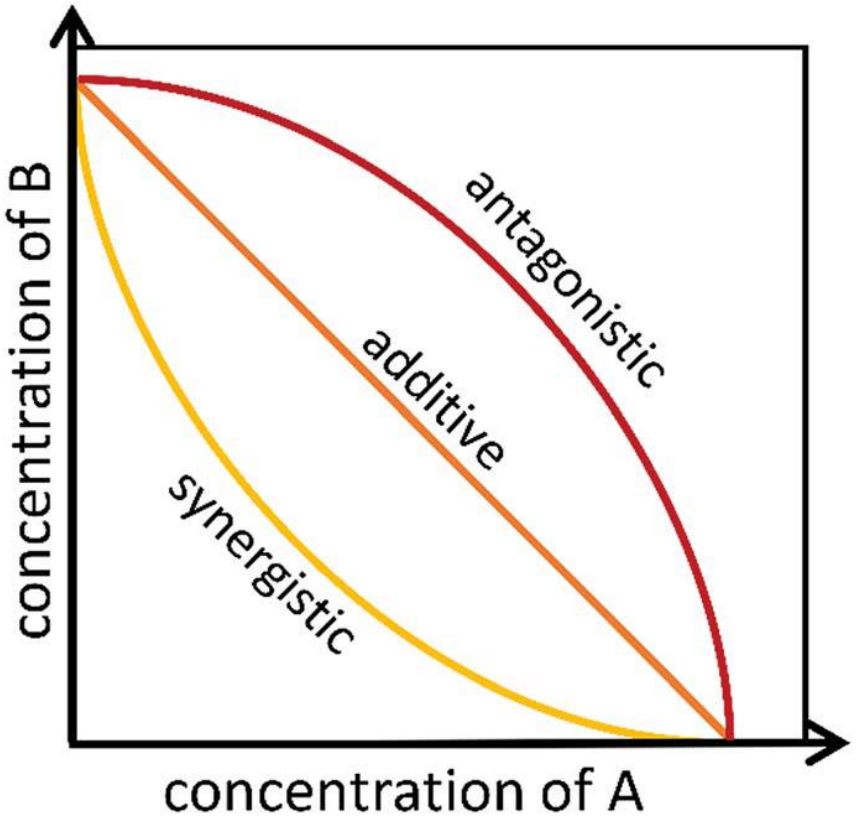
Human activities pressure our seas and impact their natural balance

Different pressures can interact, making their impacts cumulative and often greater than the sum of their individual effects

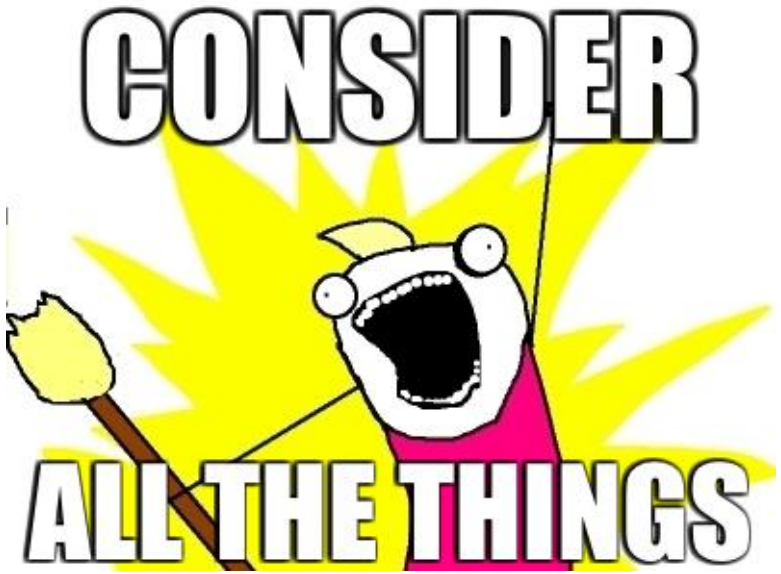


Ocean health and resilience

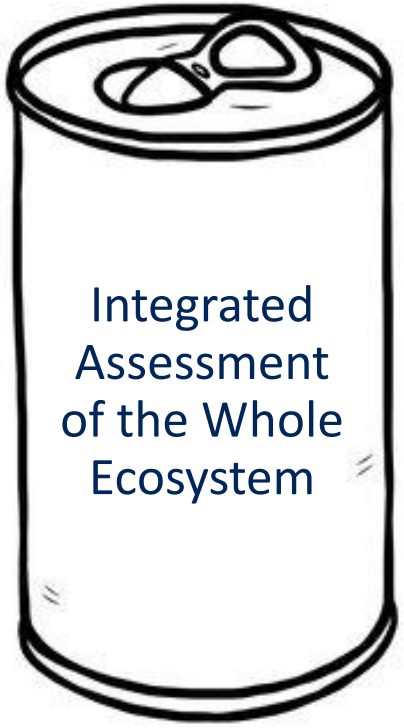
Acknowledging and assessing cumulative pressures is key to inform decision-making and protecting our seas

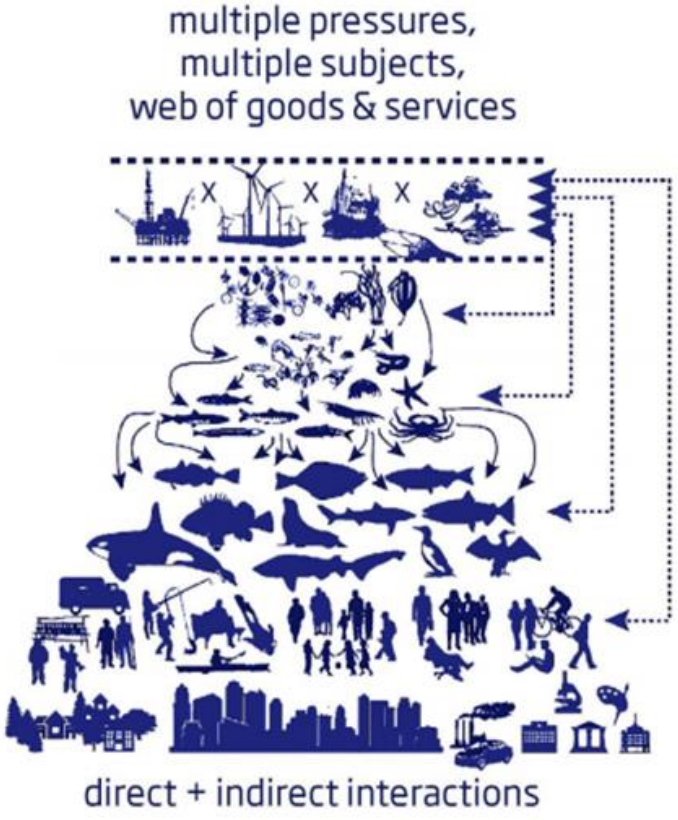


How can we account for everything?

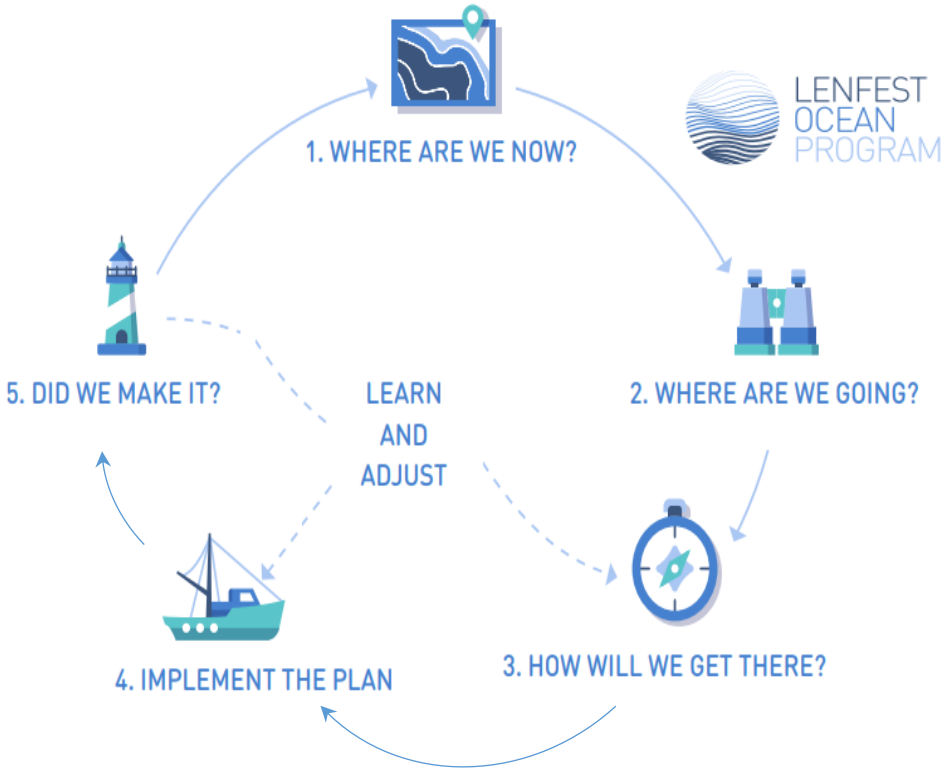


Integrated Ecosystem Assessment (IEA)…





From Holsman et al. 2017



…is a tool for Ecosystem-Based Management

…is a process

Integration

Adoption of Integrated Ecosystem Assessment (IEA) (NOAA, ICES) as a tool for EBM

IEA provides an adaptable and iterative approach to:

- Integrate multiple methods and data streams
- Identify and integrate multiple perspectives and trade-offs
- Facilitate meaningful stakeholder engagement
- Ask and answer complex questions
- Work multi-disciplinarily to produce transdisciplinary outcomes
- Operationalise EBM and provide ecosystem-informed advice

Cumulative Effects Assessment (CEA) is an inherent feature of IEA, and of EBM.

A single method for CEA is unlikely, and will ultimately be limited – but we already have a useful framework that can incorporate multiple methods….

IEA as a framework for CEA and EBM

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Analyses

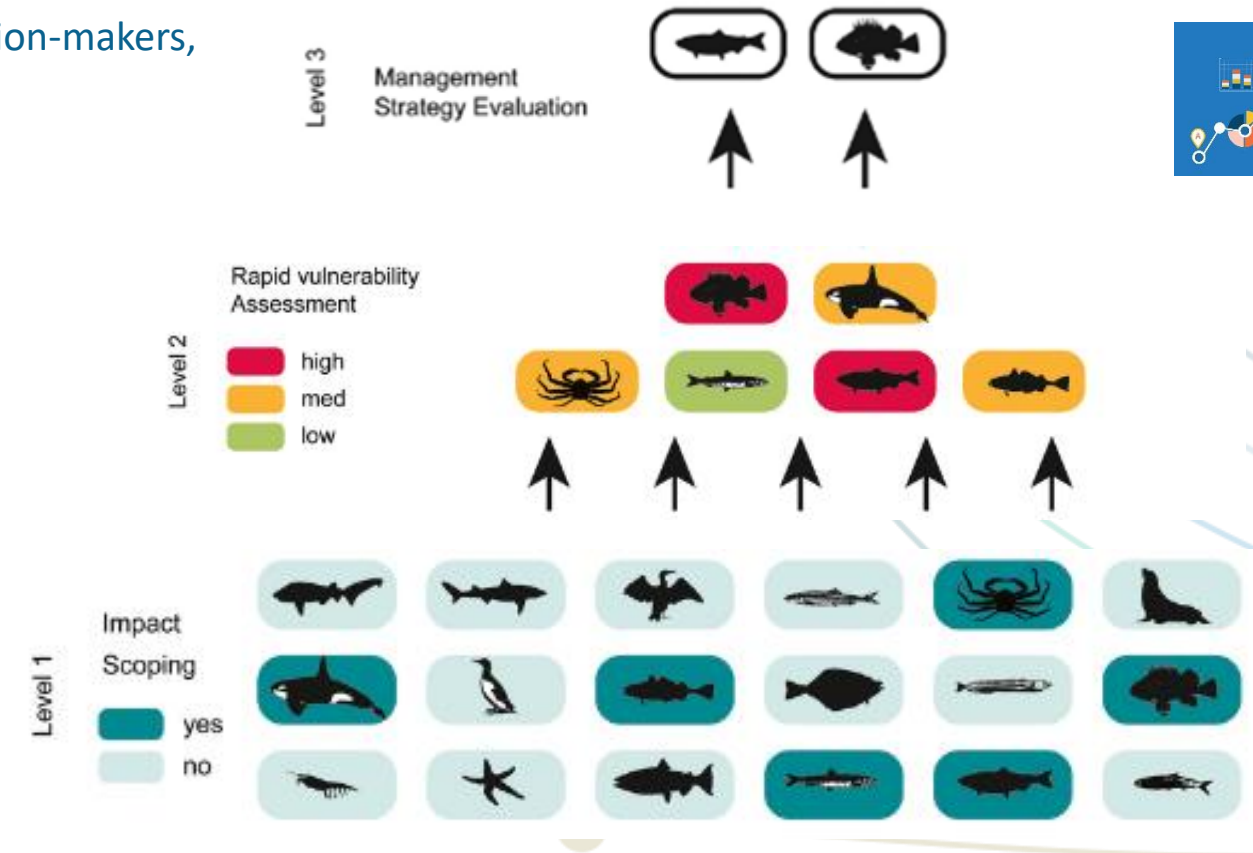
- Test Scenarios from stakeholders, decision-makers, and/or policy
- Cumulative Effects (modelling)

Prioritization:

- What should we focus on?
- Risk and/or Vulnerability assessment

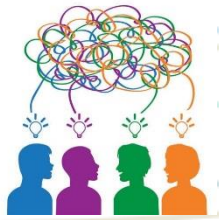
Scoping:

- Start all-inclusive
- Identify relevant components
- Define EBM Goals and Targets



Quantitative

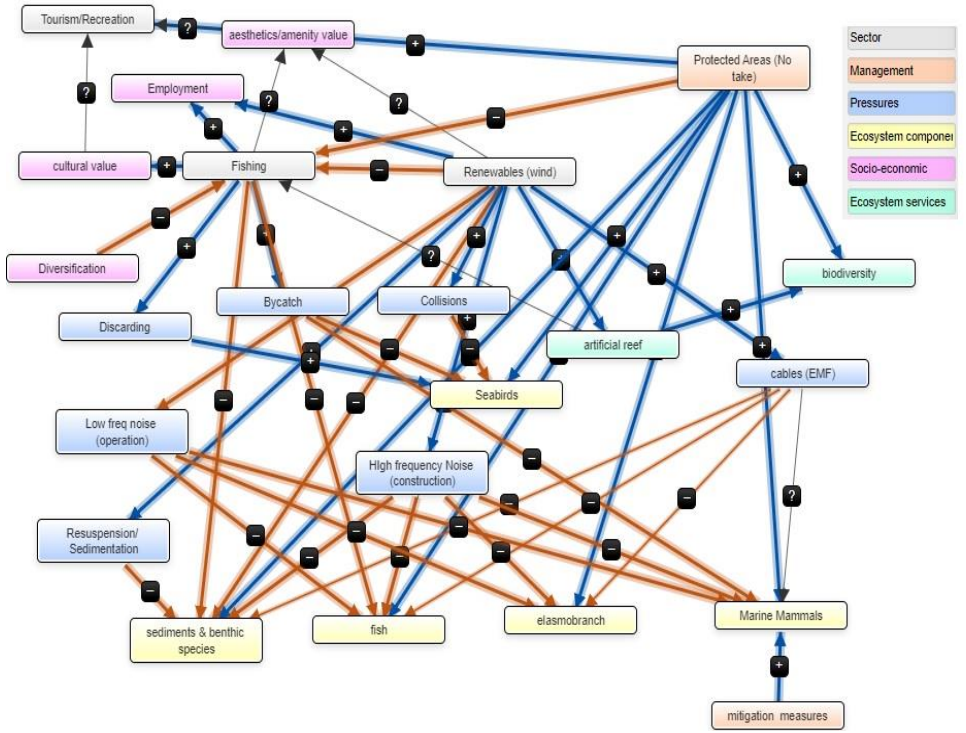
Qualitative



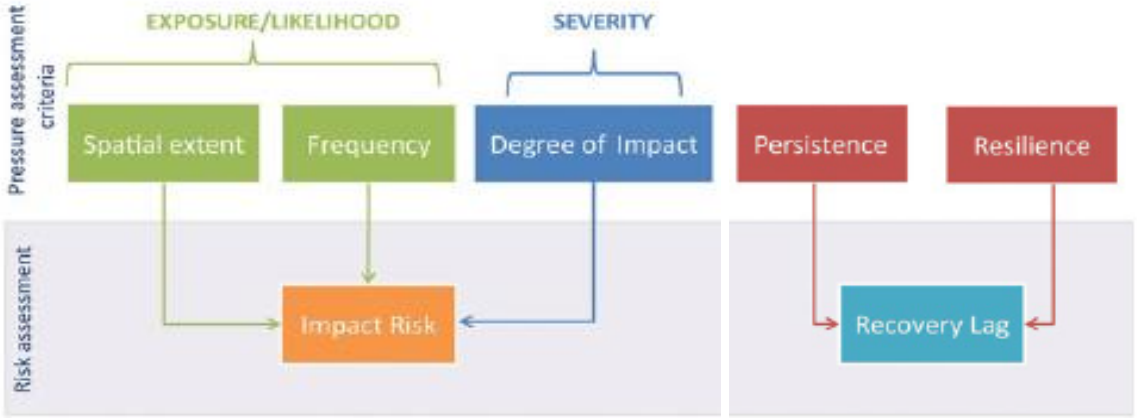
Holsman *et al.* 2017

Scoping

- 4 stakeholder meetings
- Identification of assessment elements
  - 17 Sectors, 20 pressures, 26 ecological components
  - Ground-truthing outputs
  - Conceptual model building
  - Scenario and ‘question’ development
  - Socio-ecological systems understanding

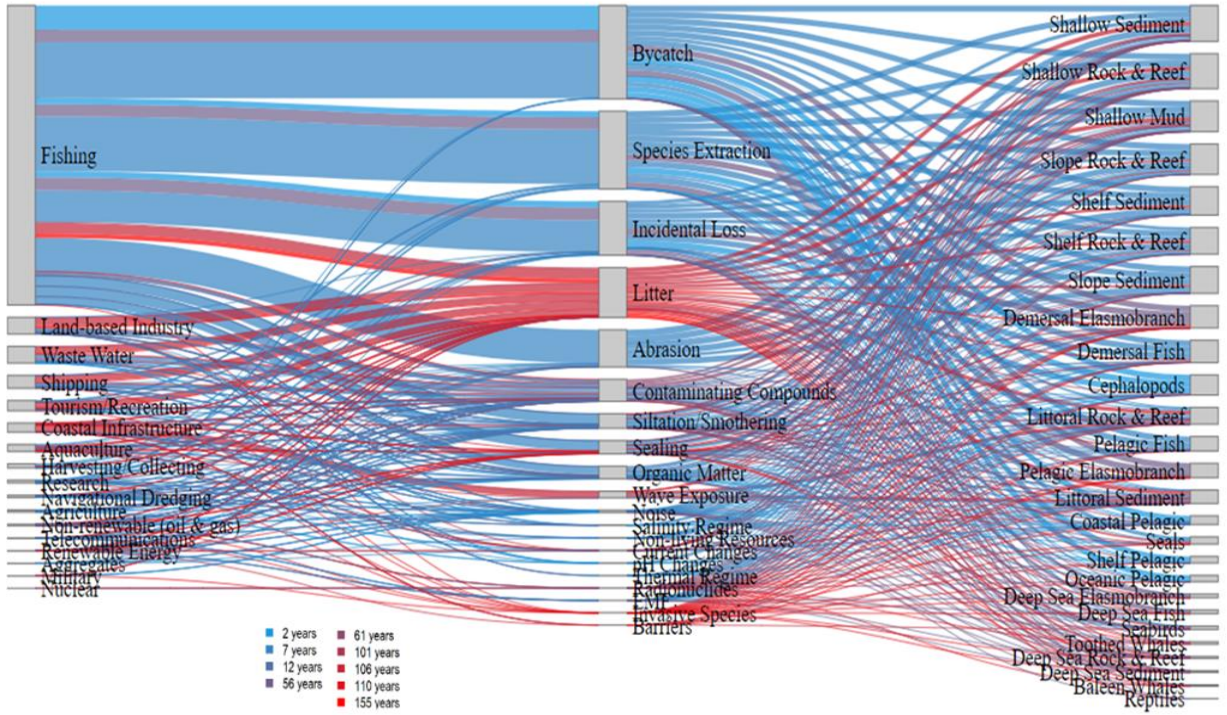


Risk & Vulnerability Analysis



RISK ASSESSMENT

VULNERABILITY ASSESSMENT



Sector	Pressure
Fishing (78%)	Bycatch (25%)
Land-based Industry (4%)	Species Extraction (21%)
Waste Water (4%)	Incidental Loss (13.6%)
Shipping (3.2%)	Litter (12.4%)
Tourism/Recreation (2.5%)	Abrasion (9.4%)
TOTAL: 91.7%	TOTAL: 81.4%

1,592

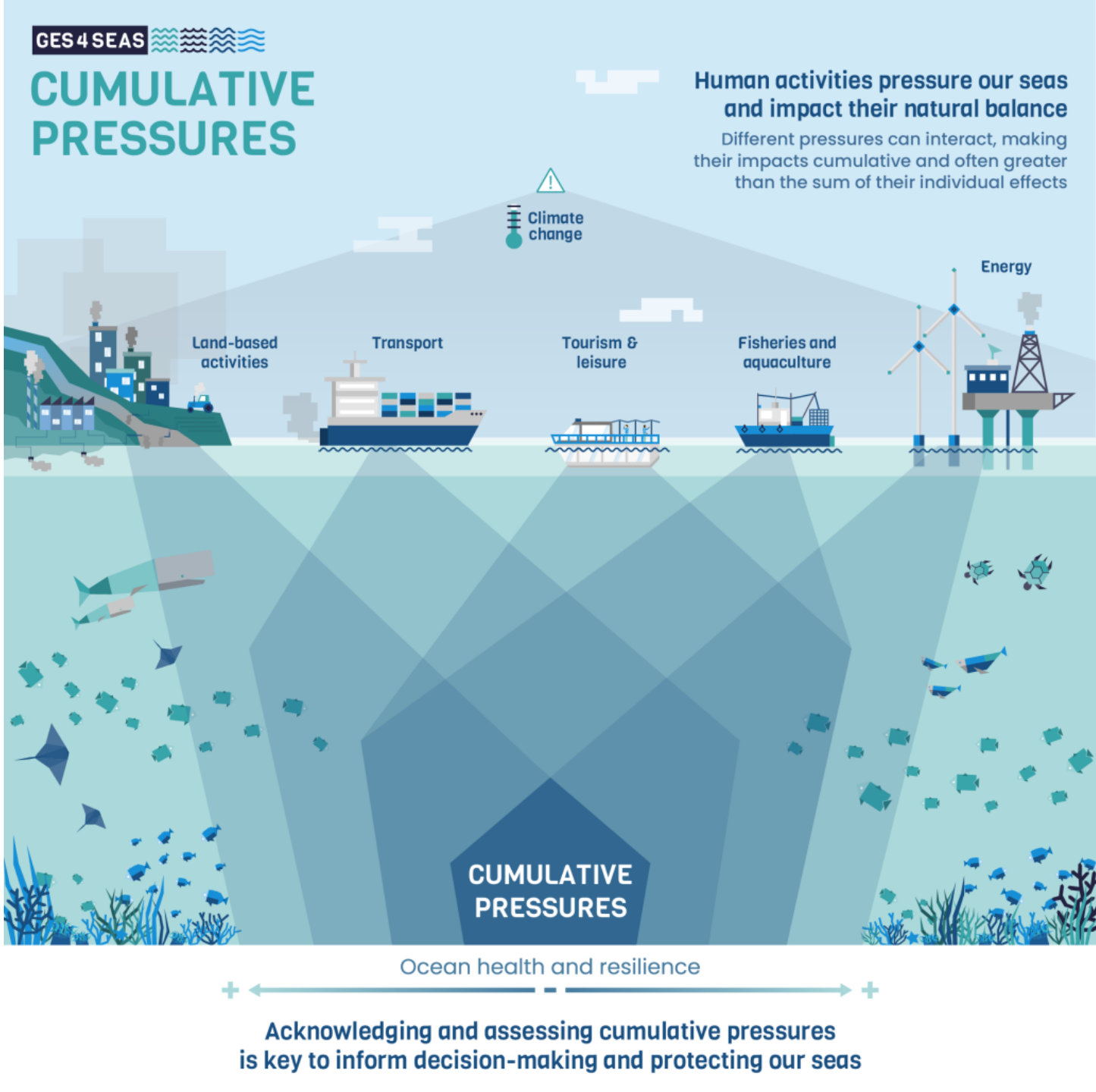
links

37

links

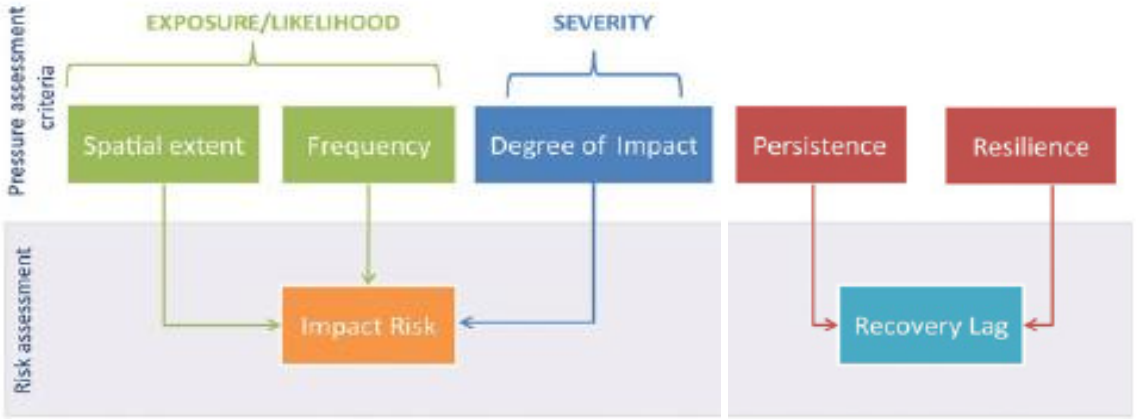
Not using IEA as a framing concept…..

…but in practice is using a very similar approach and range of tools….



MISSION ATLANTIC

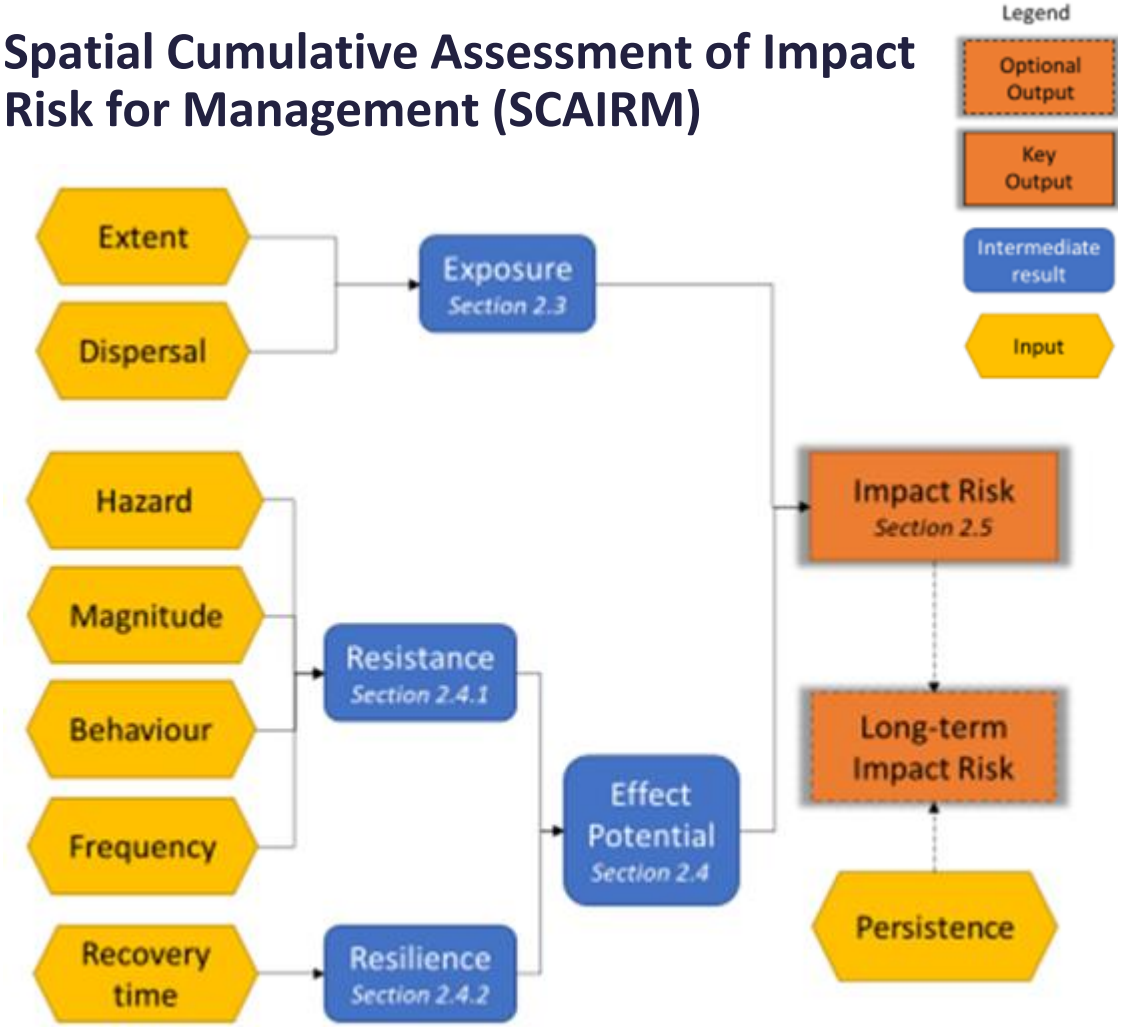
Modified ODEMM approach



RISK ASSESSMENT

VULNERABILITY ASSESSMENT

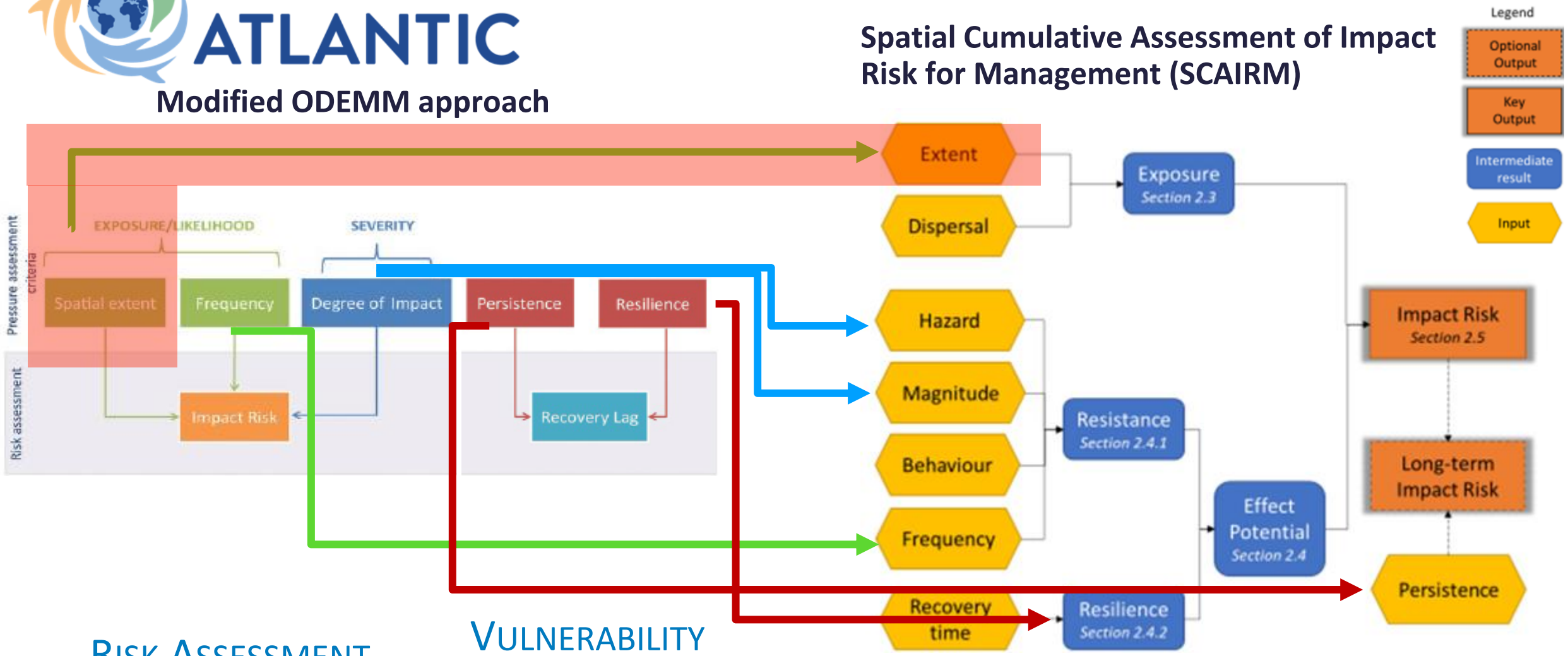
Spatial Cumulative Assessment of Impact Risk for Management (SCAIRM)



Piet et al 2023
Ecological Indicators
Volume 157, 15 December 2023, 111157
https://doi.org/10.1016/j.ecolind.2023.111157

Modified ODEMM approach

Spatial Cumulative Assessment of Impact Risk for Management (SCAIRM)



RISK ASSESSMENT

VULNERABILITY ASSESSMENT

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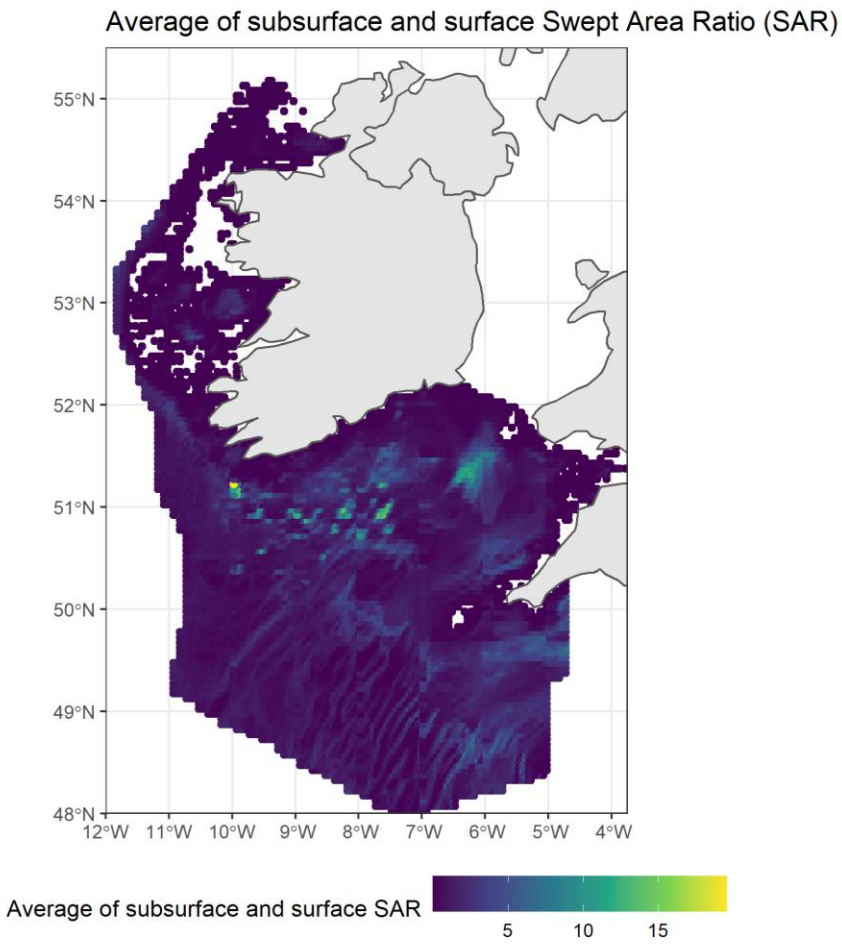
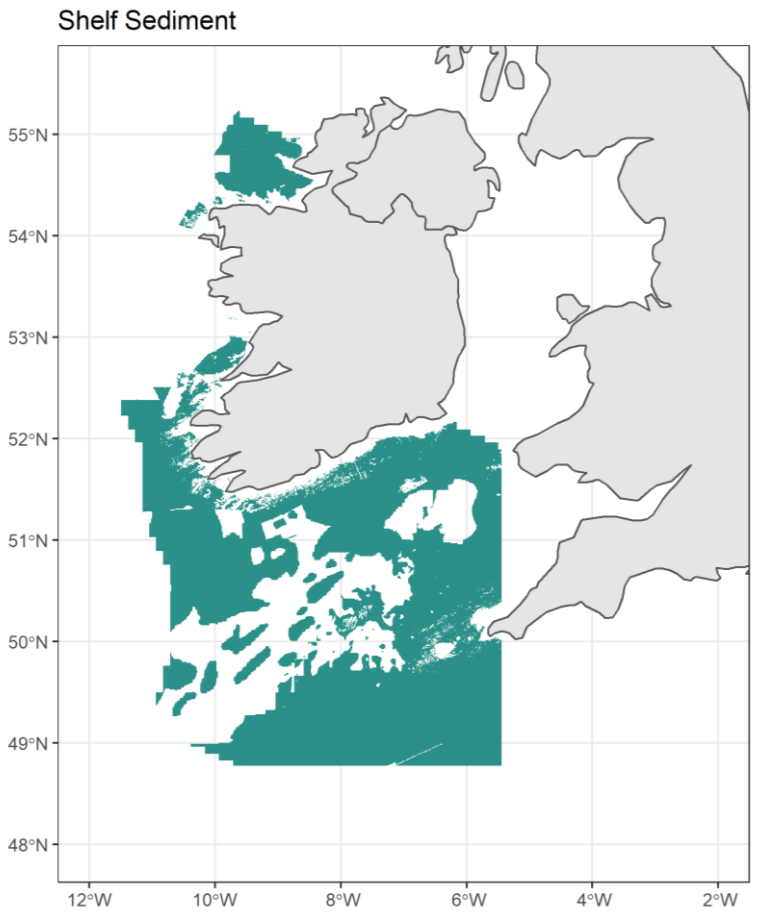
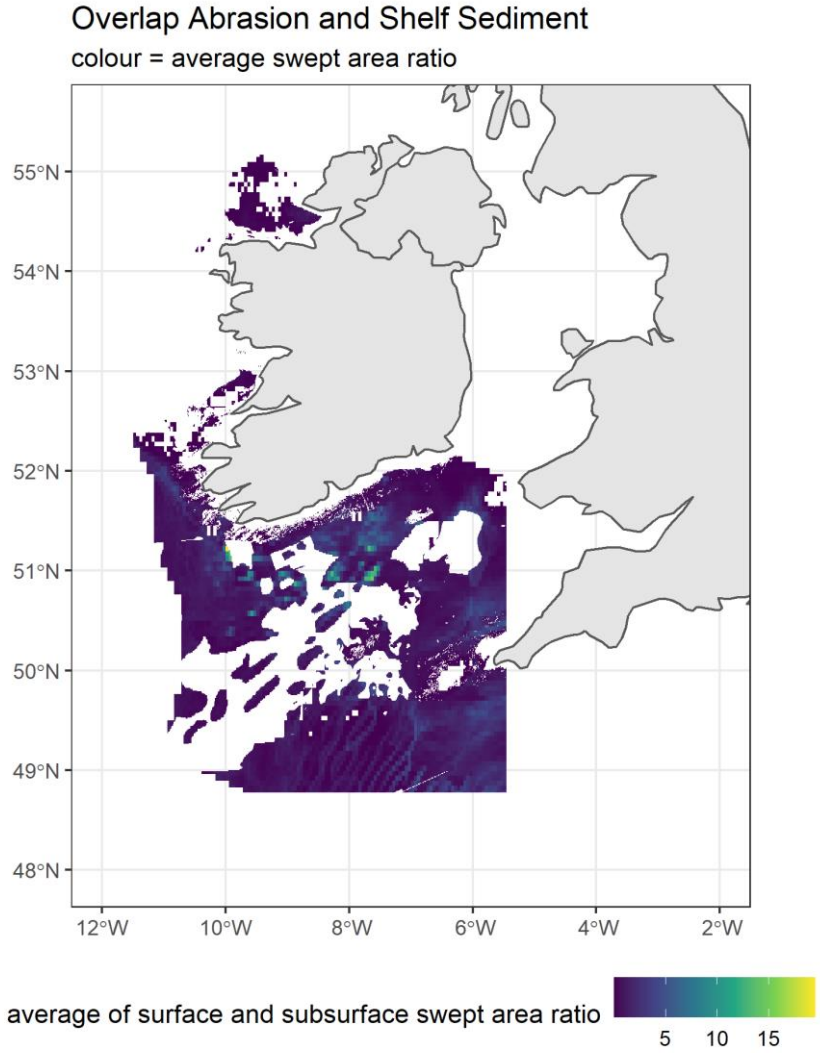
Pressure



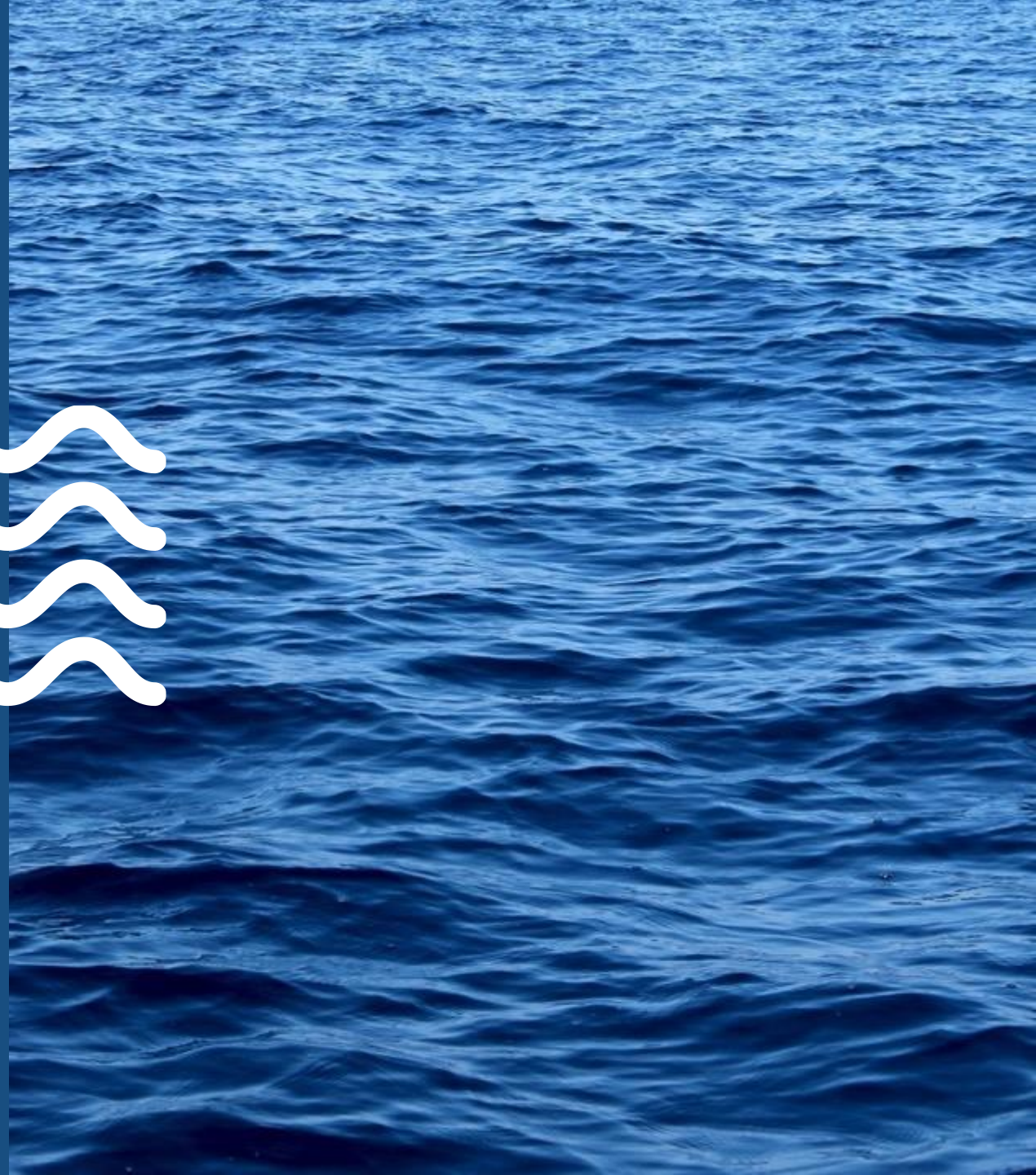
Ecosystem Component



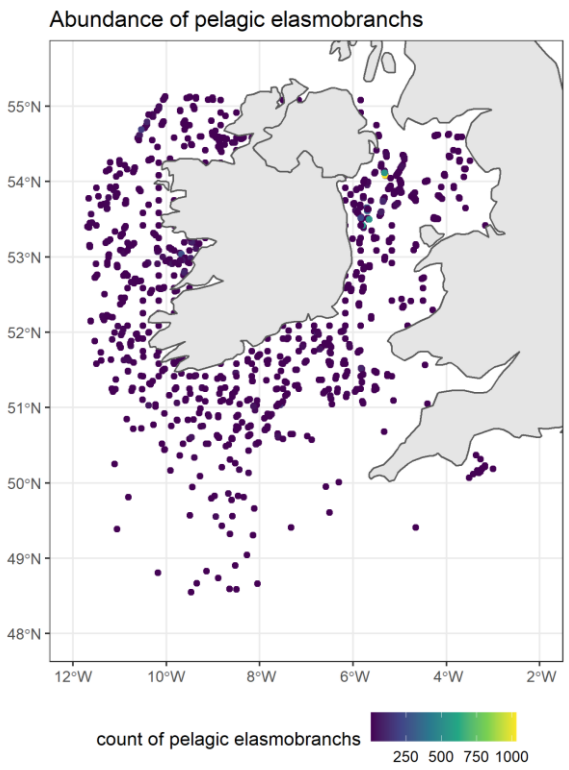
Spatial Overlap

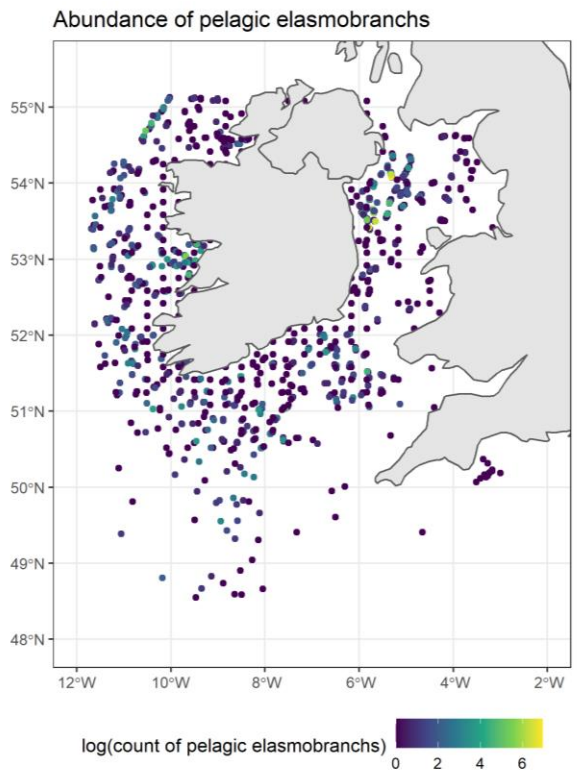


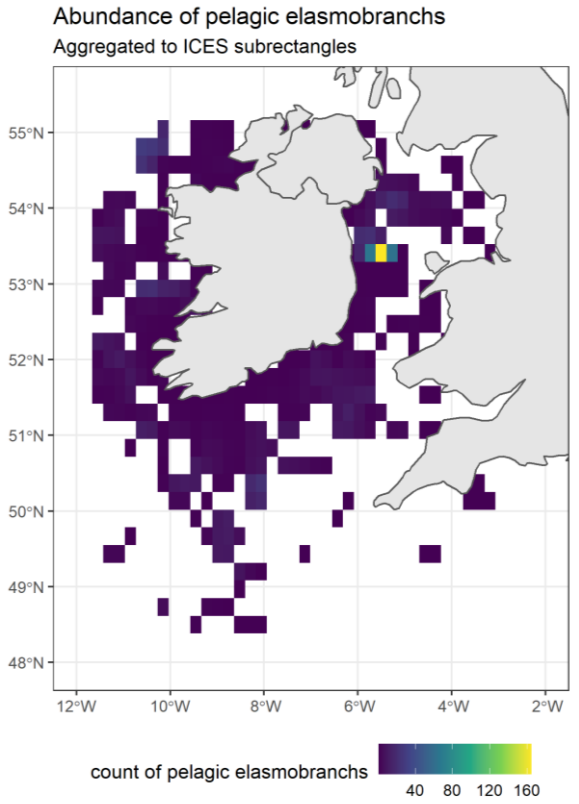
Choices affect Risk Perception

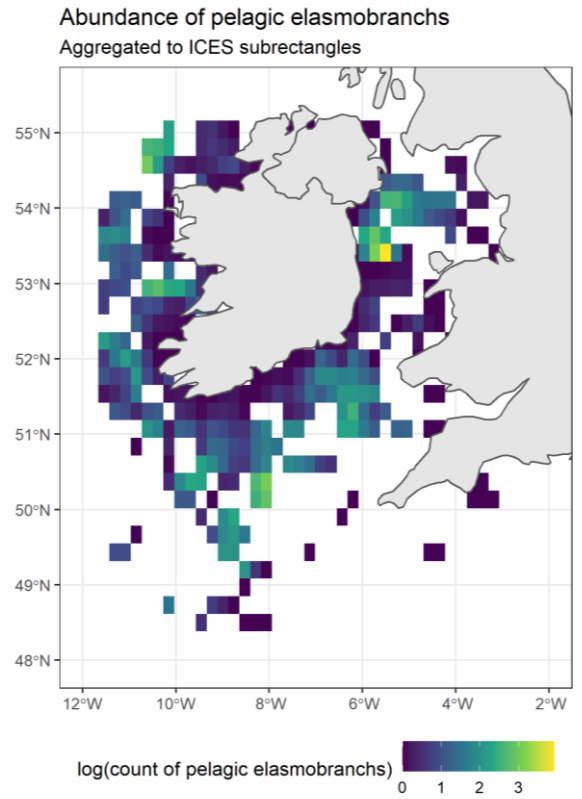


Aggregation Matters





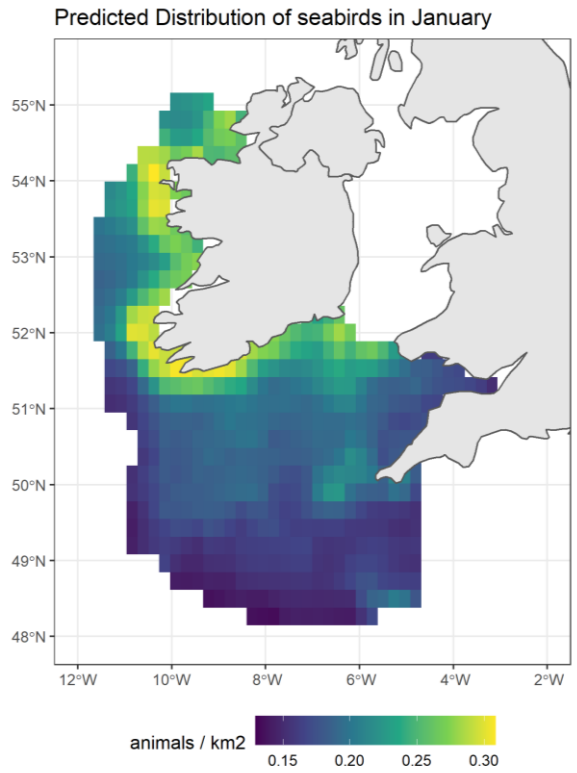




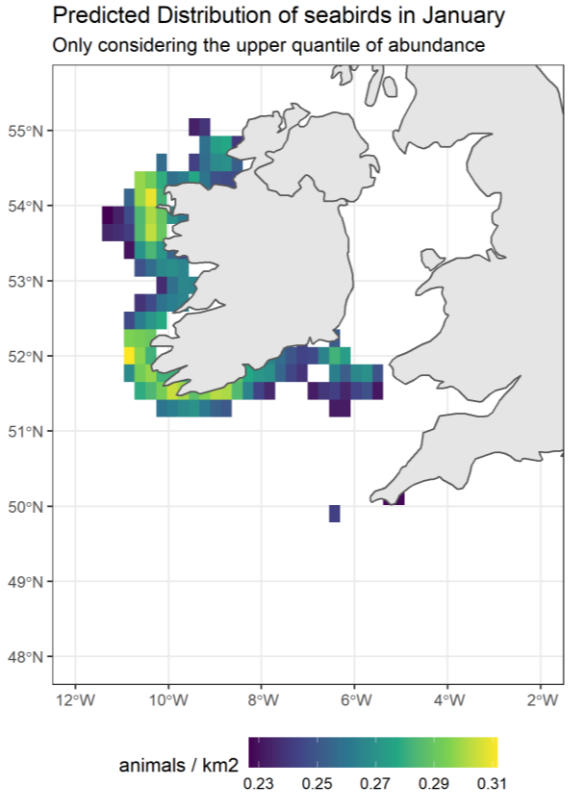
Count **Logged Values** **Count** **Logged Values**

Observations **Aggregated**

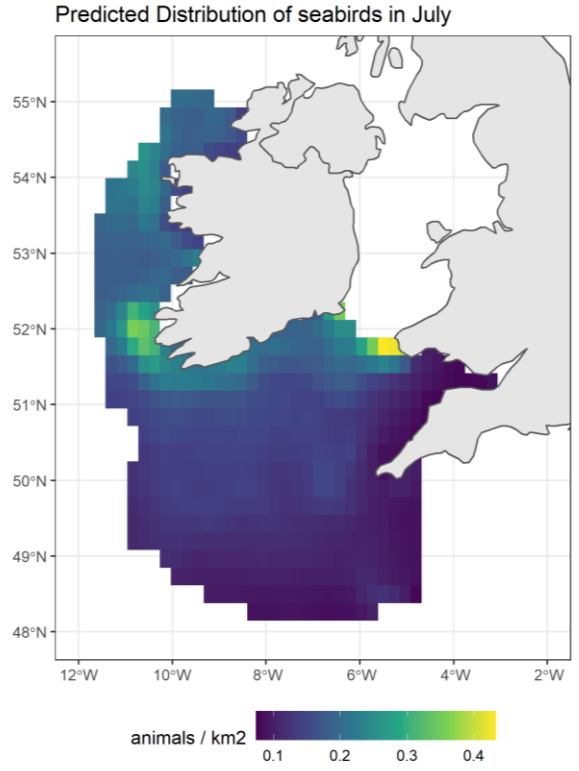
Aggregation Matters



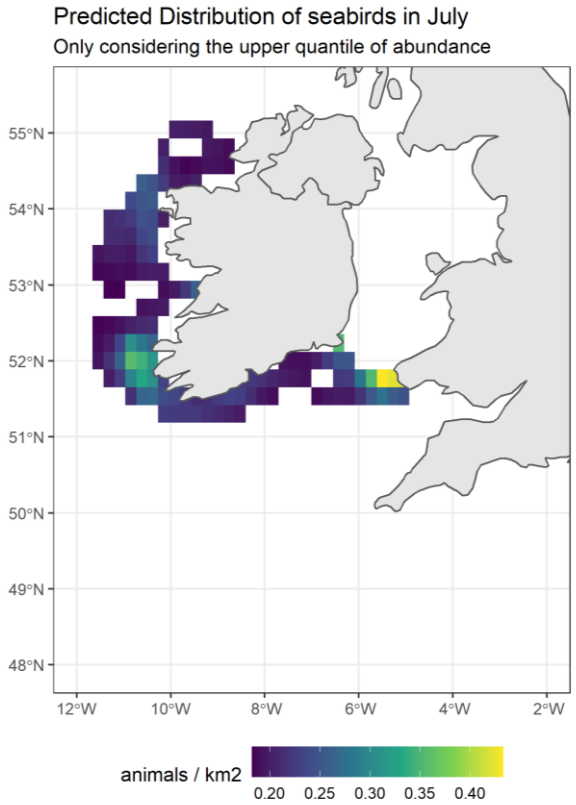
Modelled Distribution



Hotspots



Modelled Distribution

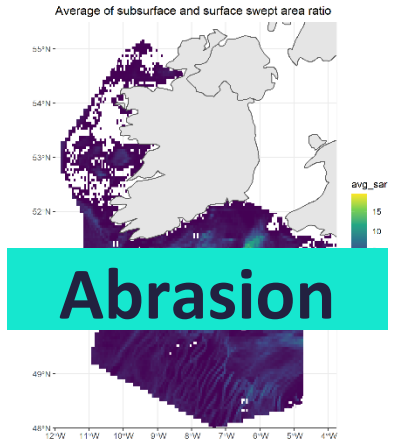


Hotspots

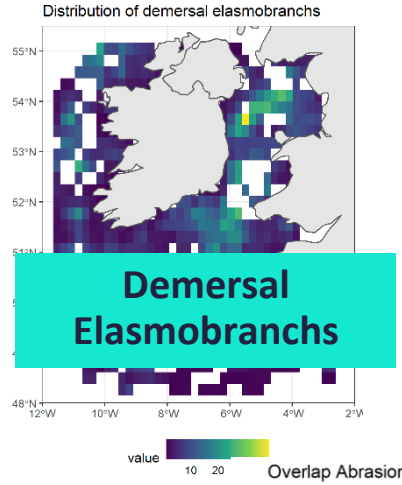
January

July

Aggregation Matters

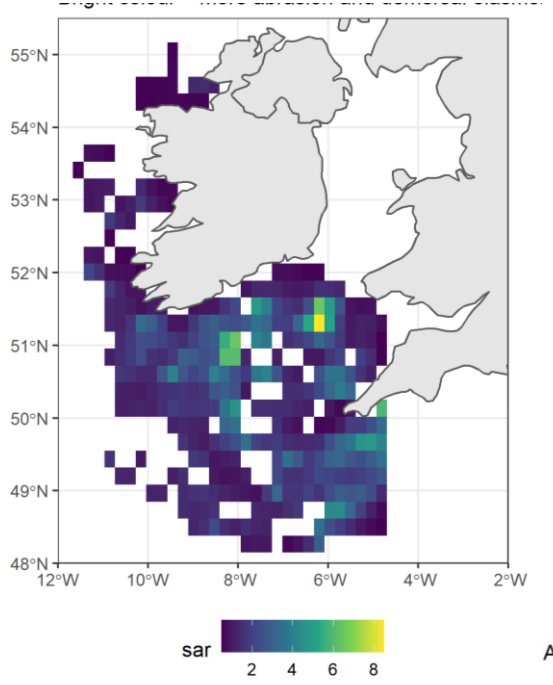


Abrasion

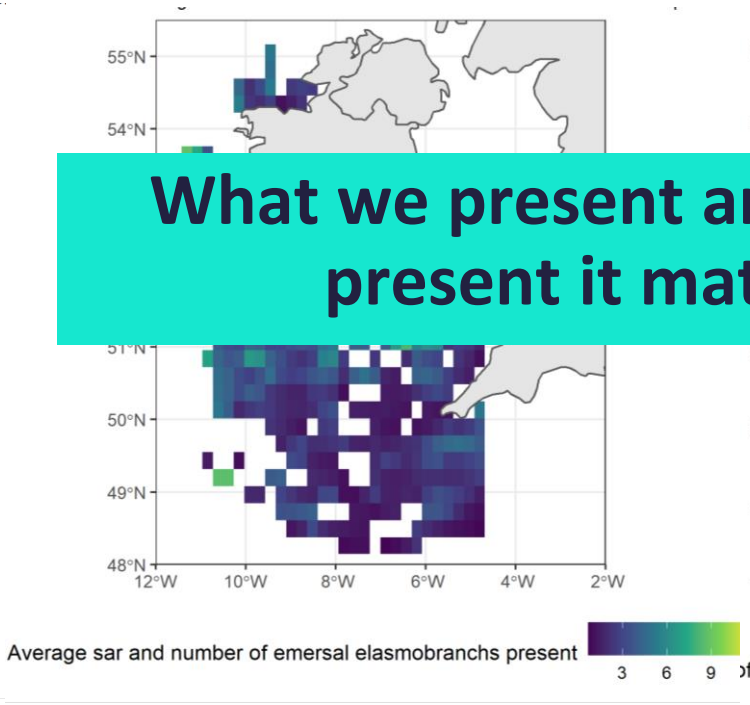


Demersal Elasmobranchs

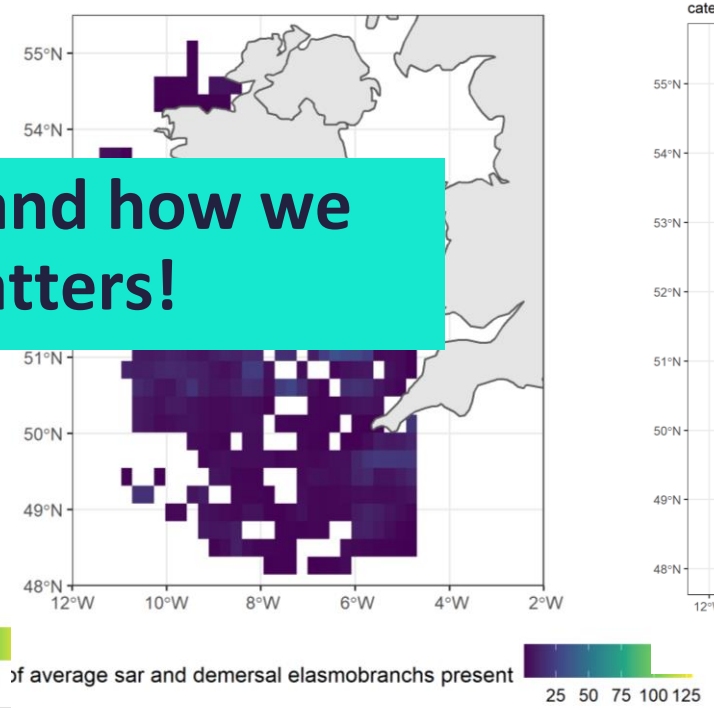
What we present and how we present it matters!



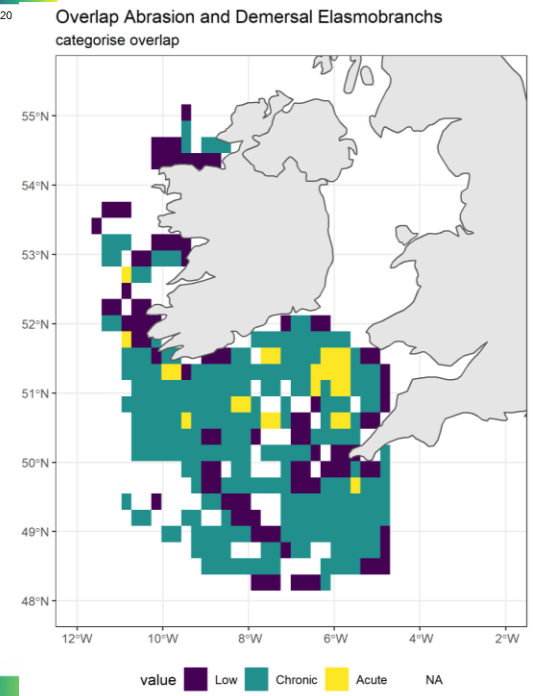
Abrasion map subset to demersal elasmobranch distribution



Abrasion map intensity combined (added) with average elasmobranch density



Abrasion map intensity combined (multiplied) with elasmobranch density



Categorised scores

Conclusions

Risk is perceived differently by different stakeholders

We are responsible for how we present and communicate such risk

We may have our own perception problem….

There is no single answer:

- Complex questions require considered answers
- Complex questions require multiple tools, approaches and disciplines
- Co-development is key to useful and applied outputs
- Trade-offs: multiple alternate outcomes/scenarios better reflect reality
- Communicating uncertainty is important for transparency

Any Questions?

debbi.pedreschi@marine