An introduction to EAFM – how science is working to support EAFM in the North Atlantic

Presented by Colm Lordan ACOM Chair
EAFM Symposium Rome 2025

ICES
CIEM

Science for sustainable seas

VISION

To be a world-leading marine science organization, meeting societal needs for impartial evidence on the state and sustainable use of our seas and oceans.

MISSION

To advance and share scientific understanding of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals.

ICES advice in 2024

Fisheries

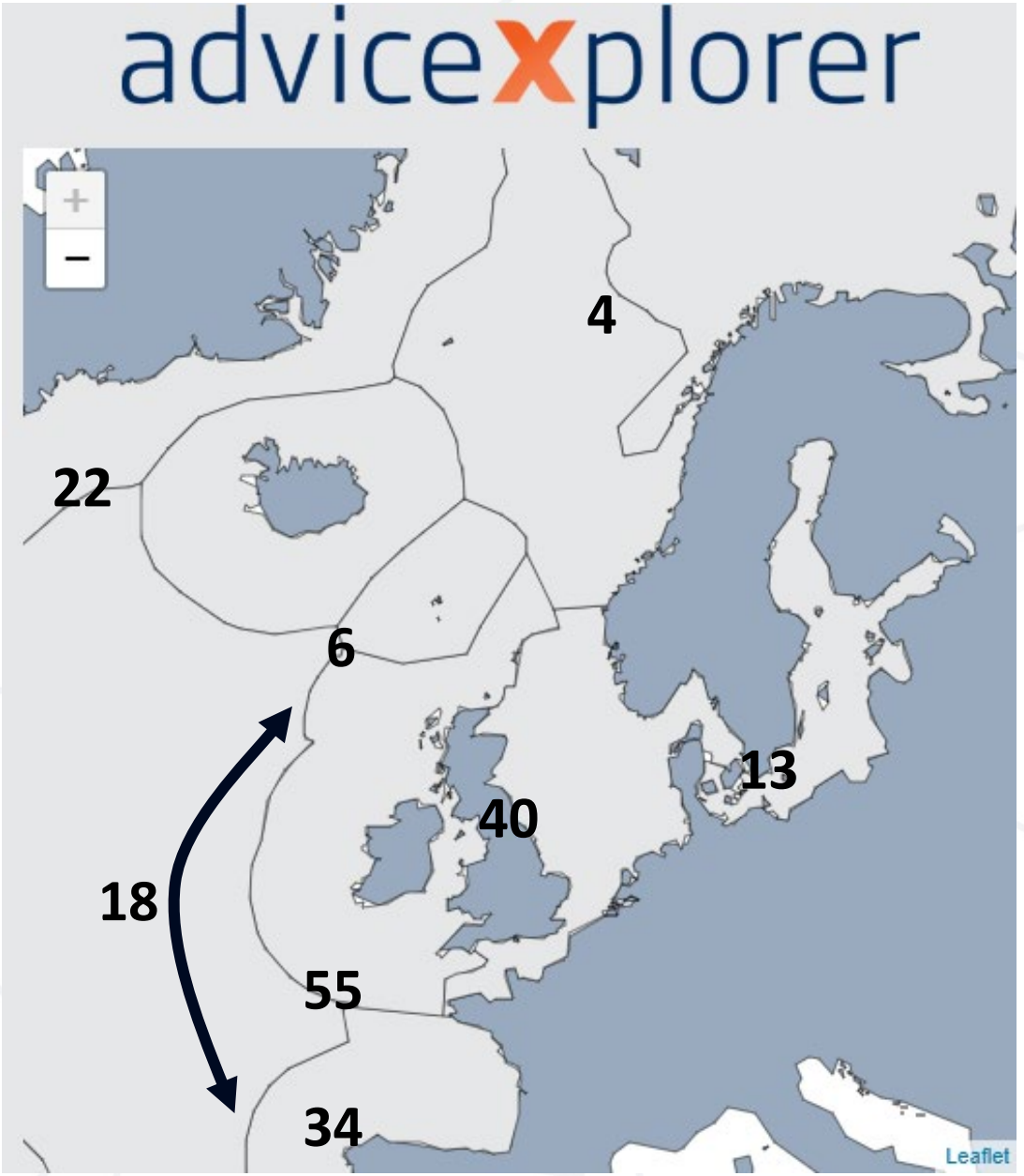
192 stocks (5.2 mT) 77% MSY/MP & 23% PA
MP Icelandic Herring, Baltic Herring Roadmap
MSFD D3C3 advice, 2 updates, 8 tech. services
NEAFC Discards

Ecosystem services and effects

Recurrent VME & Bycatch advice
Bycatch monitoring systems, Spatial trade-off
Action Plan HP, NEAFC – EBFM, OSPAR – status
NEAFC OECM & Bird bycatch

Overviews

Baltic Ecosystem Overview
Bay of Biscay Aquaculture Overview
North Sea & Greenland Fisheries Overviews



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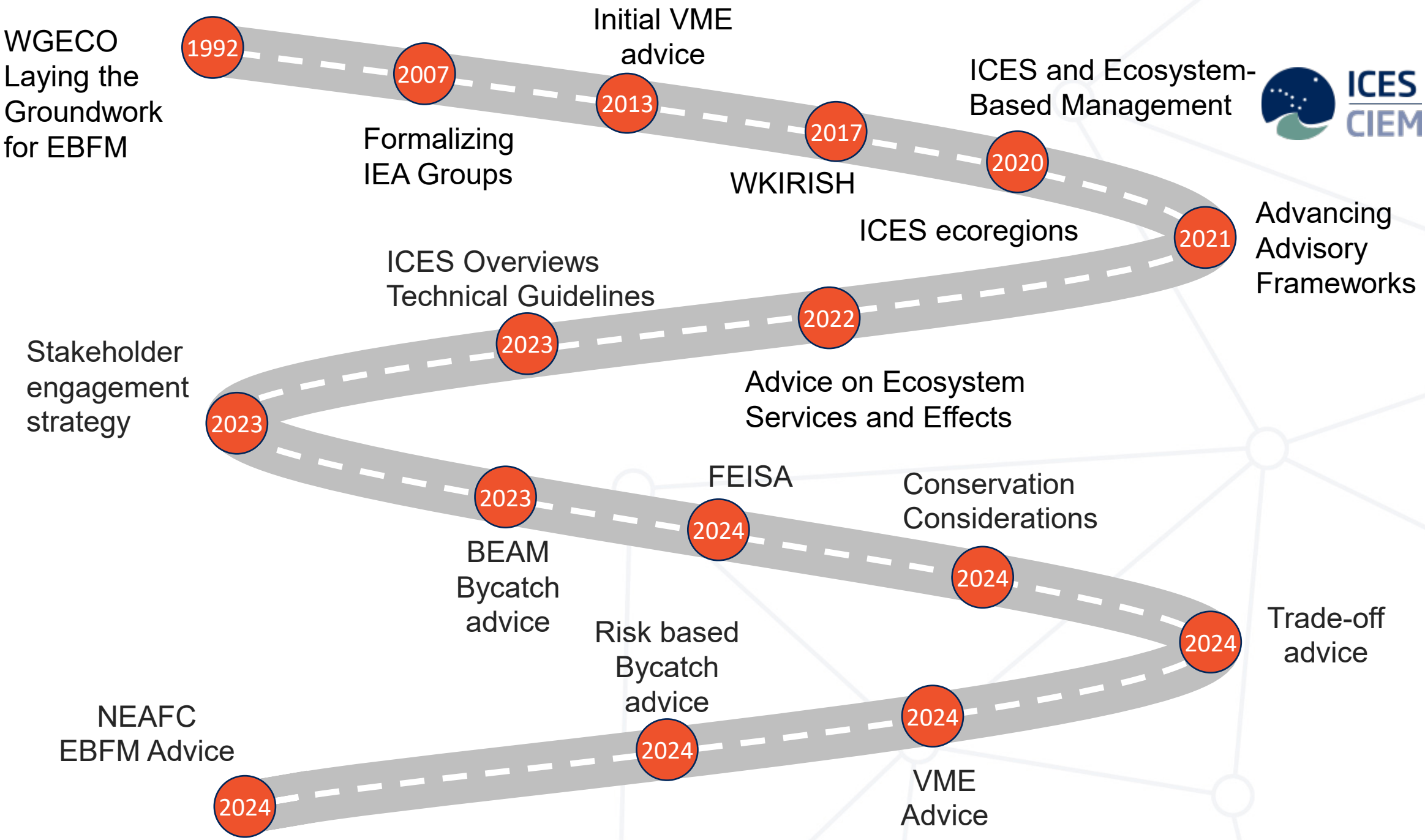
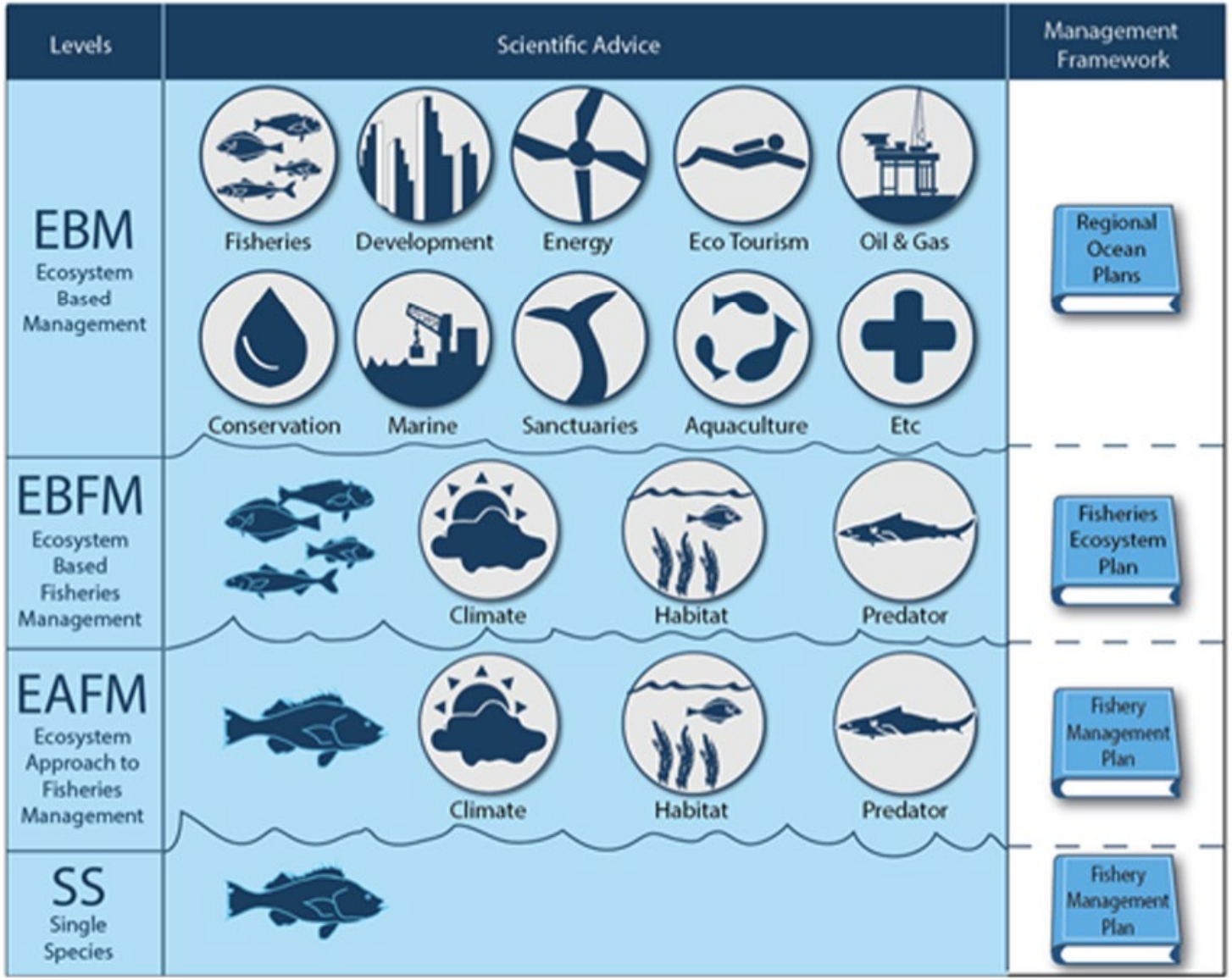

1992
WGECO
Laying the
Groundwork
for EBFM
2007
Formalizing
IEA Groups
2013
Initial VME
advice
2017
WKIRISH
2020
ICES and Ecosystem-
Based Management
2021
ICES ecoregions
Advancing
Advisory
Frameworks
2022
ICES Overviews
Technical Guidelines
2023
Advice on Ecosystem
Services and Effects
2023
Stakeholder
engagement
strategy
2023
BEAM
Bycatch
advice
2024
FEISA
2024
Conservation
Considerations
2024
Trade-off
advice
2024
Risk based
Bycatch
advice
2024
VME
Advice
2024
NEAFC
EBFM Advice

Definitions



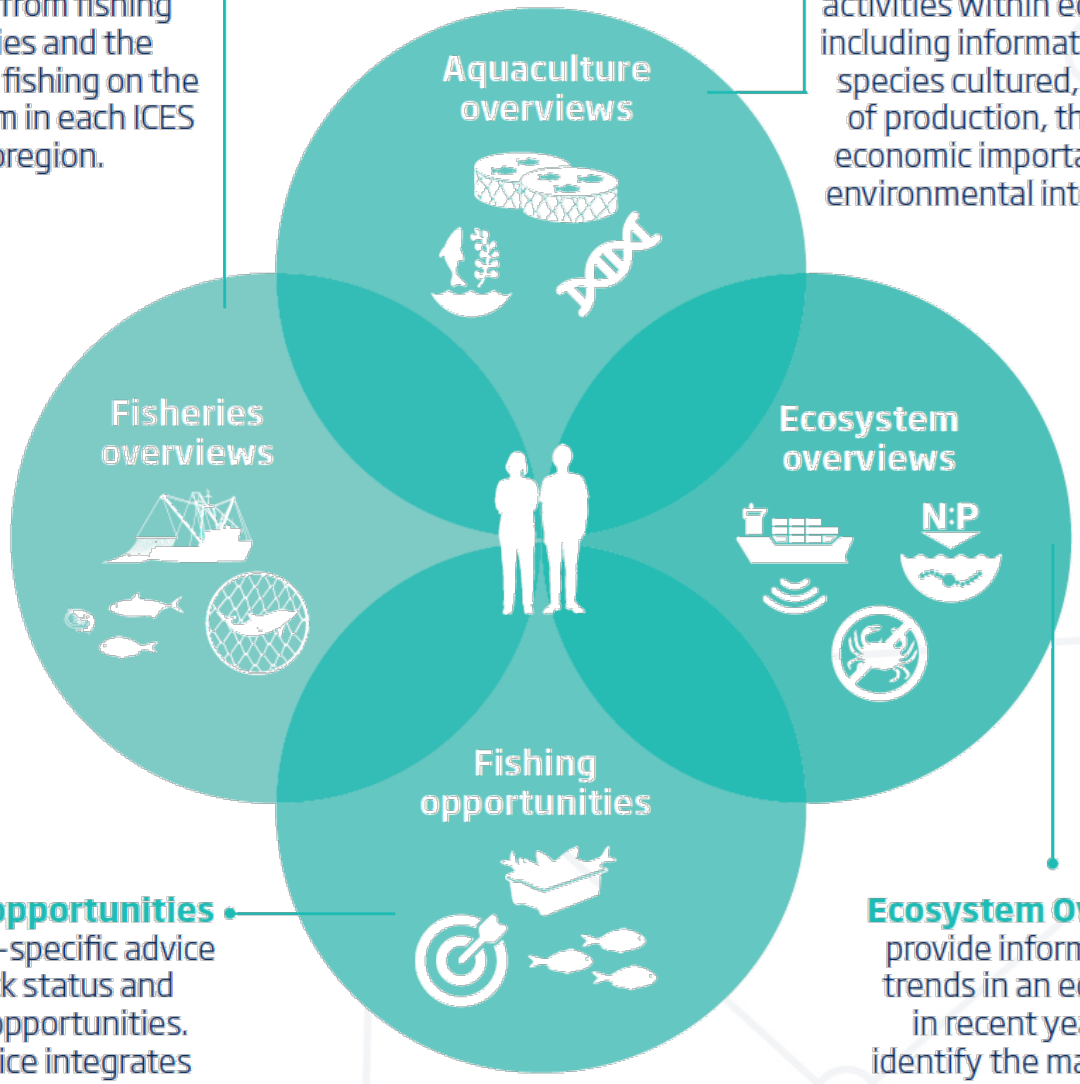
Making advice for EBFM operational

1. Influence of a dynamic ecosystem on fisheries
2. Impact of fisheries on the ecosystem
3. Put fisheries into context of other maritime activities & pressures
4. Consequences of tradeoffs between management objectives

Overviews

Fisheries Overviews summarize the services derived from fishing activities and the effects of fishing on the ecosystem in each ICES ecoregion.

Aquaculture Overviews summarize aquaculture activities within ecoregions, including information on the species cultured, the level of production, the socio-economic importance, and environmental interactions.



Fishing opportunities give stock-specific advice on stock status and fishing opportunities. This advice integrates the precautionary approach, with the objective of achieving maximum sustainable yield (MSY).

Ecosystem Overviews provide information on trends in an ecosystem in recent years and identify the main human pressures, explaining how these pressures affect key ecosystem components.

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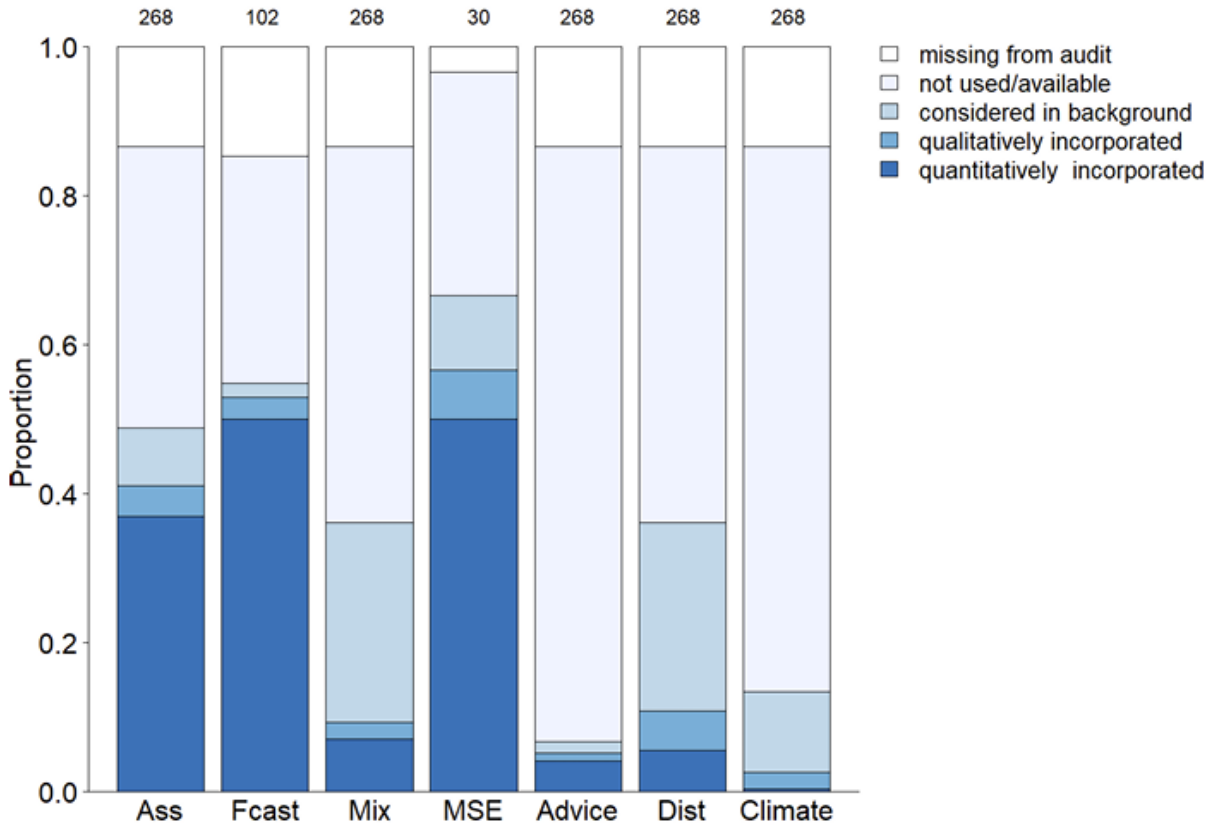
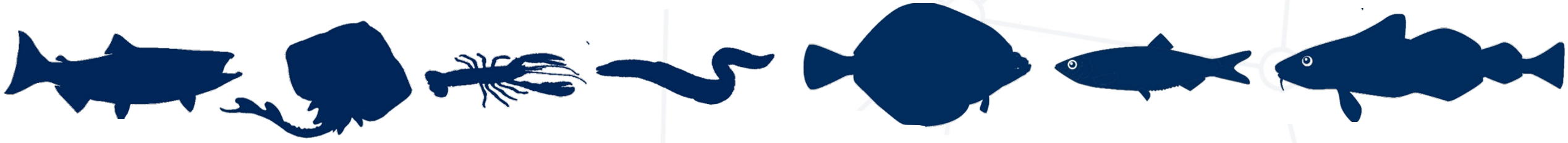
Influence of a dynamic ecosystem on fisheries



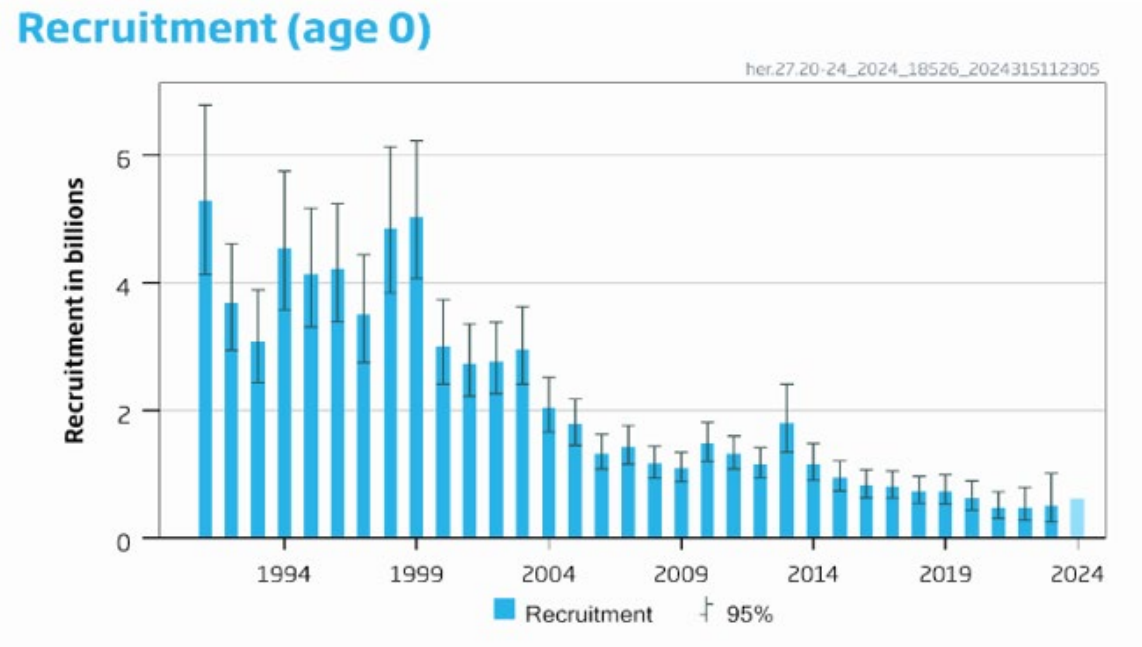
Proportion of stocks for which ecosystem trends and variability are accounted for

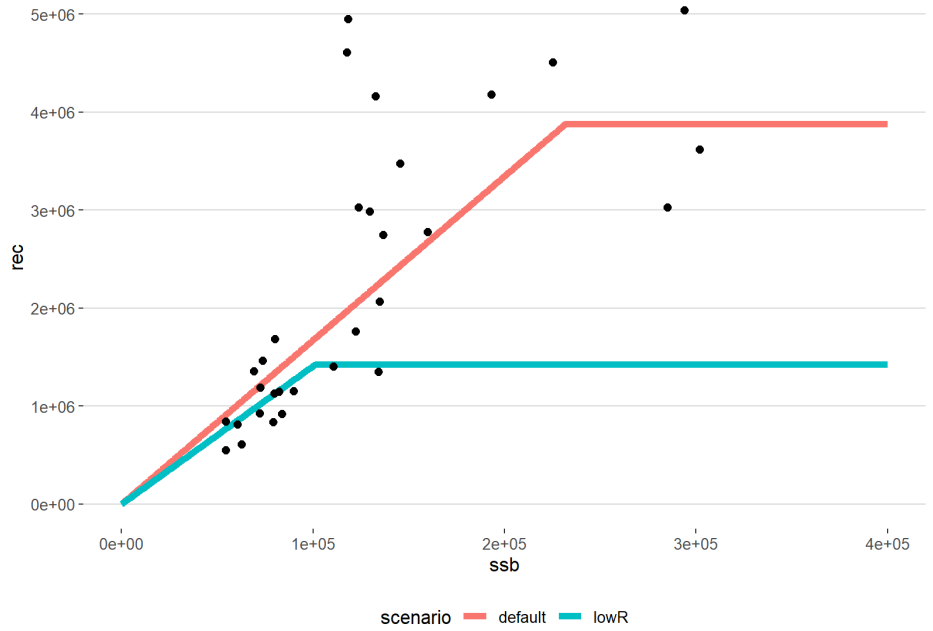
Trenkel et. al 2023 https://www.int-res.com/abstracts/meps/v704/p81-97/

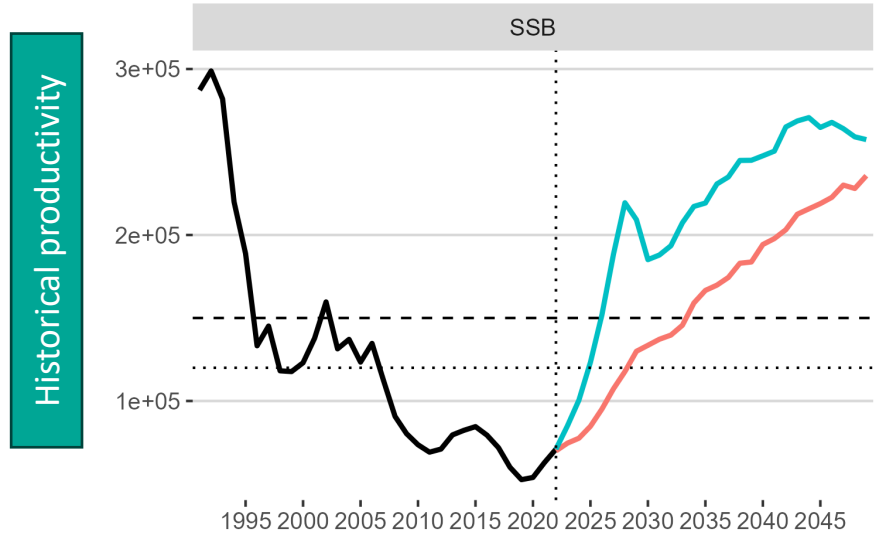
“a move from implicit to explicit instructions with routine documentation is required to accelerate on the path to EBFM in a transparent manner”

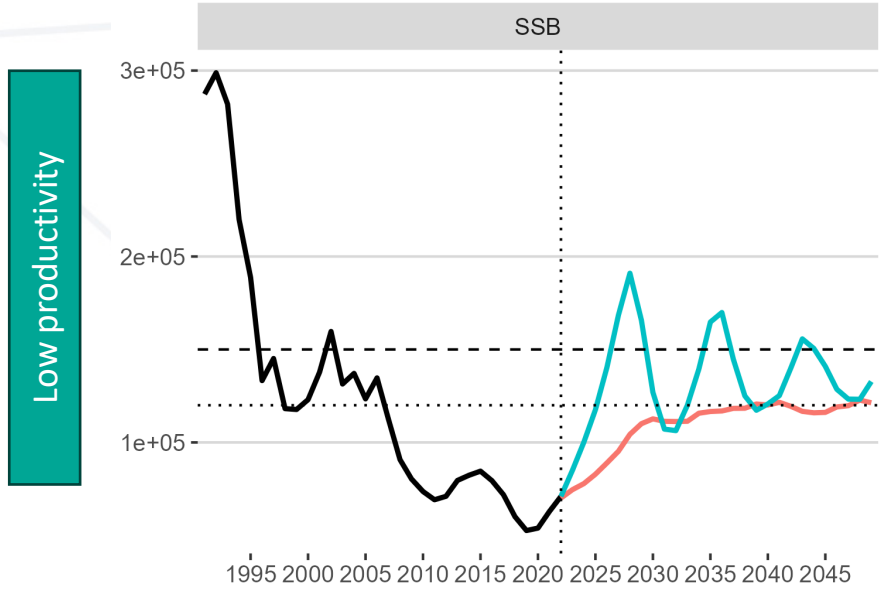


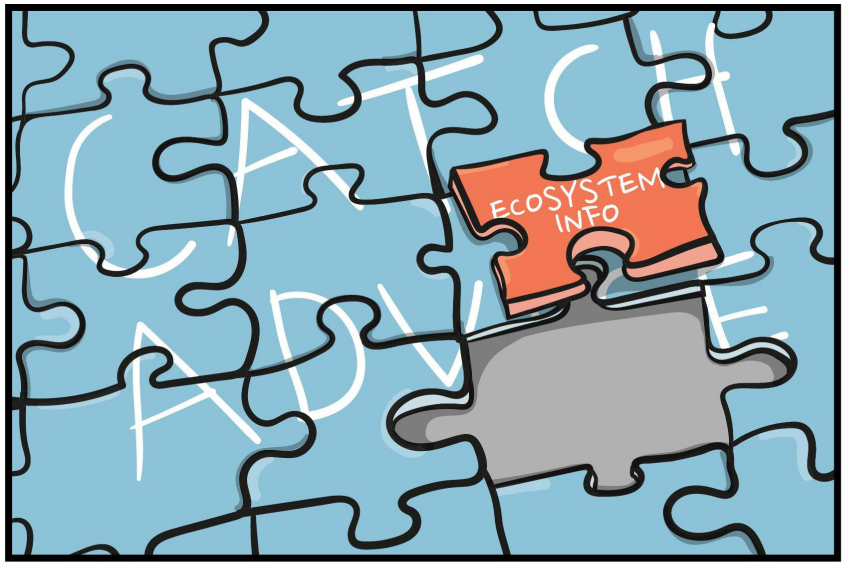
Herring recruitment



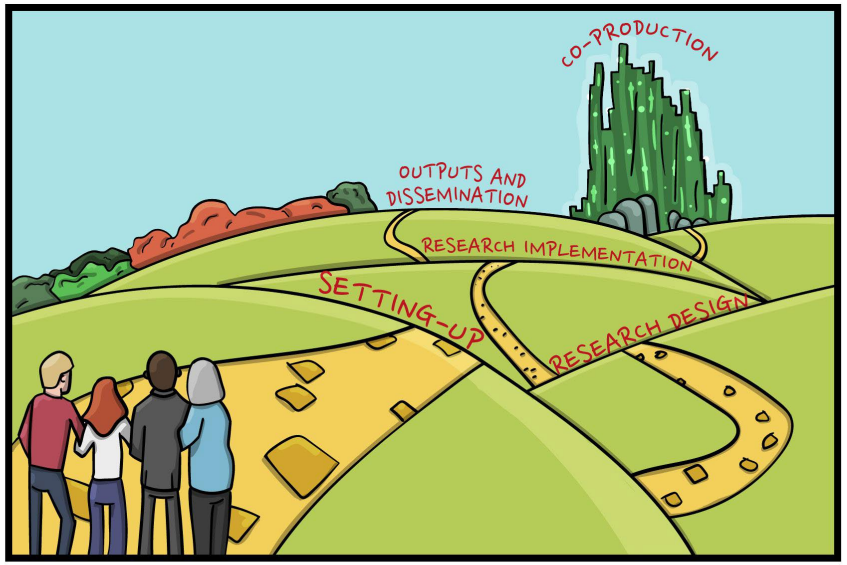




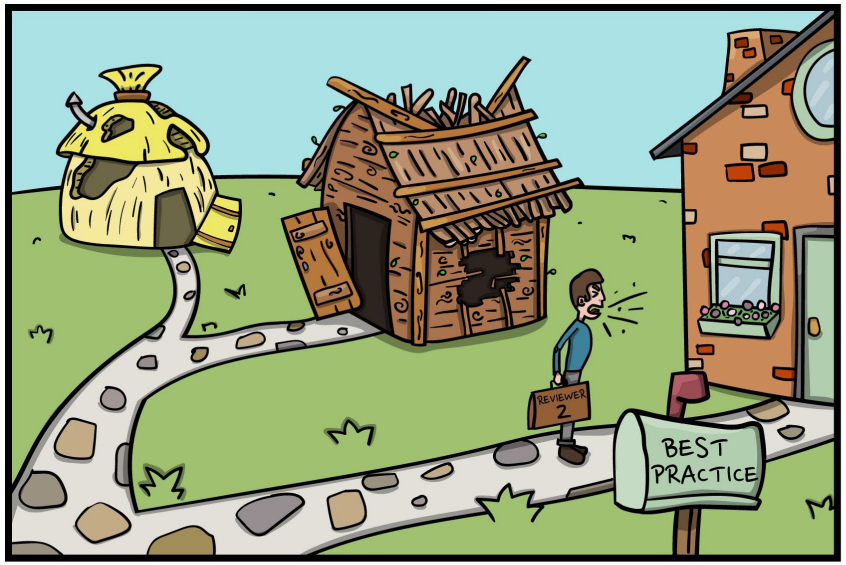




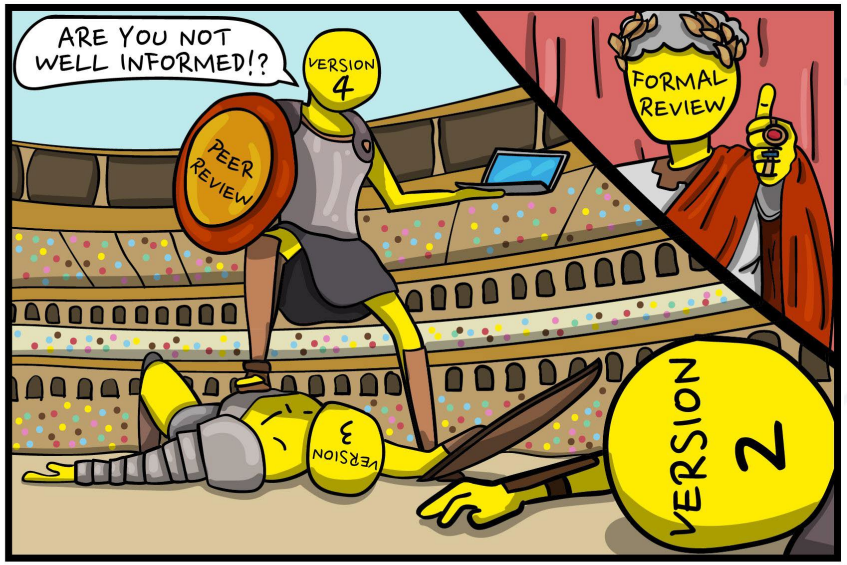
Research objectives and outputs need to be in alignment with policy questions and frameworks.



Dedicated collaboration between researchers, policy advisors, and stakeholders is needed early and often.



Follow best practices to ensure models are rigorous and consistent enough to be useful for policy advice.



Researchers should seek out periodic reviews to ensure model utility and avoid rejection at formal review.

Bently et. al 2021 https://doi.org/10.3389/fmars.2021.602072

WKIRISH Lessons learned

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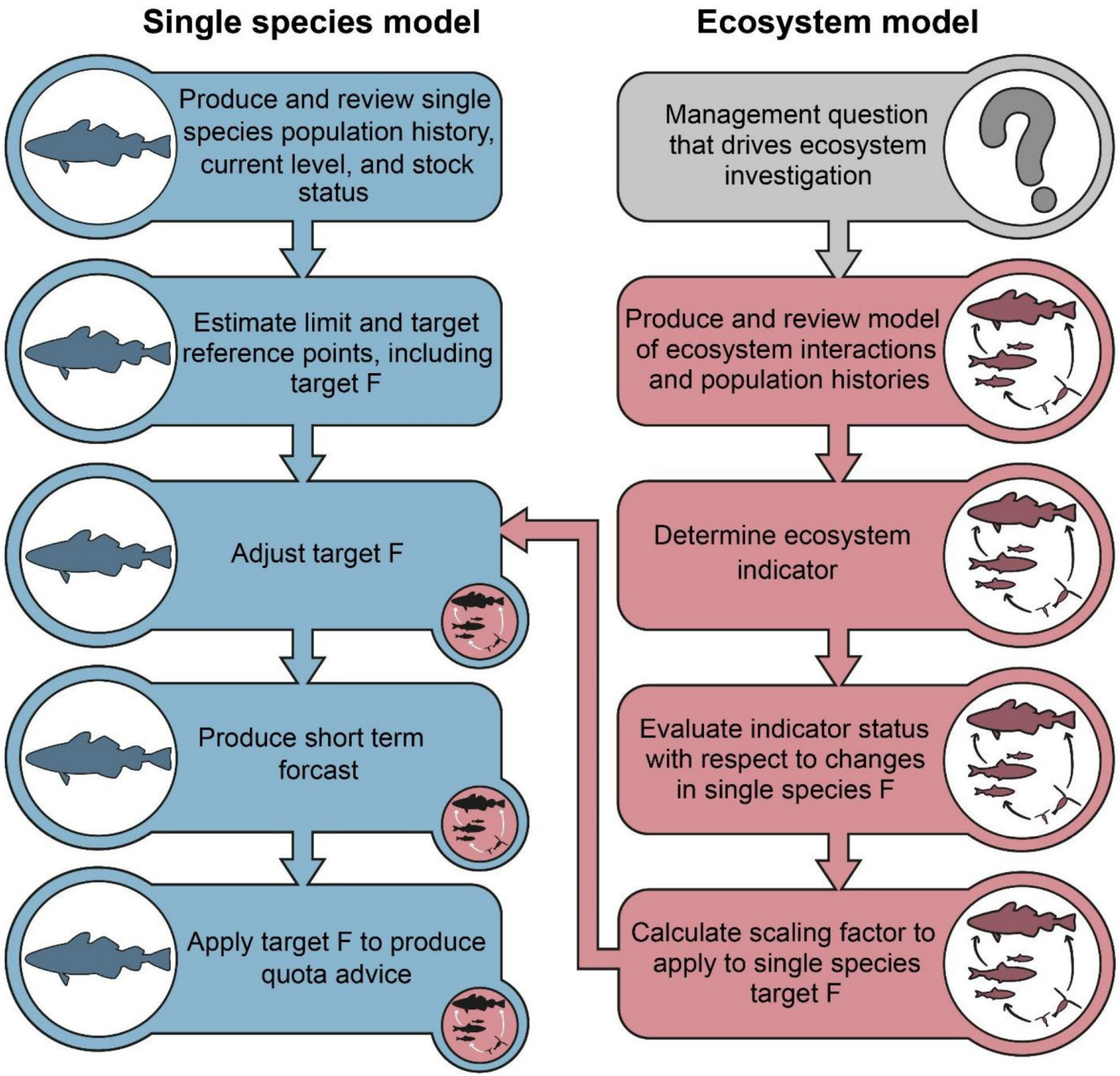
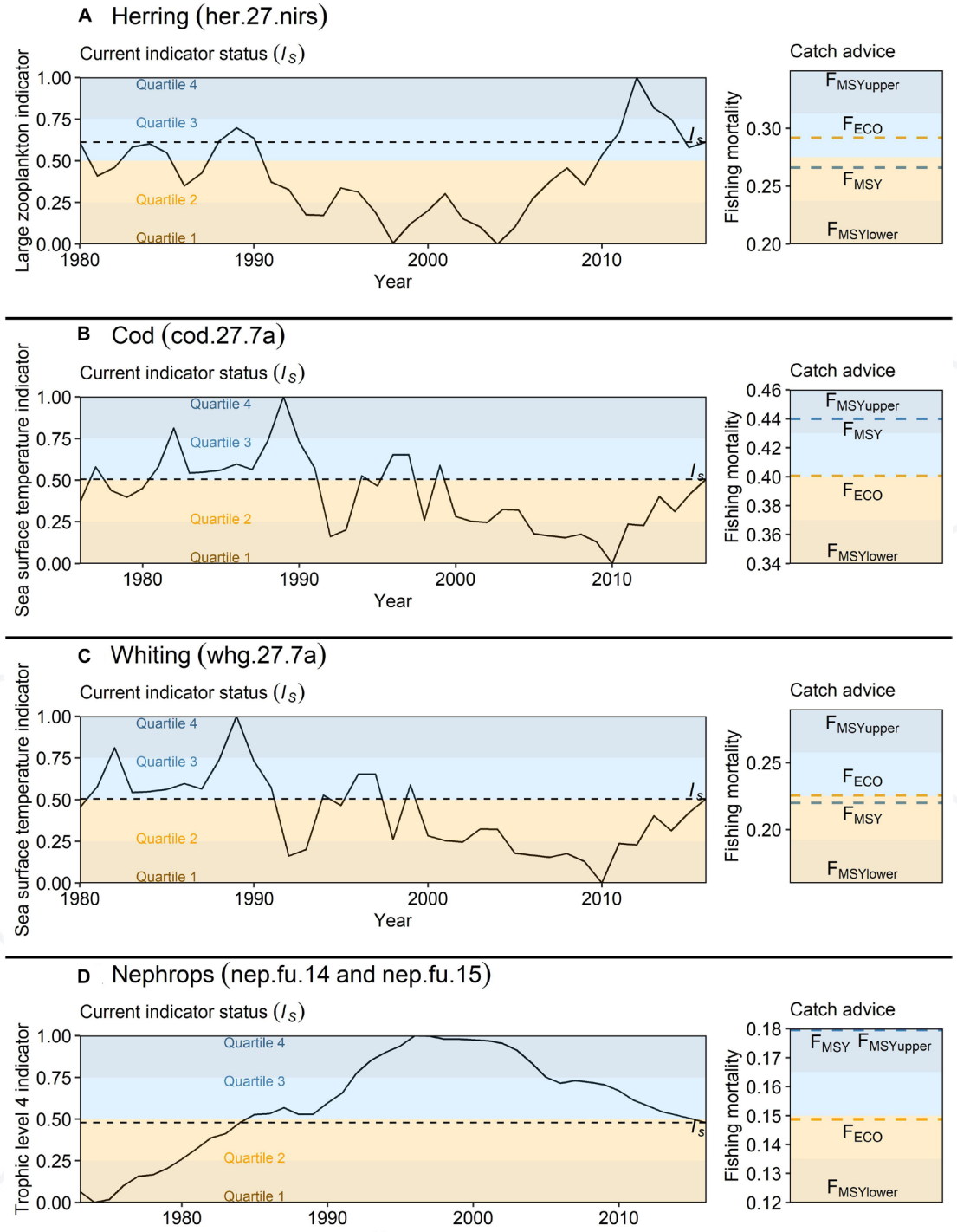
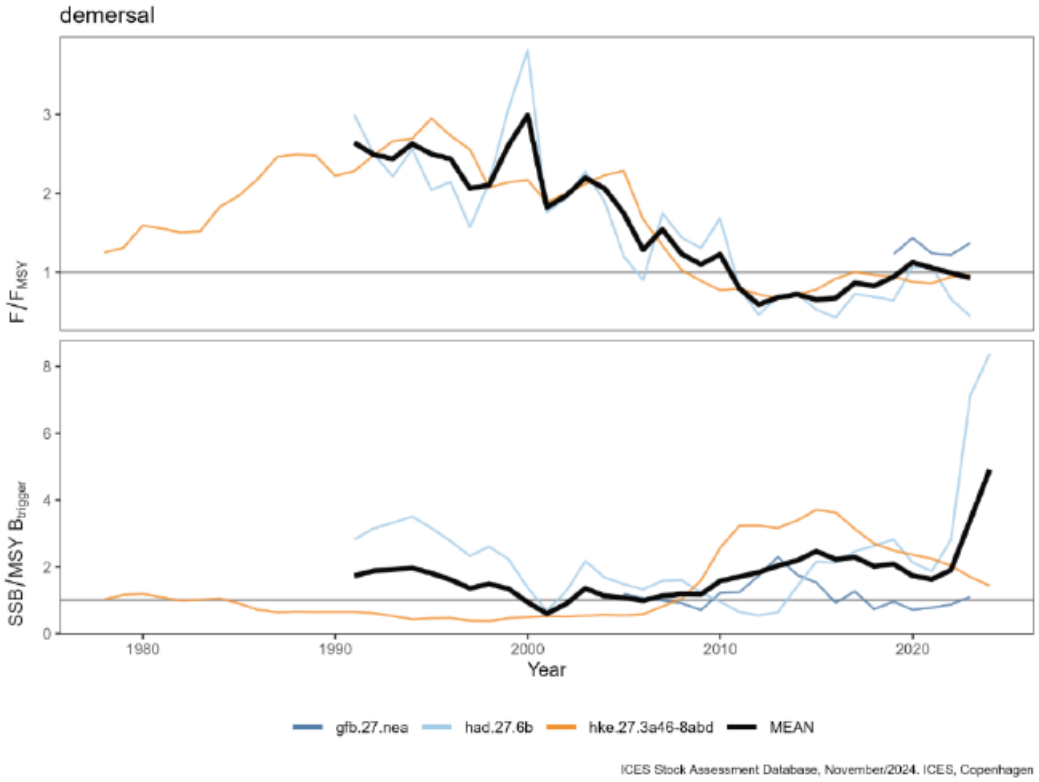
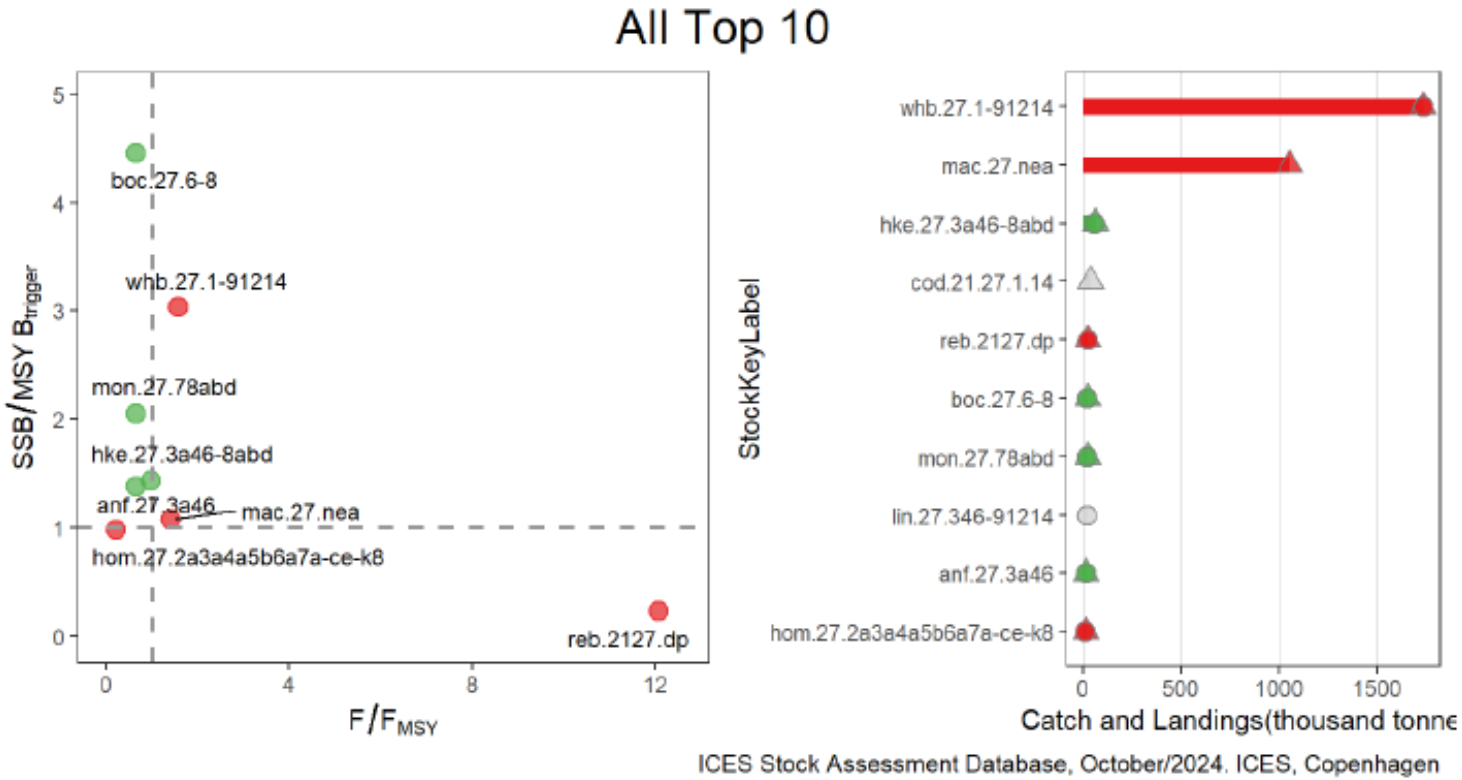


Howell et al 2021 0.3389/fmars.2020.607831



Impact of fisheries on the ecosystem





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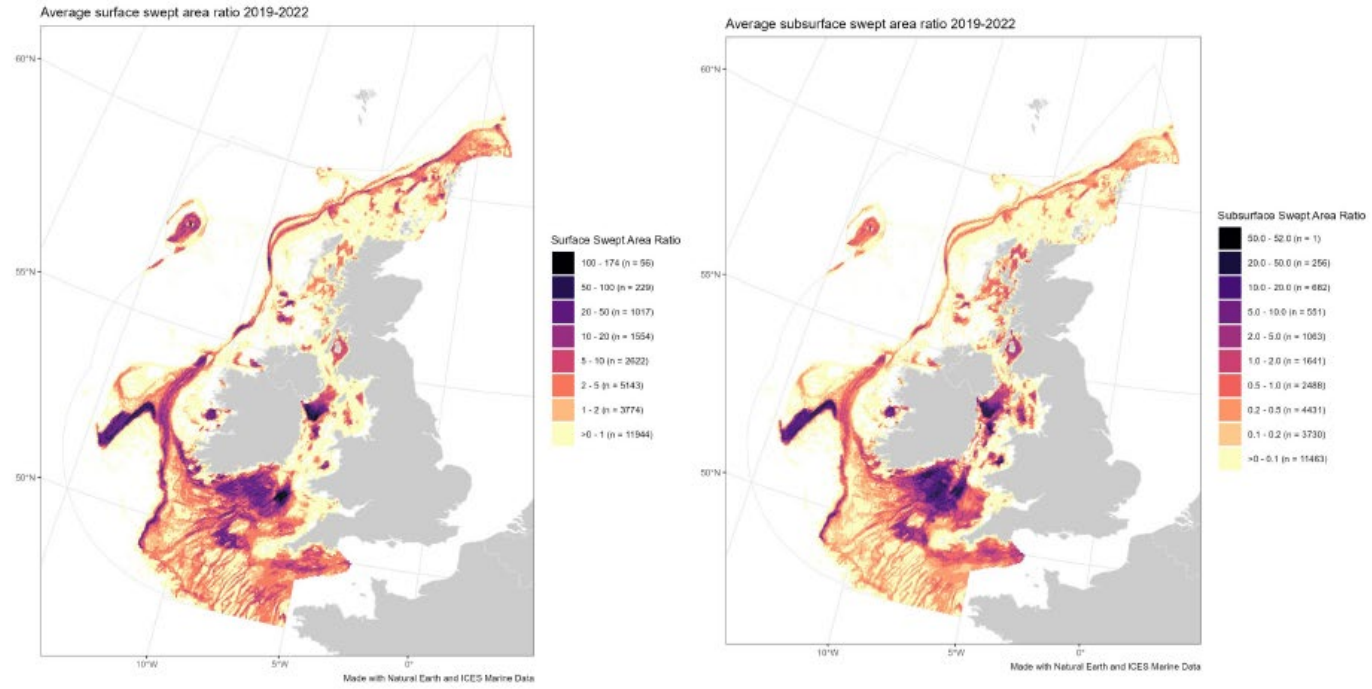
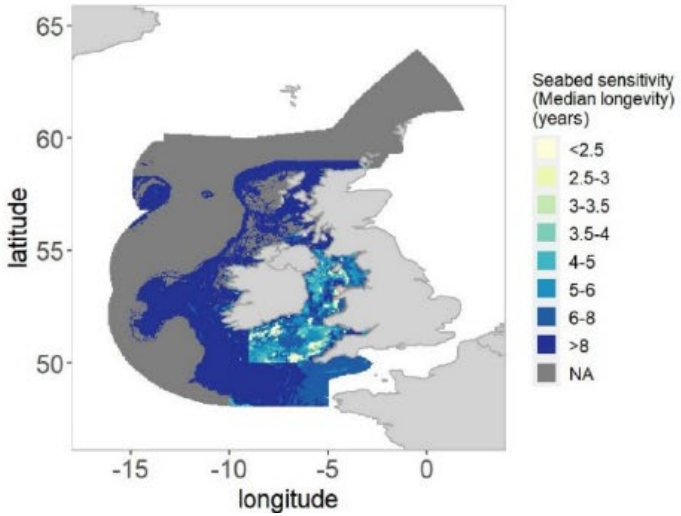
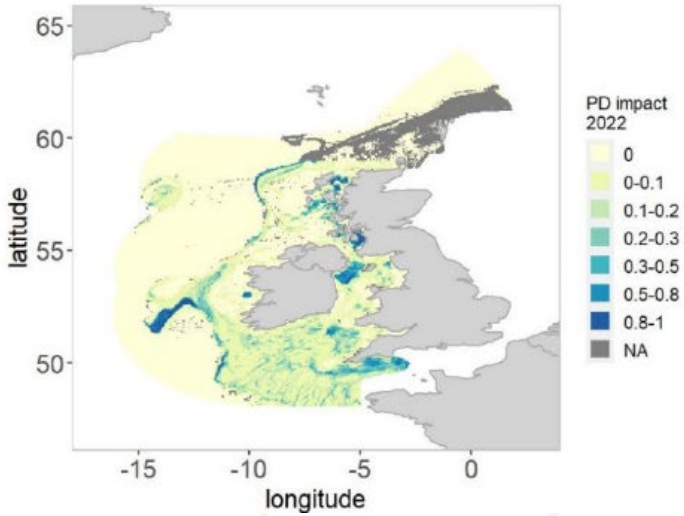
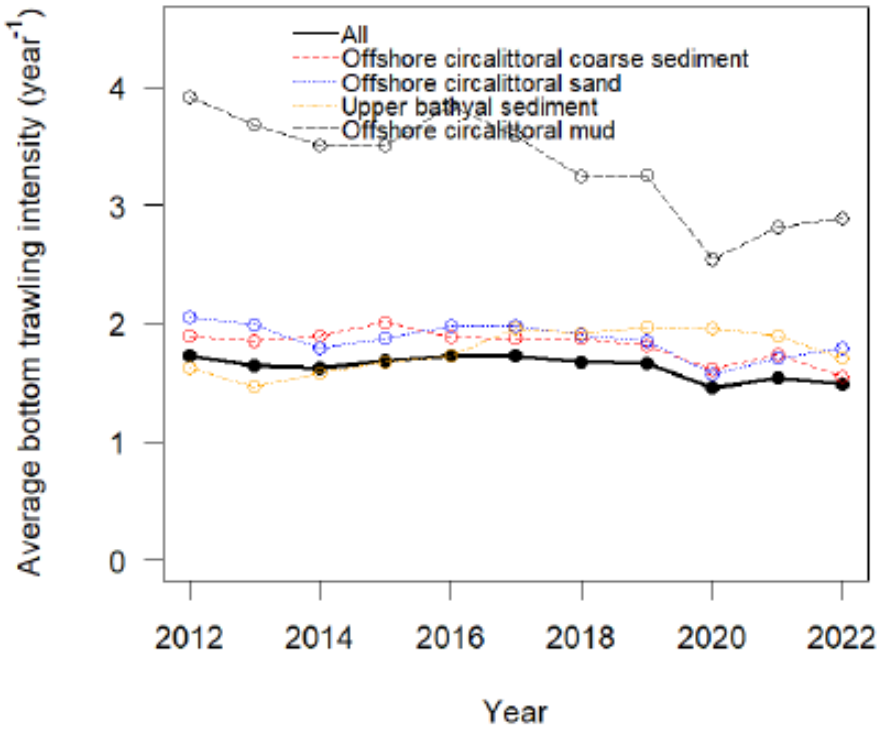








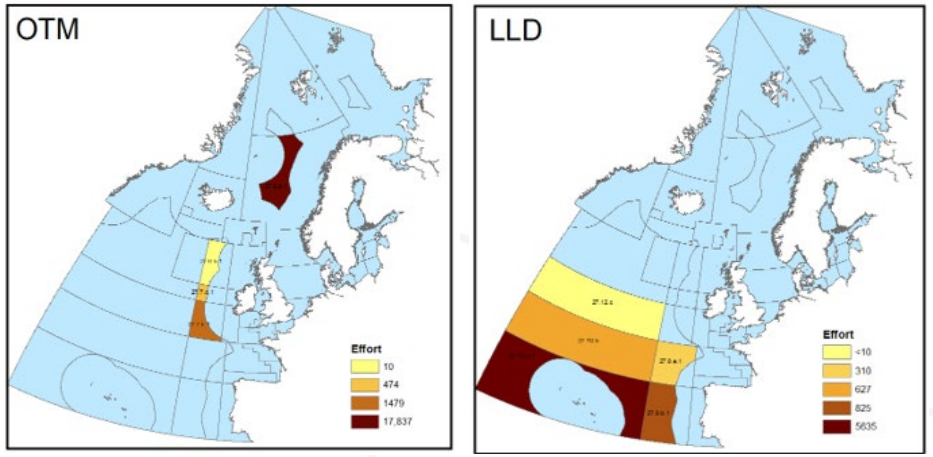
Science for sustainable seas

Science priorities (1-5 years perspective)

i. Quality of fishing effort and monitoring **data**,
ii. Scientific **sampling design** and/or monitoring programmes, **data flow**, and bycatch **estimation procedures**,
iii. Bycatch assessment methods for **data-limited** situations,
iv. Measures to prevent, minimize, and mitigate **bycatch** by advancing knowledge on ETP species behavioural interactions with fishing gear, gear modifications, and/or changes in fisheries
v. Strandings database,
vi. Threshold values for ETP species bycatch,
vii. Characteristics of ETP species **populations** affected by bycatch.

https://doi.org/10.17895/ices.pub.26003467

NEAFC request on bycatch risk gears for seabirds in the NEAFC RAs



The gear types of higher bycatch risk to seabirds in the NEAFC RAs are:

- **midwater otter trawls and drifting longlines in the NEAFC RA1**
- **midwater otter trawls in the NEAFC RAs 2 and 3**

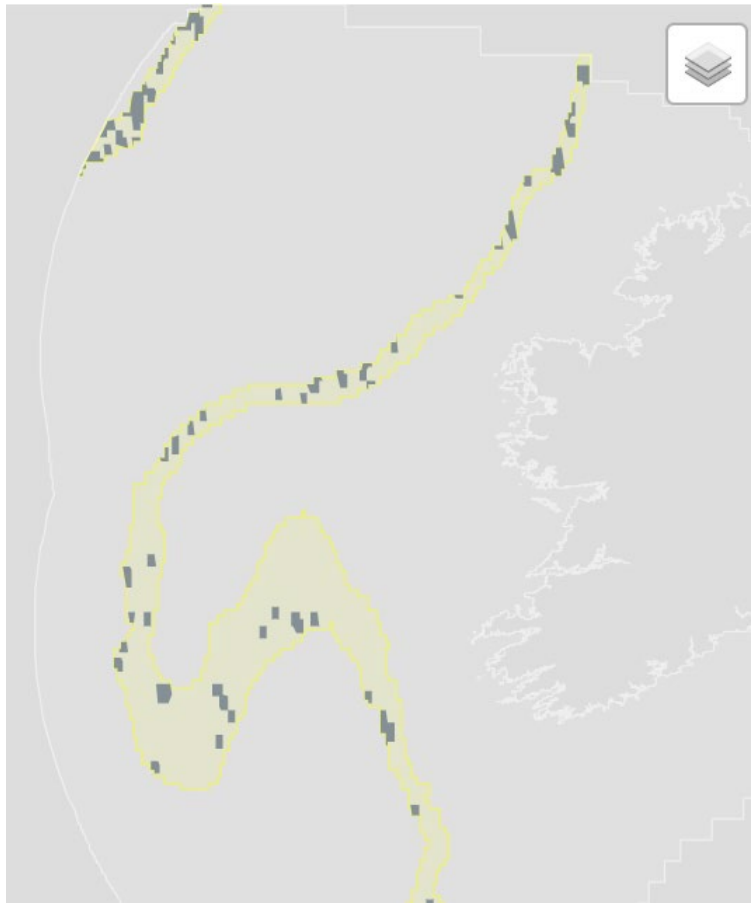
Northern gannets and auks are most likely to be vulnerable to bycatch from otter trawls (mainly midwater) and shearwaters to bycatch in drifting longlines.

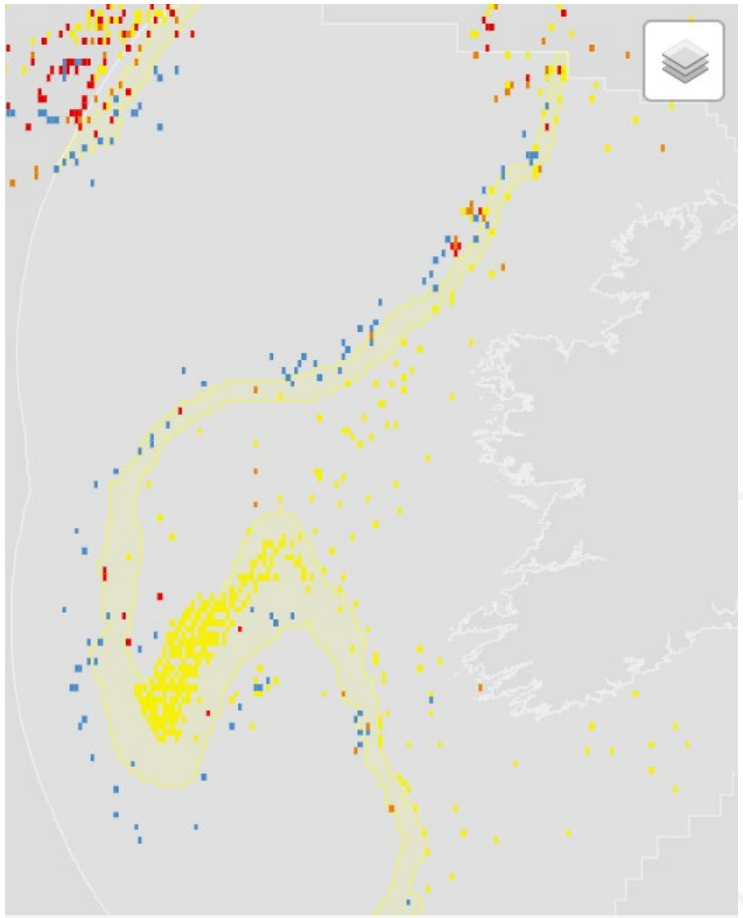
Fulmars, shearwaters, gannets and auks may be vulnerable to **bottom otter trawls** in the NEAFC RA1.

The available data suggest little fishing effort using static gear. This gear type tends to be generally of high bycatch risk to several seabird species.

Methods
Fishing effort data (2021-2022) from the ICES VMS/Logbook data call for fishing activities in the NE Atlantic and Baltic Sea
Review of relevant literature to assess the presence and status of species of seabirds occurring in the NEAFC RAs
Review of relevant literature to qualitatively assess bycatch risk for species occurring regularly in the NEAFC RAs

Impact of fisheries on the ecosystem: VME advice





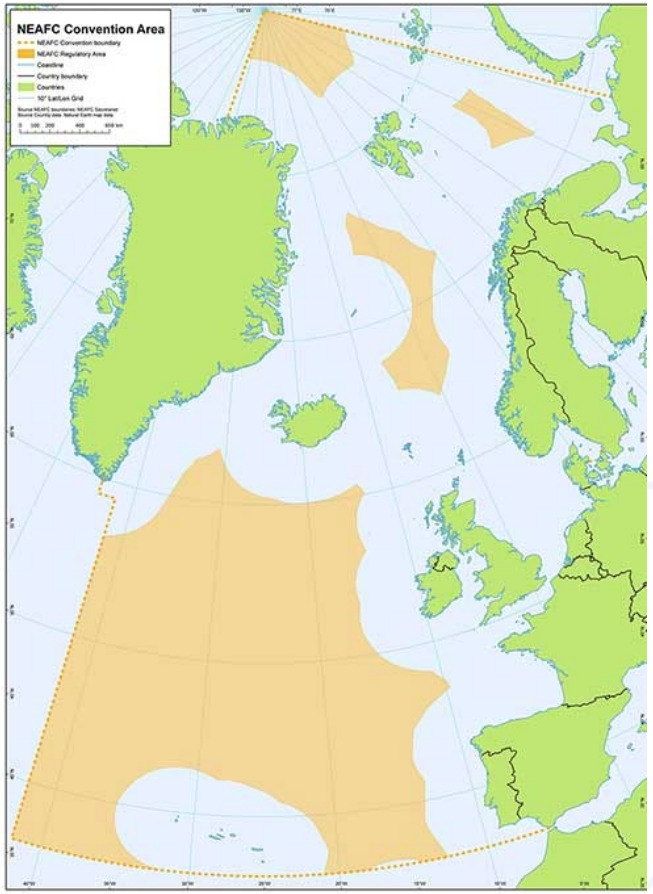
VME Advice Data Products
ICES. 2024. Advice on areas where Vulnerable Marine Ecosystems (VMEs) are known to occur or are likely to occur in EU waters. ICES data product, https://doi.org/10.17895/ices.advice.26983726.

OECMs Advice for NEAFC

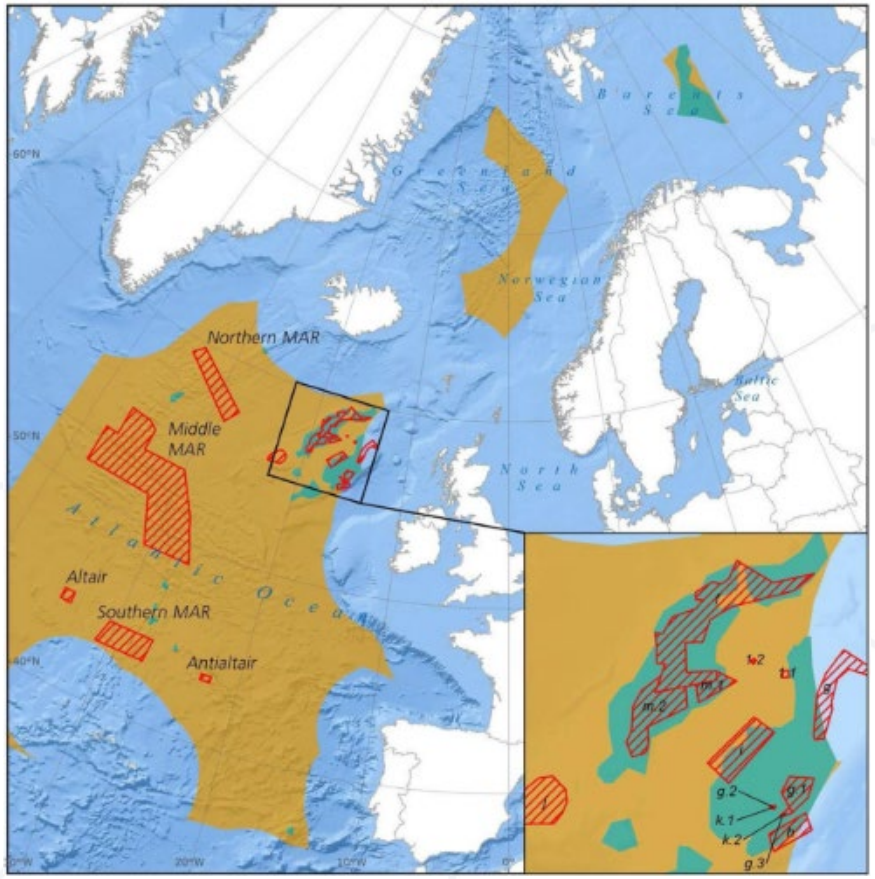
NEAFC restricted and closed areas

- Long-term biodiversity/ecosystem benefits?
- Other evidence to support OECM designation?
- Maximum depth of bottom fishing?

Restricted to bottom fishing



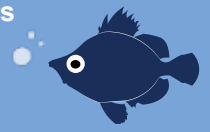
Closed areas to bottom fishing



FISHERIES OVERVIEW 2022

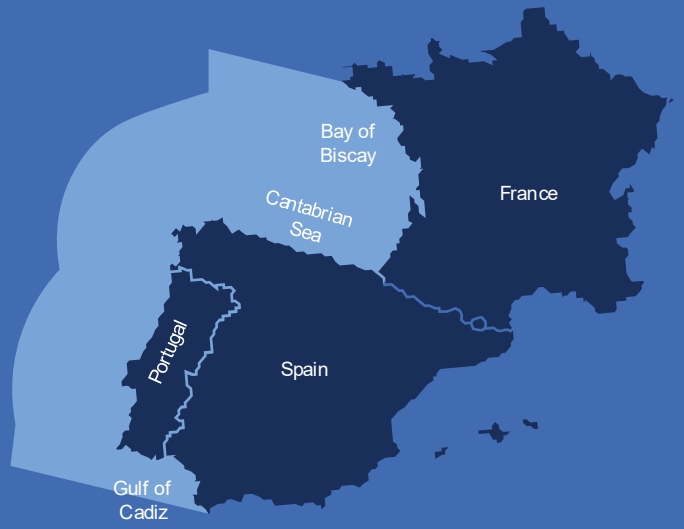
BAY OF BISCAY AND IBERIAN COAST

ICES provided advice in 2022 on 73 stocks



- **10** Benthic
- **6** Crustacean
- **20** Demersal
- **26** Elasmobranch
- **11** Pelagic

This ecoregion includes areas of the deeper eastern Atlantic Ocean, as well as coastal areas from Brittany in the north to the Iberian Peninsula and Gulf of Cadiz in the south.



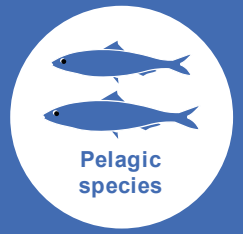
Who is fishing?

7 countries currently have fisheries targeting the many marine stocks within the ecoregion.

Countries with the largest landings: **Spain, Portugal, and France**

Countries with minor landings: **The Netherlands, Ireland, Belgium, and UK**

Species caught in the ecoregion



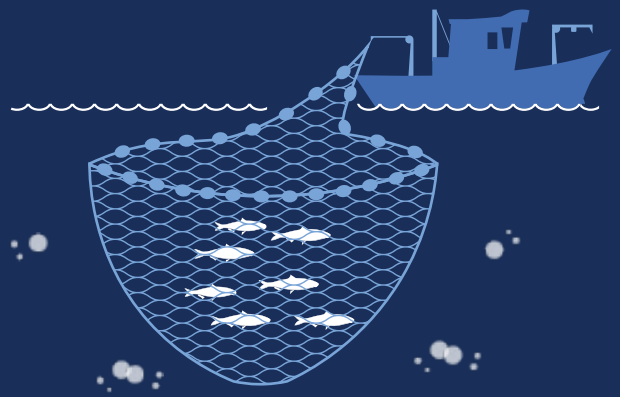
Ecosystem effects of fisheries

- Biomass removal
- Abrasion
- Ghost fishing
- Damage to benthic fauna
- Bycatch of marine mammals, elasmobranchs, and seabirds

Fishing gears used in the area

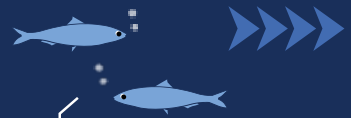
Bottom trawls are the most common gear used in the area and targets demersal species.

Midwater trawls take the highest landings in the area and target blue whiting and mackerel.



Landings by species in 1950–2020

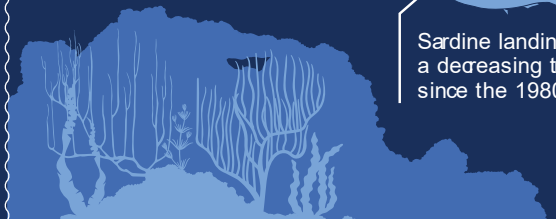
Sardine gives the highest proportion of the total landings followed by blue jack mackerel and horse mackerel.



Blue jack mackerel

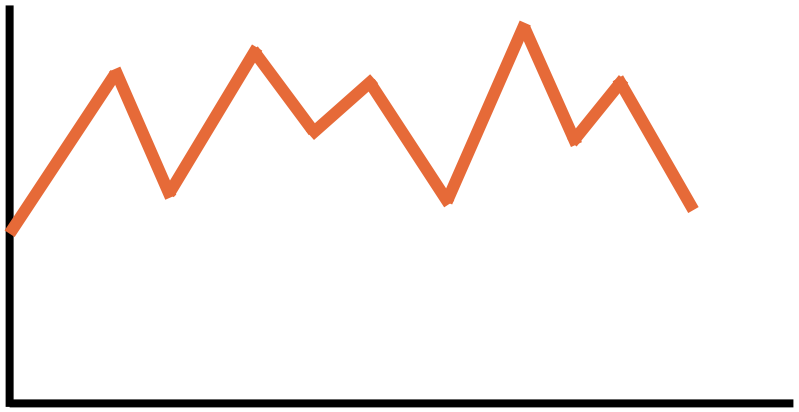
Horse mackerel

Sardine landings show a decreasing trend since the 1980s.

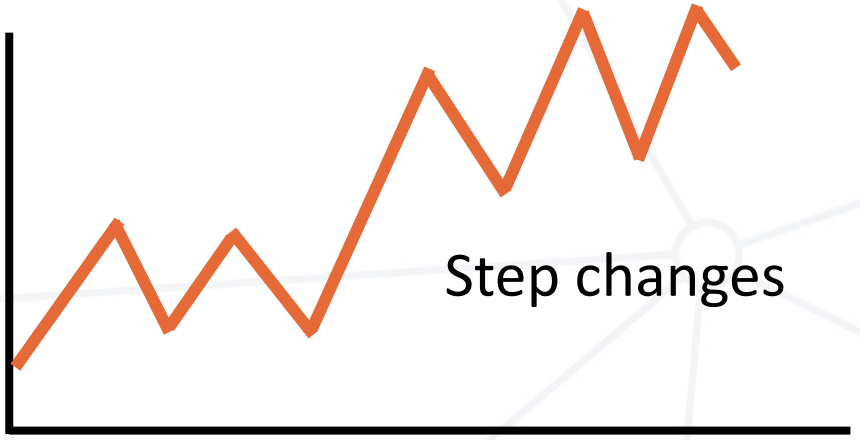


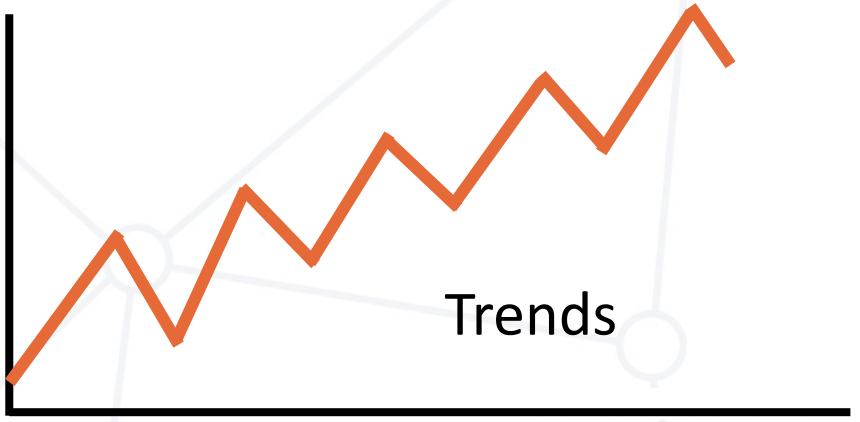
Fishery management systems in a changing climate

Designed for dealing with variability…



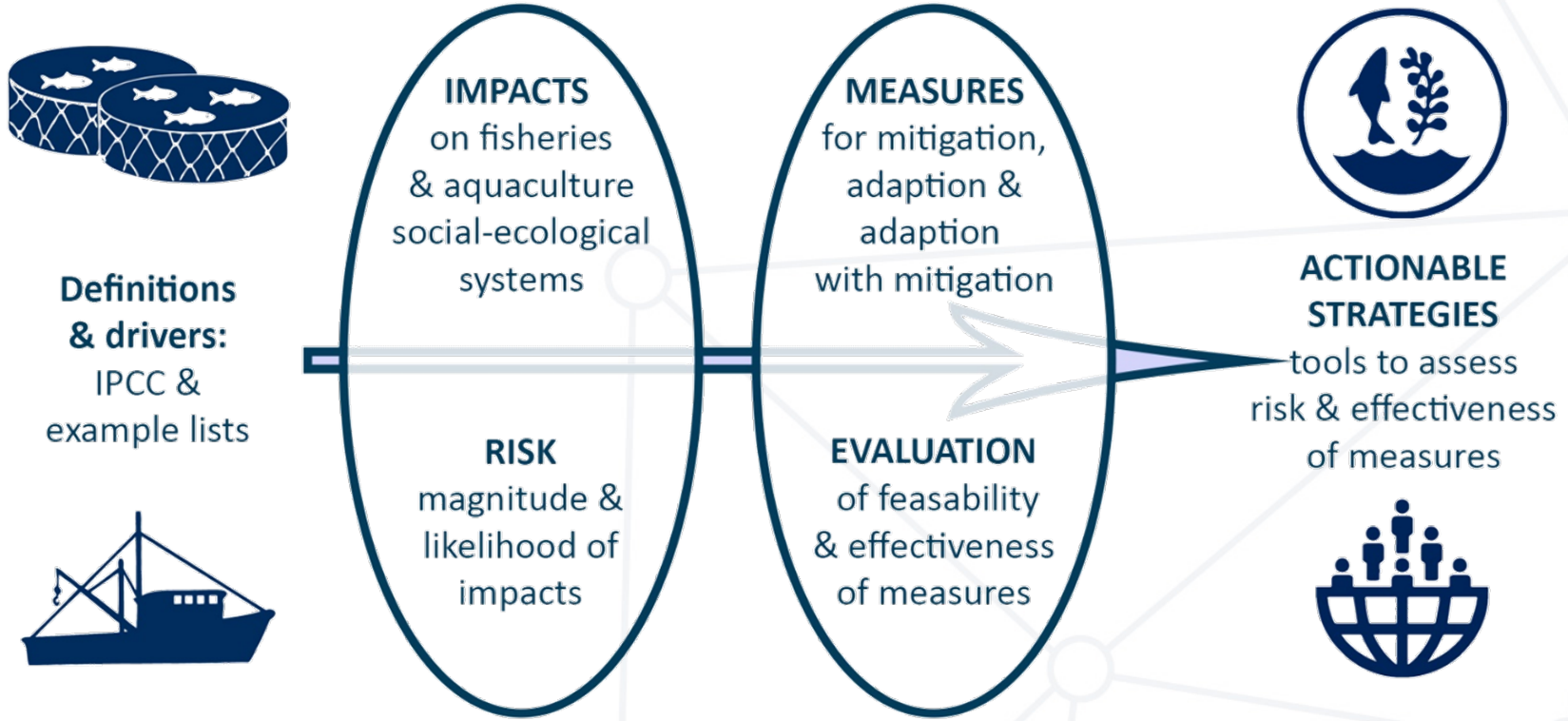
But not:





Fisheries are social-ecological systems

Resilience in social-ecological systems relies not only on the availability of assets but also on capability to mobilize those assets to enable adaptive behavior.

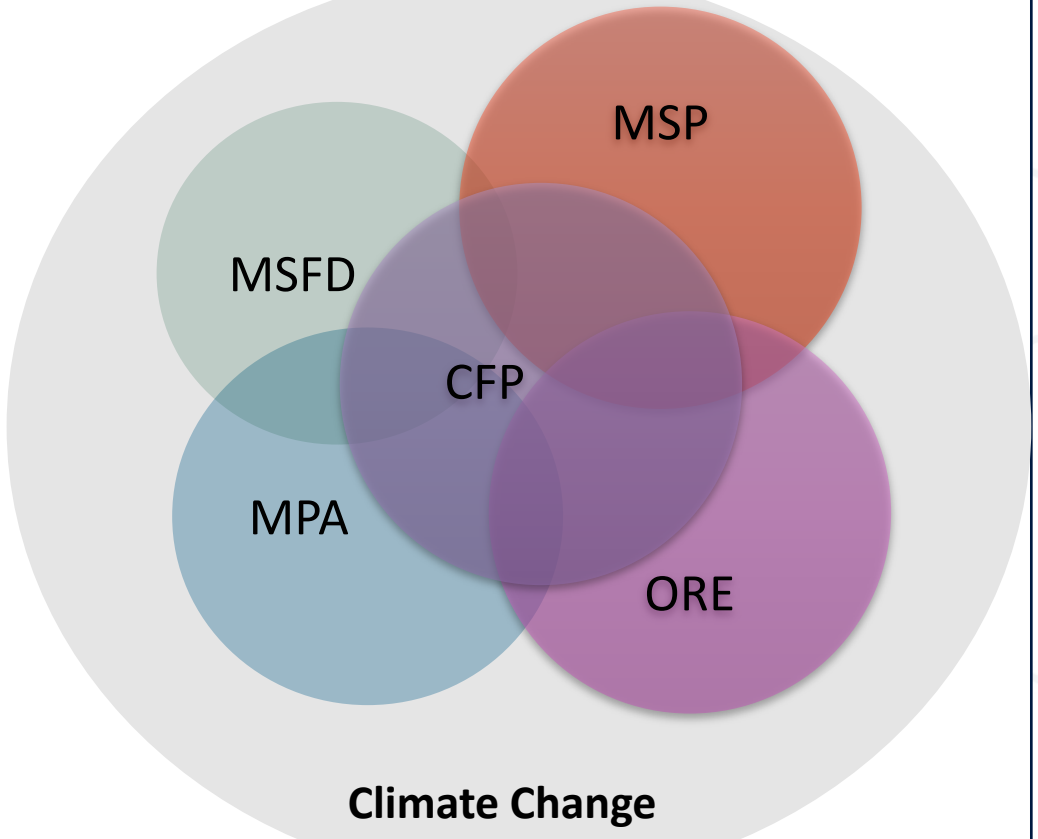


EU Legal and Policy Context

DGMARE

DGENV

- ✓ **Common fisheries policy** (Regulation (EU) 2013/1380)
- ✓ **EU-MAP** (Regulation (EU) 2017/1004)
- ✓ **Technical conservation measures regulation** (Regulation (EU) 2019/1241)
- ✓ **Measures concerning incidental catches of cetaceans in fisheries** (Regulation (EC) 2004/812)
- ✓ **EU Action Plan for reducing incidental catches of seabirds in fishing gears** (COM(2012) 665 final)
- ✓ **Marine strategy framework directive** (Directive 2008/56/EC)
- ✓ **Nature Restoration Regulation** (EU 2024/1991)
- ✓ **Natura 2000**
- ✓ **Water Framework Directive** (EU 2000/60)
- ✓ **Birds directive** (Directive 2009/47/EC)
- ✓ **Habitats directive** (Directive 1992/43/EC)



Green Deal
Biodiversity strategy for 2030

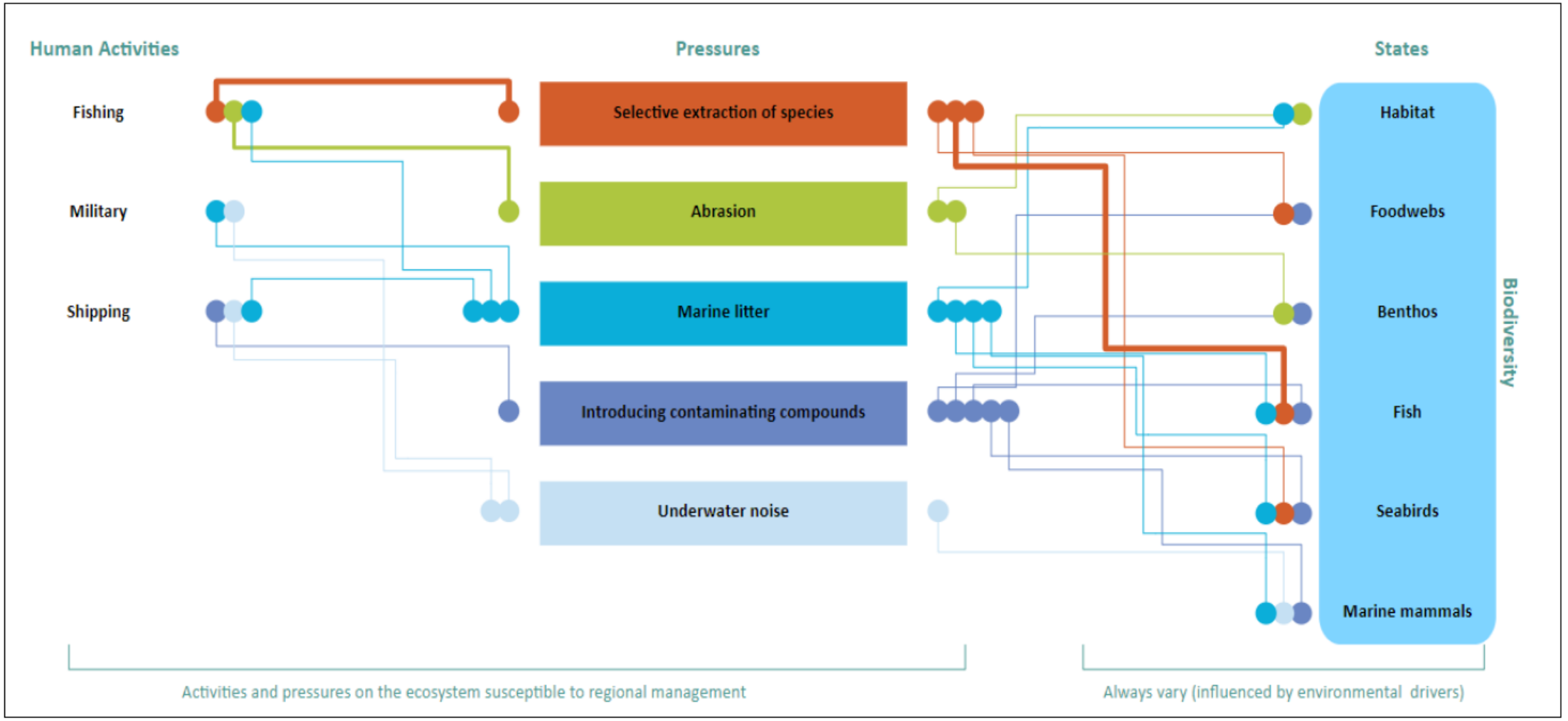
European Commission

4. Consequences of tradeoffs between management objectives

- Integrated ecosystem assessment groups explore suites of management objectives in each ecoregion
- Tools developed for comparing the consequences for tradeoffs between objectives
- Stakeholder engagement to explore methods, ideas & consequences
- Practical application to advice – seabed impact, MSFD & mixed fisheries

Examples
https://www.ices.dk/advice/ESD/Pages/Ecosystem-overviews.aspx
https://www.ices.dk/advice/Fisheries-overviews/Pages/fisheries-overviews.aspx
https://doi.org/10.17895/ices.advice.25601121

Put fisheries into context of other maritime activities & pressures



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Baltic Sea

Ecosystem Overview 2024

Human activities and their pressures

Main activities impacting the ecosystem

Fishing

Agriculture and forestry

Wastewater discharge

Major pressure on the ecosystem through nutrient and organic enrichment

Major contaminant pathways

Land-based industry

Shipping

Wastewater discharge

Offshore windfarms expected to increase

2019	2030	2050
2 GW production	**60 GW** EU planned production	**300 GW**

Socio-economic context

Tourism is the largest blue economy sector

Tourists, profit, and employment since 2010

33.7 billion EUR per year

Expected loss due to environmental degradation

9 billion EUR per year

Other important economic sectors

Fishing

Offshore wind

Shipping

Aquaculture

Fish population

Pelagic species are the most abundant

Non-commercial species

Cod

Bottom Trawling intensity

Limited trawl fishery targeting mostly flatfish

Impact from fishing on benthic habitat and biota declining since 2012

Eutrophication

Contributes to a shift in ecosystem dynamics, less species diversity, and decline in size of organisms

Cyano bacterial blooms have intensified causing hypoxia and decreased recreational use of the waters

Anoxic waters

The Baltic Sea is naturally prone to **low oxygen levels**, especially in the deep basins

O_2

Hypoxic bottom water extent stable for the past two decades

(< 2 mL/L O_2)

Reduces cod reproduction

Anoxic area has increased since the mid-1950s

(< 0 mL/L O_2)

Oxygen deficiency causes mortality in benthos

Plankton shifts

Summer phytoplankton community has increased in species richness

Spring blooms appear earlier, more prolonged but lower average biomass

Provides more than **50%** of the energy to higher trophic levels

Zooplankton composition has shifted due to climate-induced changes, eutrophication, and predation

Large copepods

Small-bodied taxa

Climate Change

Water temperature

Salinity

Stratification

Impacts growth, spatial distribution, and abundance of several species

Marine heatwaves are increasing in frequency and spatial extent, and may contribute to reduction in bottom oxygen concentration

Sea ice extent shows a long-term downward trend since the 1980s

1980

2010

Impacts all organisms that rely on ice habitat, from phytoplankton to seals

Ringed seal

Ecosystem Approaches to Fisheries Management

NEAFC Request:

For given higher-level biodiversity and ecosystem objectives describe the available approaches to define related operational objectives and to monitor and assess progress towards meeting these operational objectives.

Consider at least three approaches: ranging from a risk assessment approach to a more comprehensive and resource demanding approach.

Describe fourteen elements associated with each approach including:

- An assessment of the extent to which the approach contributes to implementation of an EAFM.
- Comparative analysis of the approaches with description of benefits and drawbacks of each.

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Ecosystem Approaches to Fisheries Management

Qualitative risk assessment: Usually applied when evidence base is sparse. Can address almost all EAFM issues. Many applications. Rarely used alone but to give a rapid overall assessment, to address specific data-limited issues or provide an initial scan of risk in a hierarchical process that then applies more quantitative assessments to issues with higher risk.

Semi-quantitative Risk Assessment: Method selection depends on available data. Can address almost all EAFM issues. Many methods and applications. Methods may provide absolute estimates of risk and attribution between fleets, strengthening connections to management decision making. Outputs may trigger specific management actions.

Ecosystem Status Indicators Framing Fisheries Decision Making: Supplements existing management decision processes with information on ecosystem issues provided by indicators. Resource demands variable. Some applications. Decision-making most effective when information is provided as risk tables to improve consistency of information use.

NAFO Ecosystem Approach to Fisheries Roadmap: Addresses a subset of EAFM issues and includes operational ecosystem objectives with corresponding indicators and reference points for target species, protection of VMEs and biodiversity, and ecosystem overfishing. Data collection, management, and implementation are relatively resource demanding.

Marine Strategy Framework Directive: Largely an empirically driven approach, addressing many ecological issues and resource intensive, providing detailed and regularly updated information on trends in ecosystem components, habitats, and pressures. Target setting is incomplete, and impacts of uncertainty are not formalized in decision making.

Ecosystem Approaches to Fisheries Management

Tables used to compare elements of the five approaches

Range and scope of operational objectives that could be identified
How targets, limits and other reference points would be defined
Associated monitoring and assessment requirements, and the extent to which they are met by available data
Timelines and resources for development of the approach (e.g. provision of technical guideline)
Timelines and resources for implementation of the approach
Maturity of science underpinning the approach
Whether there are applications of the approach in other jurisdictions
Assumptions and caveats
Gaps in scope in relation to higher-level objectives
Consequences of uncertainty
Extent to which progress towards objectives will be determined by fisheries management actions
Extent to which the approach contributes to implementation of an ecosystem approach
Comparative analysis of the suggested approaches with the description of benefits and drawbacks of each

Ecosystem Approaches to Fisheries Management

Summary of the advice: operational objectives

- The range of issues for which operational ecological objectives are potentially relevant is described in the FAO EAFM Monitoring Tool: target species, bycatch species or groups, discards, ETP species, benthic habitat impacts, and ecosystem structure and function impacts. ICES advises this is an appropriate and complete set of ecological issues to consider when setting operational objectives.
- These issues span interpretations of “living marine resources”, “marine ecosystems”, “other (non-target) species”, and “marine biological diversity” in the NEAFC Convention. Methods to assess ecosystem structure and function issues, and to establish targets for these issues, are at early stages of development.

Ecosystem Approaches to Fisheries Management

Summary of the advice: operational objectives

- Clarifying the interpretation of higher-level objectives and creating operational objectives will help identify and prioritize management issues to address.
- Process for setting operational objectives is ideally inclusive, consultative, and informed by evidence, and based on shared understanding between the regulator, scientists, and stakeholders.
- Operational objectives should be linked to existing and potential management actions within the competence of the managing authority(s).
- Effective operational objectives are generally specific, measurable, achievable, realistic, and time-bound and make clear linkages to reference points, including appropriate precaution.

Ecosystem Approaches to Fisheries Management

Summary of the advice: approaches

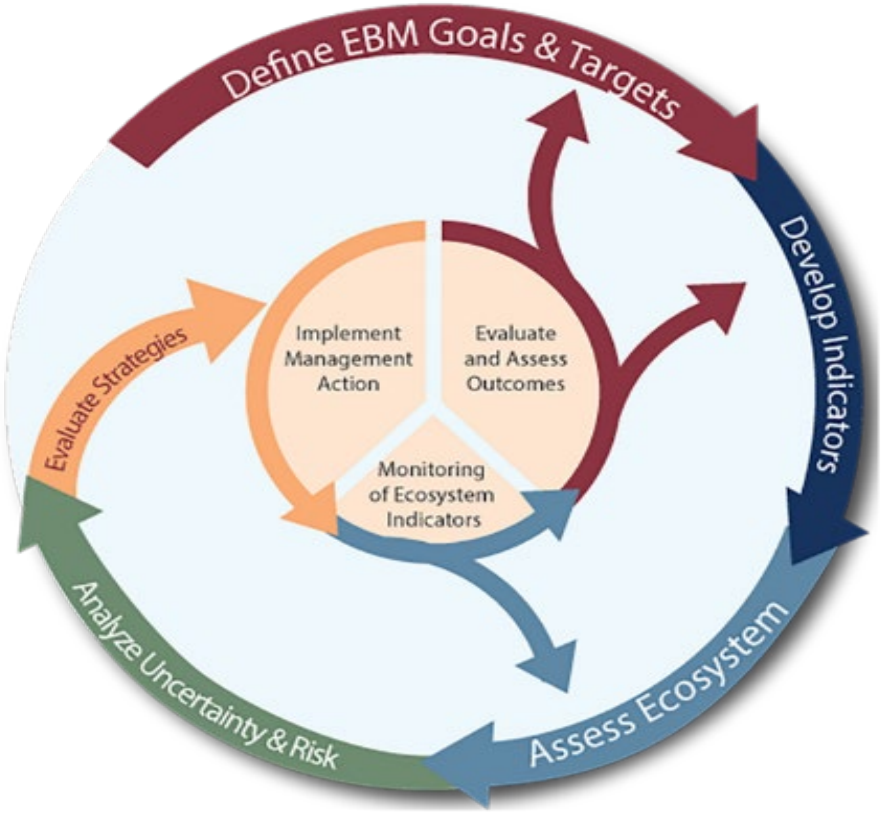
- ICES advises that approaches to implement an EAFM, and methods within approaches, are selected based on available evidence and data, resources to support development and implementation, understanding of stakeholder and management priorities, and strength of links to management actions.
- Implementation of an EAFM may be incremental, for example through restricting initial scope and expanding to more EAFM issues and/or initially screening many EAFM issues with less resource demanding approaches to identify priorities for additional assessment.

Ecosystem Approaches to Fisheries Management

Summary of the advice: approaches

- Qualitative RA and semi-quantitative RA include methods to identify risks to achieving operational objectives, providing a basis for defining a smaller set of issues to address with more resource-demanding approaches and methods.
- Each of the five approaches described may have elements to support the development of EAFM in NEAFC.

Adaptive environmental management: Ecosystem Based Fisheries Management



FROM	TO
Individual species	Ecosystems
Small spatial scale	Multiple scales
Short-term perspective	Long-term perspective
Humans: independent of ecosystems	Humans: integral part of ecosystems
Management divorced from research	Adaptive management
Managing commodities	Sustaining production potential for goods and services

Global governance
EBFM management approach
robust decision making
public participation

→ conservation of biodiversity
sustainable use of ecosystem services
in a changing climate

ICES Framework for Ecosystem-Informed Science and Advice (FEISA)

To guide knowledge development in support of EBM and its practical implementation into ICES advice

To support and evaluate incremental progress from conventional to ecosystem- informed science and advice

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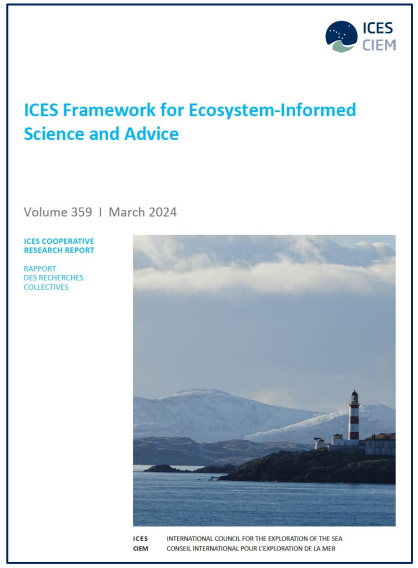
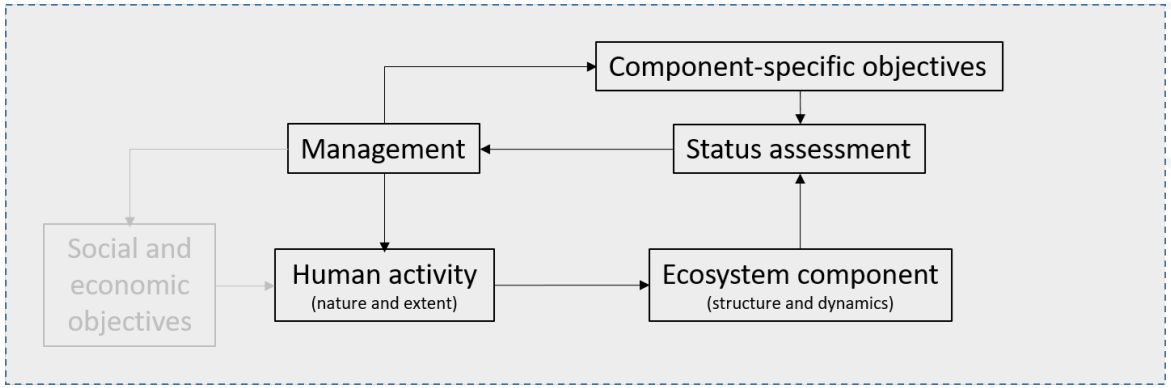
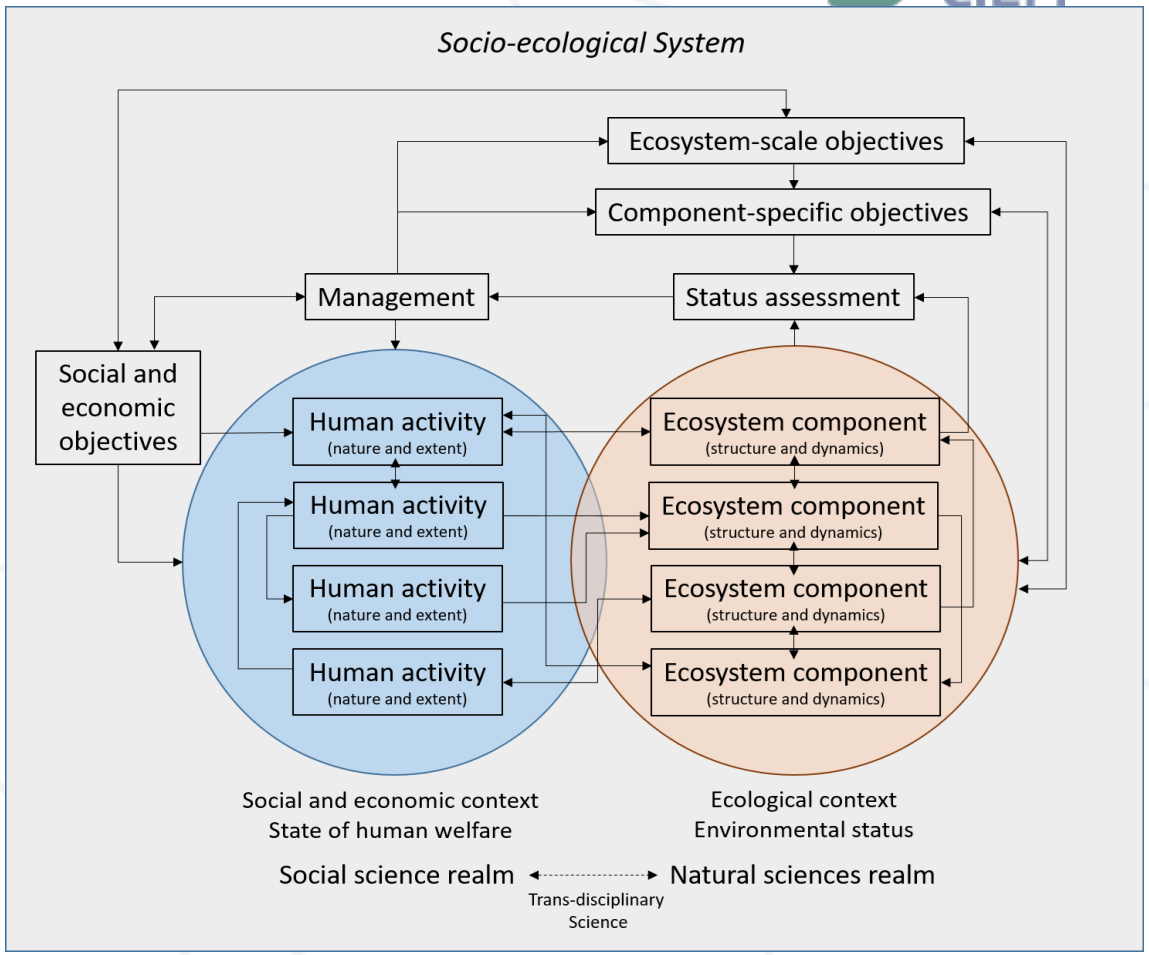


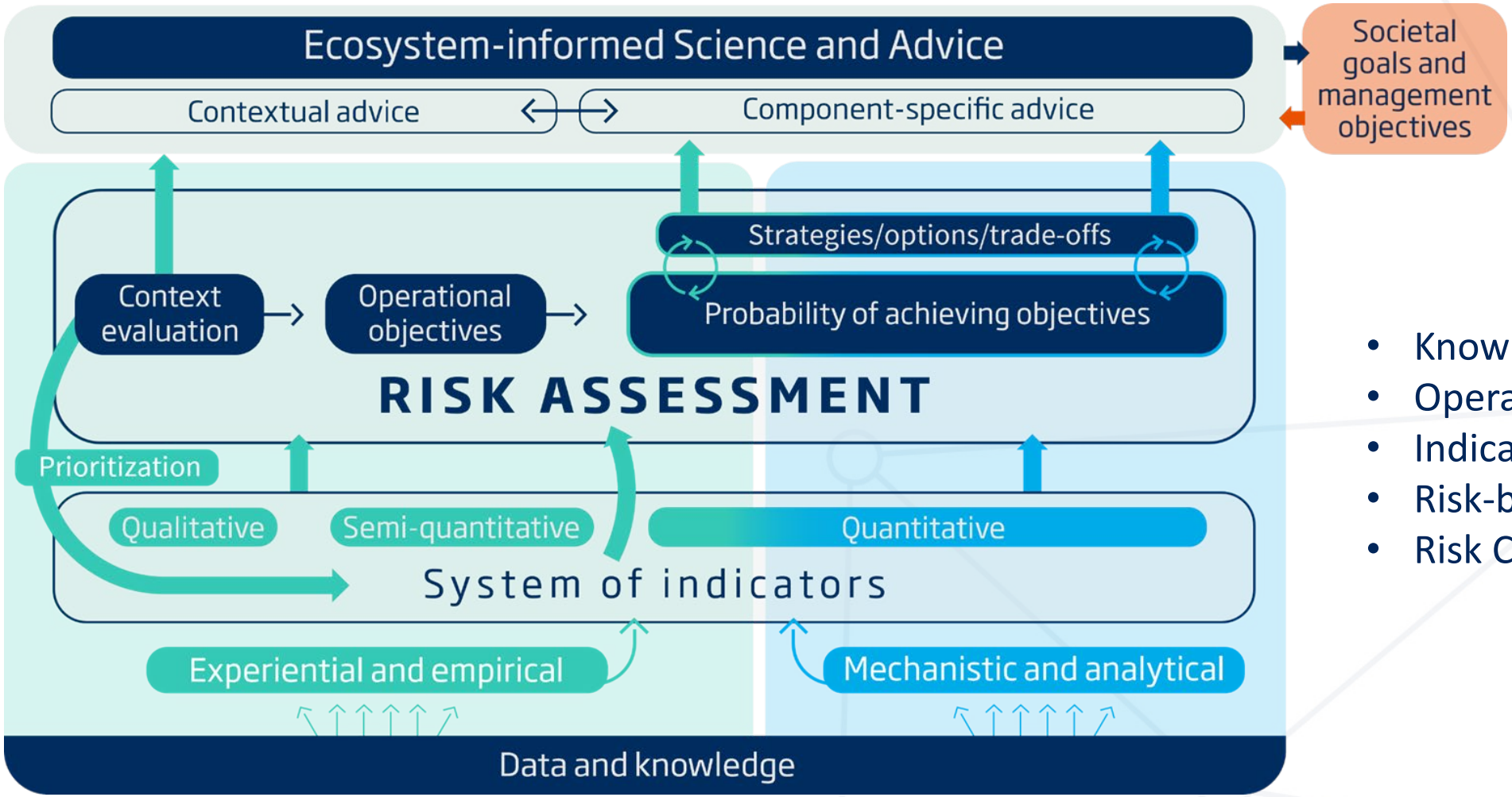




From conventional science and advice…

…to ecosystem-informed science and advice

FEISA architecture – main components



- Knowledge plurality
- Operational objectives
- Indicators
- Risk-based approach
- Risk Communication

Thank you for your attention.

ICES CIEM

Science for sustainable seas