What are the challenges and solutions for ecosystem-based management of highly variable fish populations?

Verena Trenkel, Ifremer, France

Overview

What is ecosystem-based management?

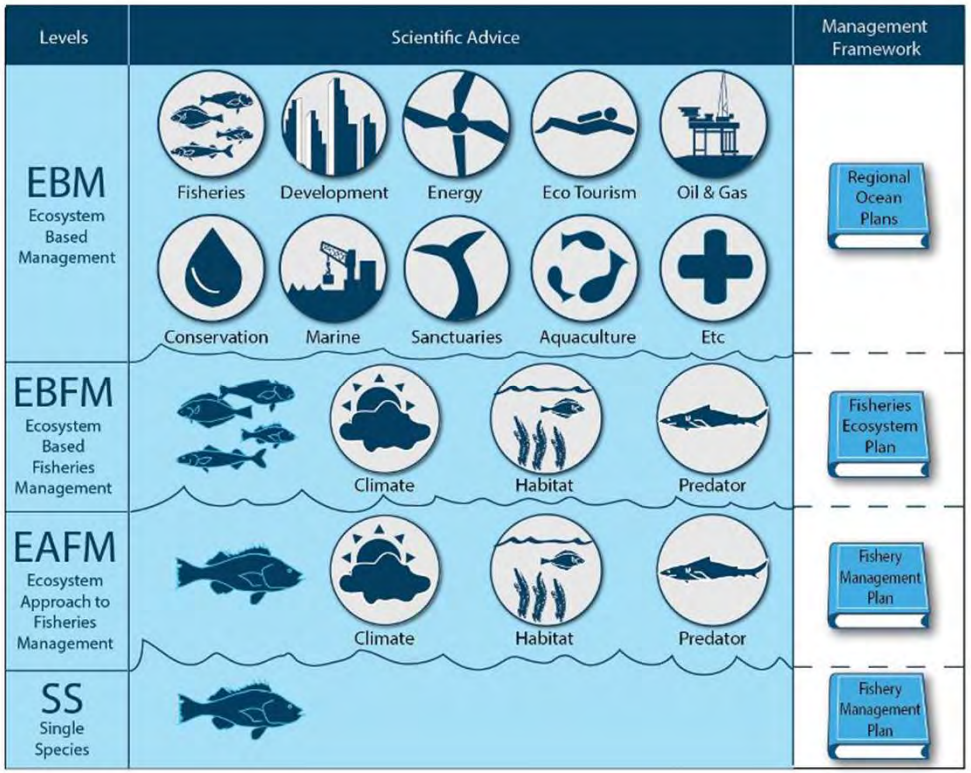
Where are we with EBM for small pelagics?

What remains to be done?

Management types

EBM

Current



Regional

Stock focus

Where are we with EB(F)M?

Ecosystem-based fisheries management

Six myths impeding progress in EBFM (Patrick & Link 2015)

1 EBFM suffers from crippling **linguistic uncertainty**

2 Fisheries management **lacks governance structure & mandates**

3 Needs **copious data and complicated models**

4 Results in too conservative & **restrictive advice**

5 Ignores **socio-economic realities**

6 **Lack of ressources** for implementation

EBFM is feasible! …but how?

Ecosystem-based fisheries management

Elements of an EBFM procedure (Fogarty 2014)

1. Select spatial management units
2. Establish specific management objectives, reference points & decision rules
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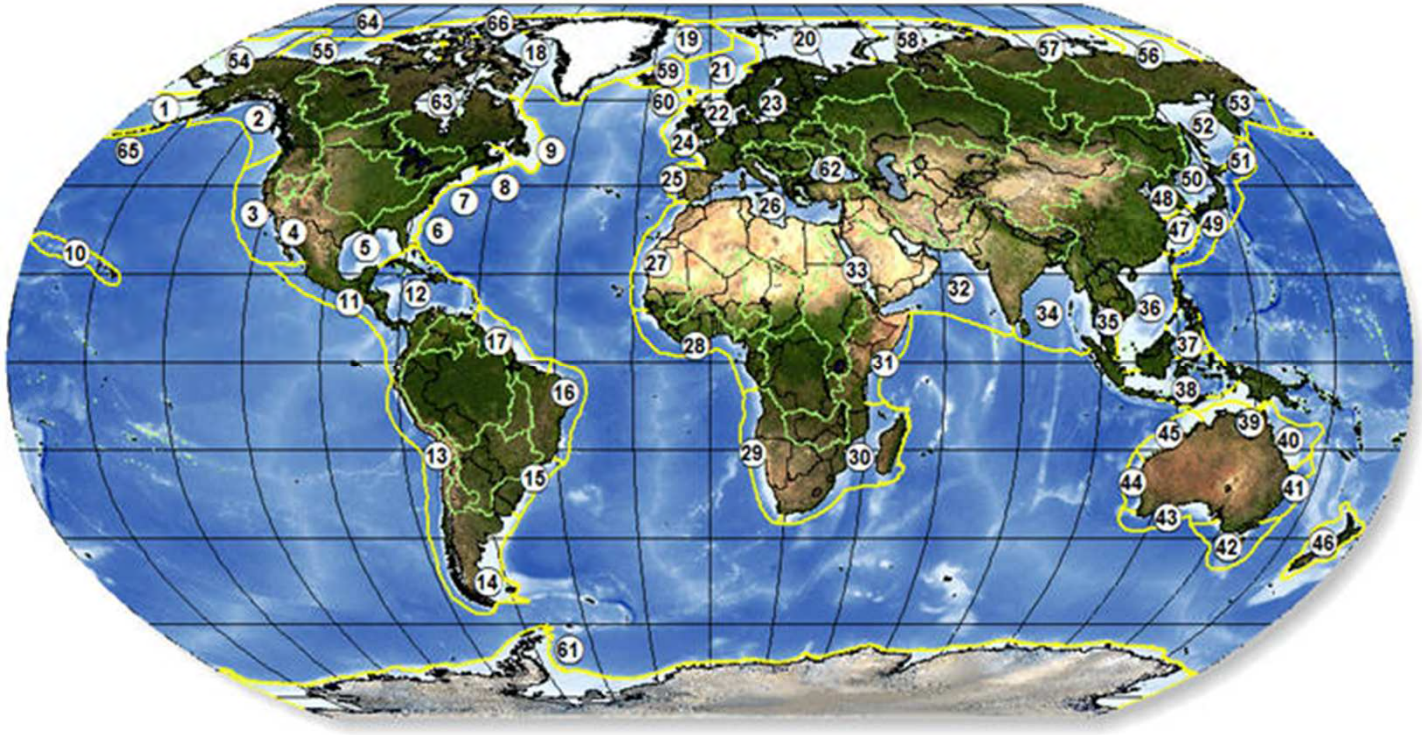
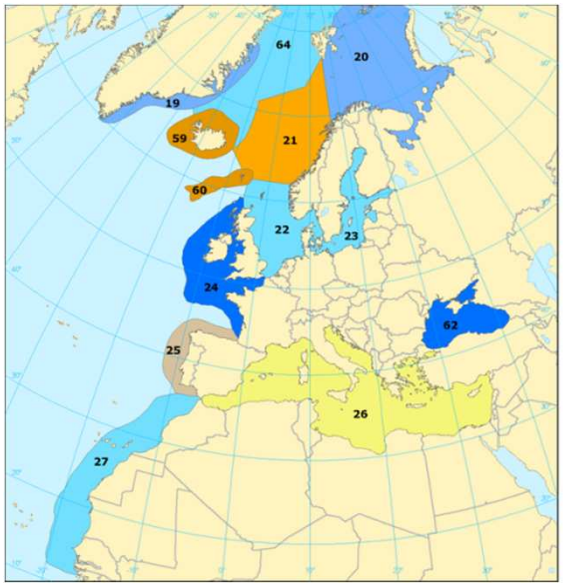
Spatial management units

Option: Large Marine Ecosystems (Sherman & Duda 1999)



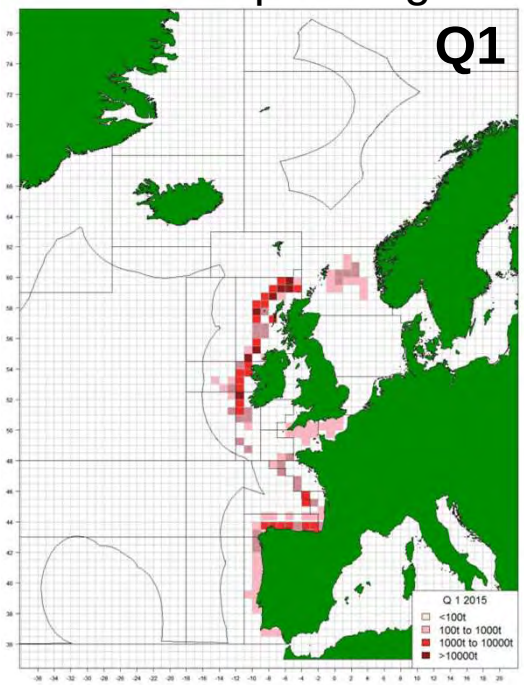
Spatial distribution of small pelagics

LMEs

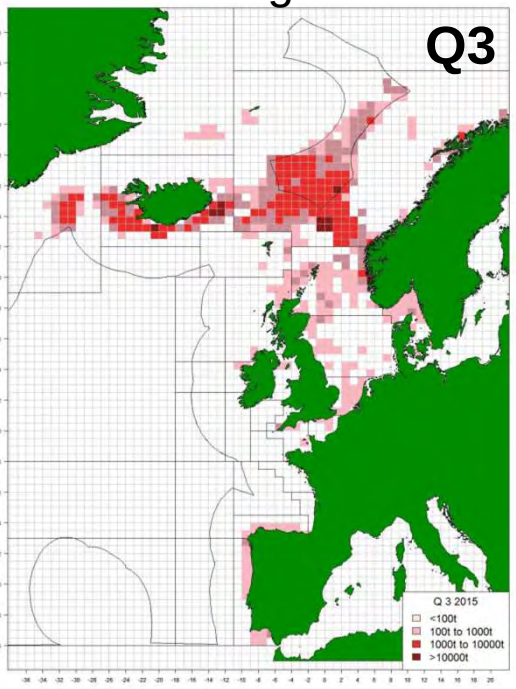


NE Atlantic mackerel

Spawning



Feeding



ICES (2016)

NE Atlantic mackerel moves between at least 5 LMEs

Challenge: need for hierarchical spatial units?

Ecosystem-based fisheries management

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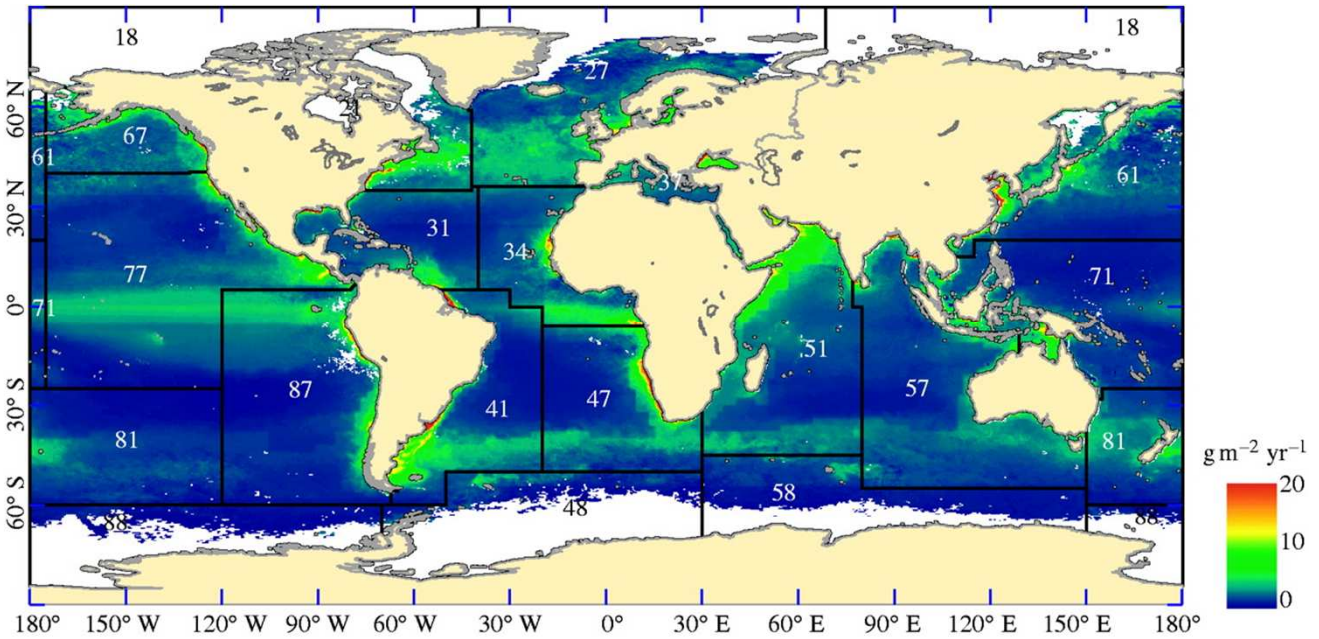
Management objectives, reference points, decision rules

Objective: Maintain system wide productivity (Fogarty 2014)

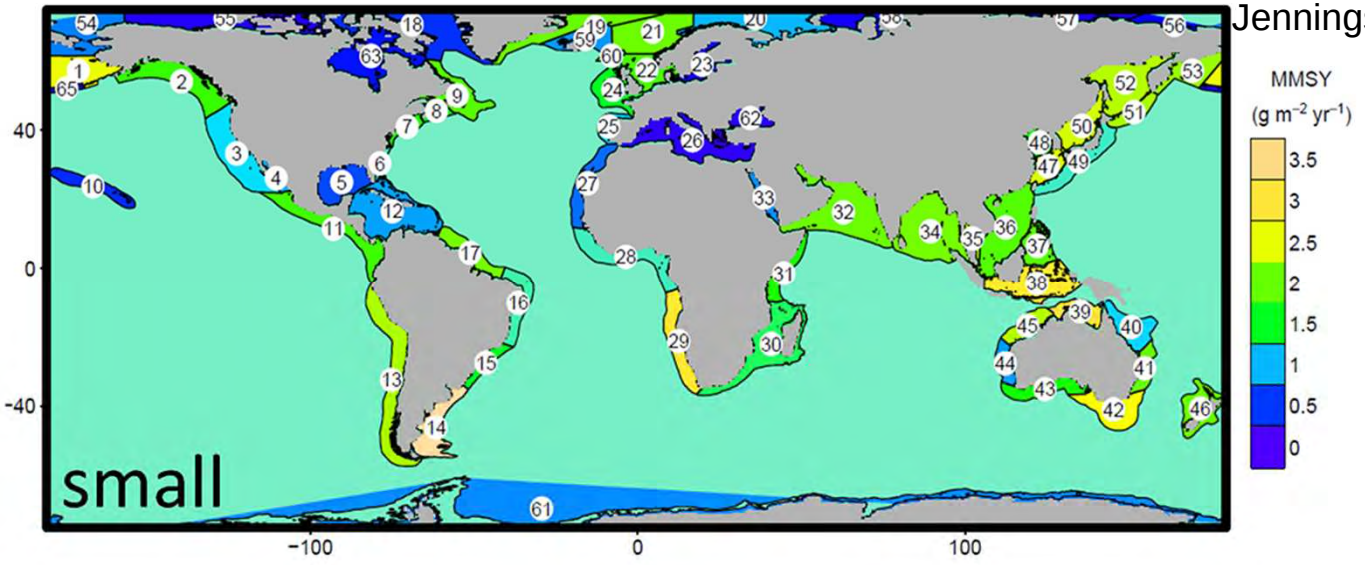
Estimated annual teleost production Jennings et al (2008)



Management objectives, reference points, decision rules

Reference points: System wide productivity bounds

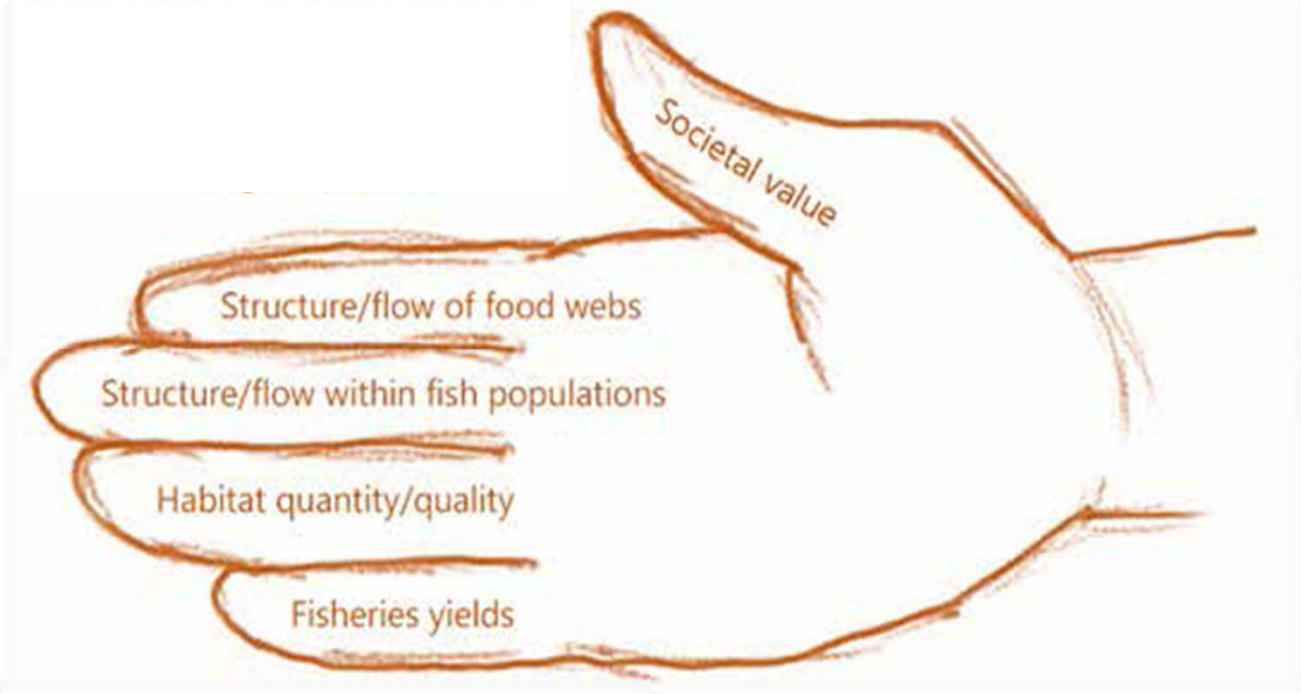
Predicted maximum multispecies sustainable yield in LMEs



Jennings & Collingridge (2015)

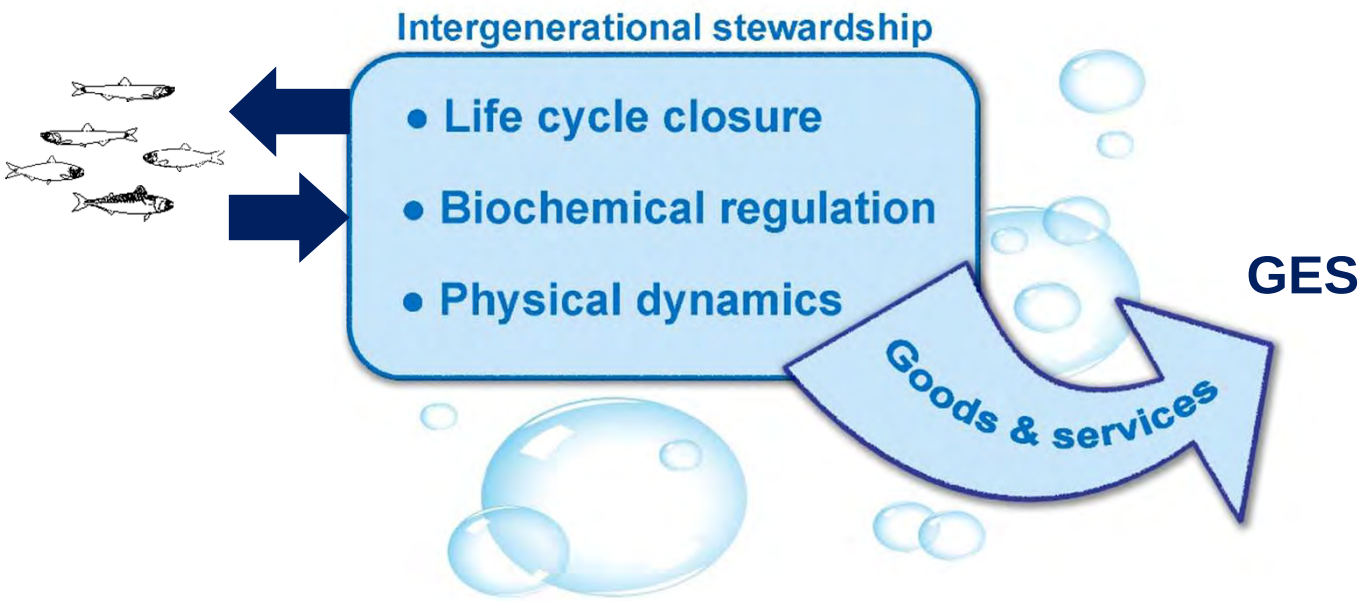
Management objectives, reference points, decision rules

Objective: Maintain exploited pelagic ecosystem (Trenkel et al. 2014)



Management objectives, reference points, decision rules

Objective: Maintain good pelagic habitat (Dickey-Collas et al. in Prep)



Management objectives, reference points, decision rules

- Pelagic ecosystem objectives: available
- Reference points: model derived or empirical
- Decision rules: to be agreed on

Ecosystem-based fisheries management

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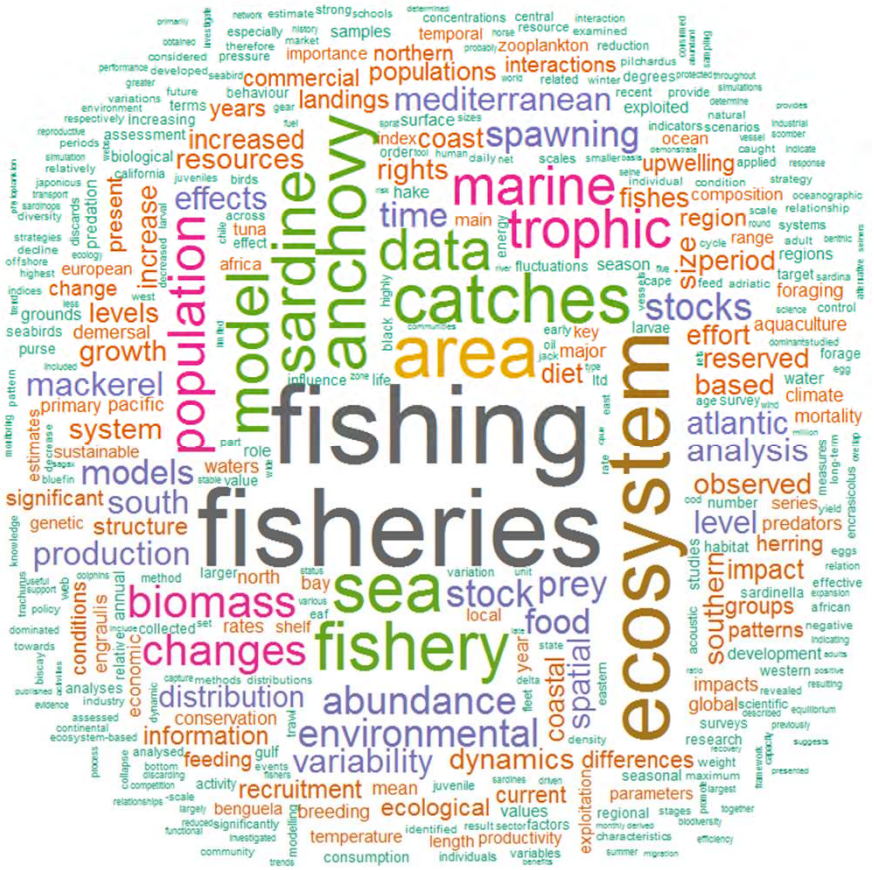
Modelling approaches & data to assess status



Science for the management of small pelagics

1991-2016 Web of Science:

352 papers 'small pelagics & management'

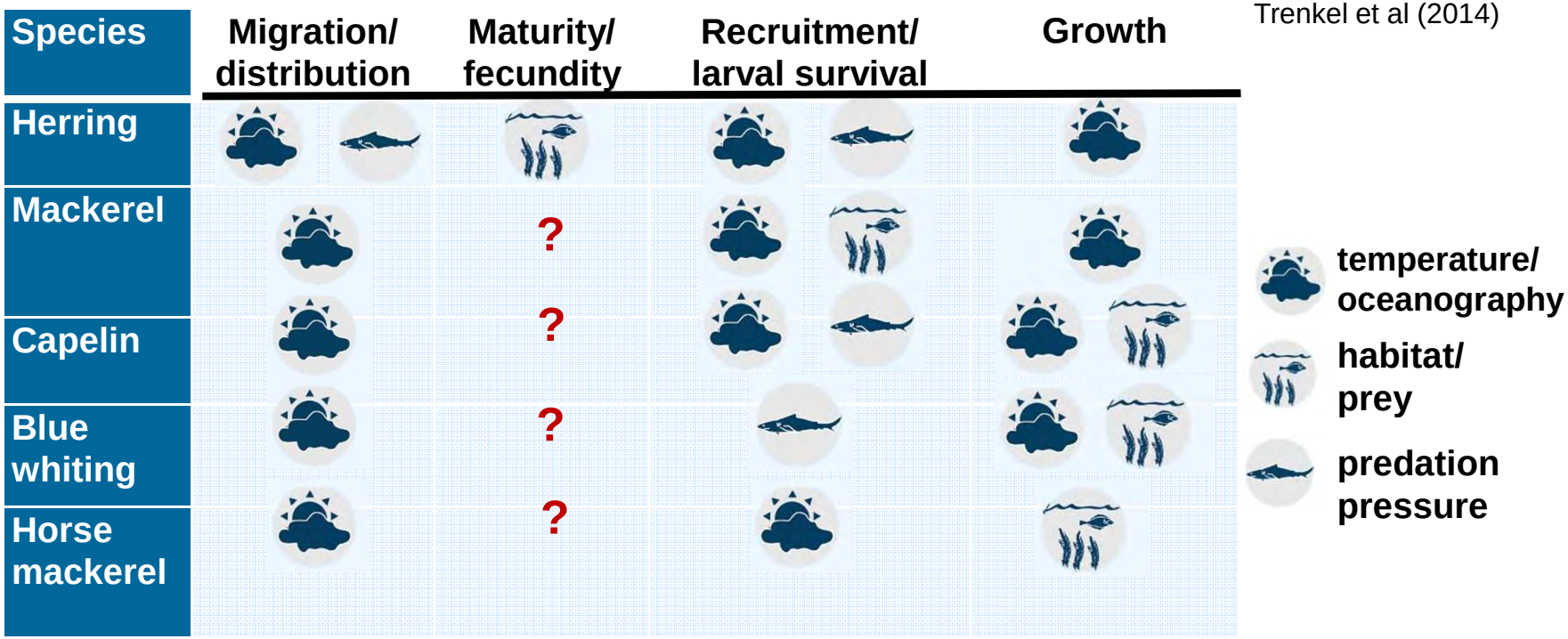
22 papers 'ecosystem-based'

Few papers on EBFM & small pelagics, but much ecological knowledge

Modelling approaches & data to assess status

Identifying environmental factors for models: Literature review

Trenkel et al (2014)



Challenge: how to include environmental conditions in models?

Modelling approaches & data to assess status

Identifying environmental factors for models: Literature review

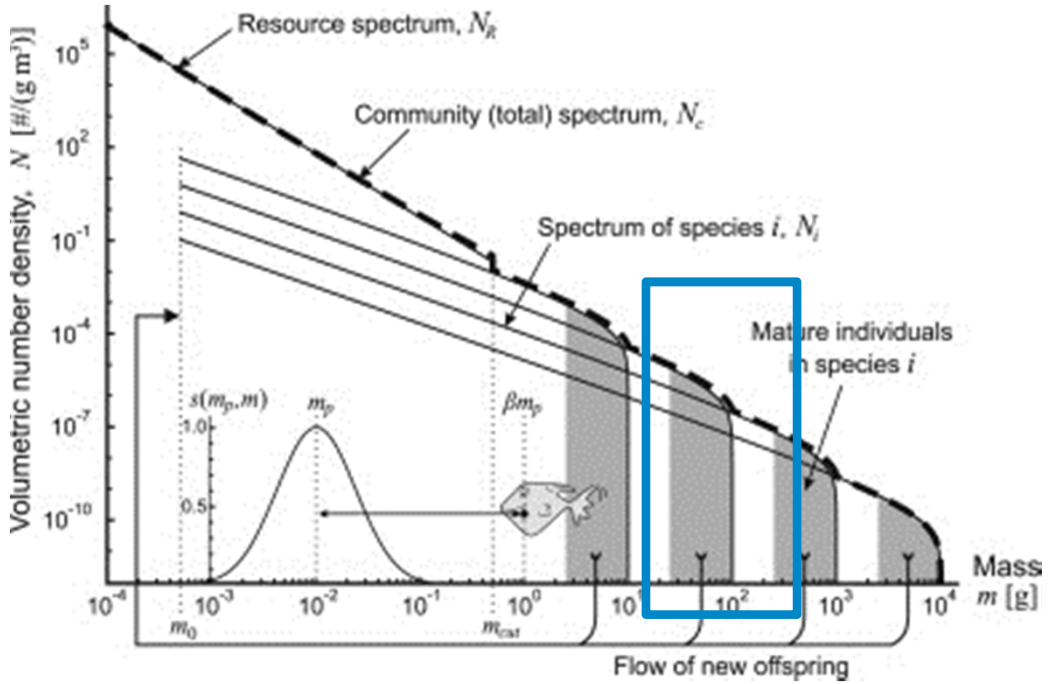
Trenkel et al (2014)

Species	Migration/ distribution	Maturity/ fecundity	Recruitment/ larval survival	Growth
Horse mackerel		?		

Challenge: how to include environmental conditions in models?

Modelling approaches & data to assess status

Grouping species for modelling: size-structure



Hartvig et al (2011)

small pelagics

Modelling approaches & data to assess status

Grouping species for modelling: trophic level & position

Bentho-demersal

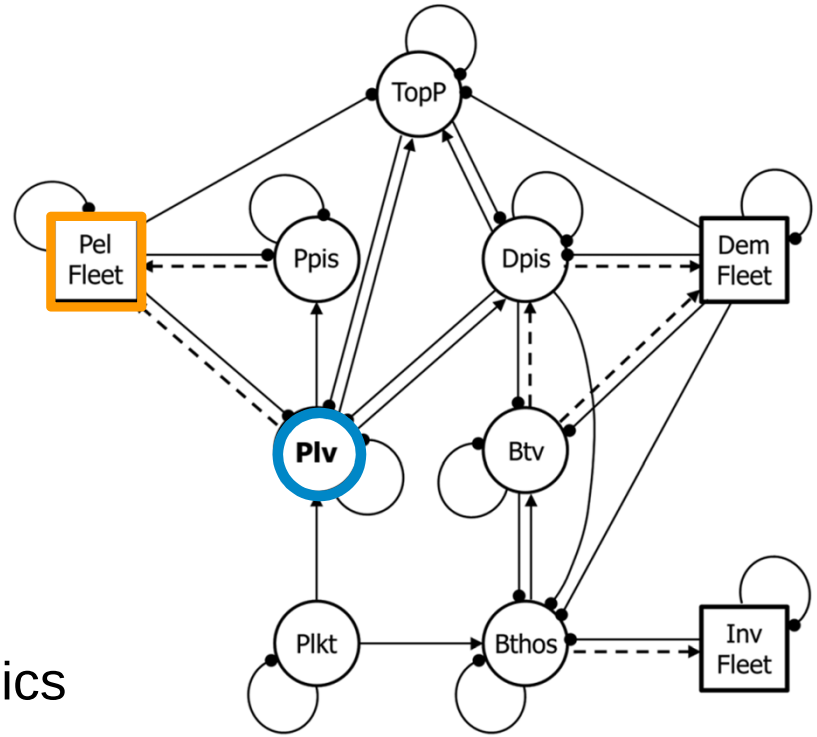
Pelagic

Lasalle et al (2011)

small pelagics

Modelling approaches & data to assess status

Grouping species and fleets for modelling: trophic level & position



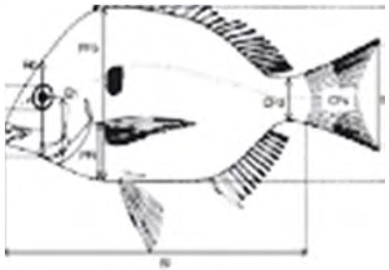
small pelagics

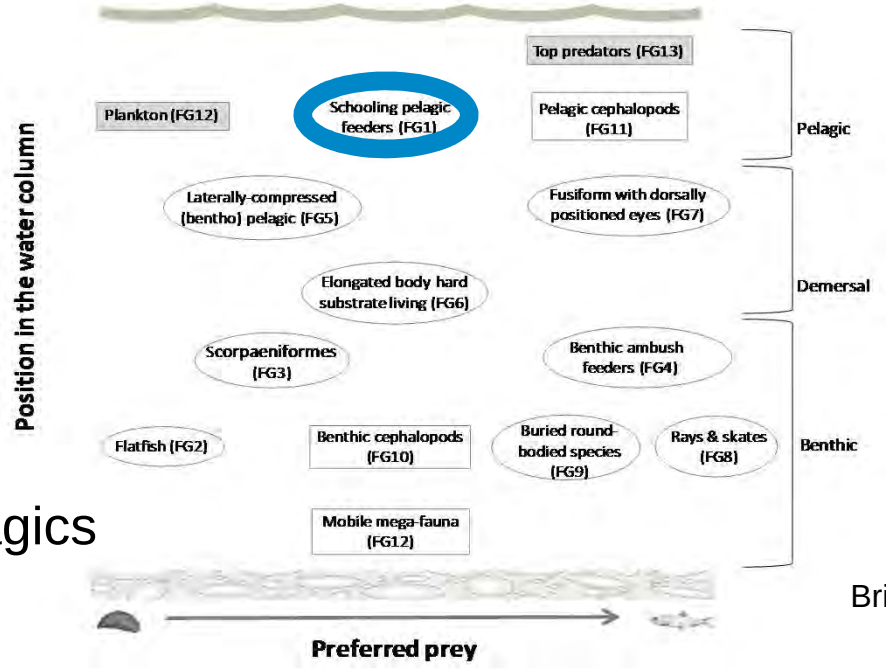
pelagic fisheries

Lassalle et al (2014)

Modelling approaches & data to assess status

Grouping species for assessment: Morphometrics





small pelagics

Brind'Amour et al. (2016)

Appropriate species resolution depends on objectives

Modelling approaches & data to assess status

Levins (1966): The Strategy of Model Building in Population Biology

ICES Journal of Marine Science

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

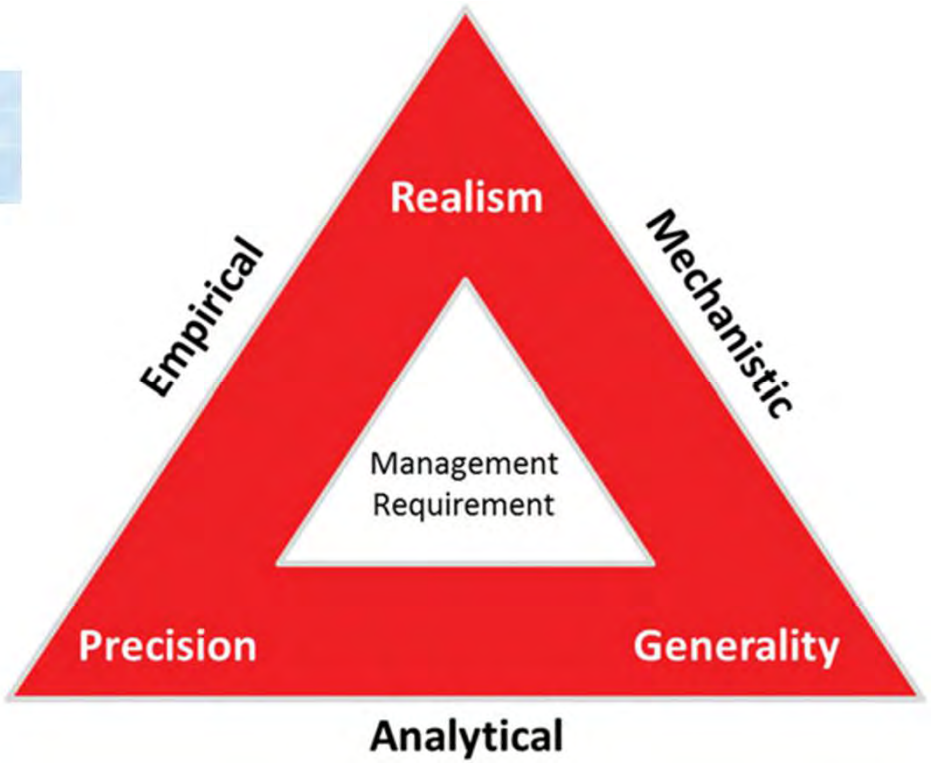
ICES Journal of Marine Science (2014), 71(8), 2300–2306. doi:10.1093/icesjms/fst215

Contribution to the Special Issue: 'Commemorating 100 years since Hjort's 1914 treatise on fluctuations in the great fisheries of northern Europe'

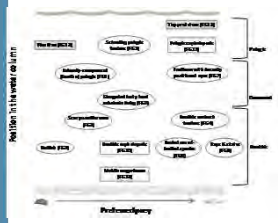
Food for Thought

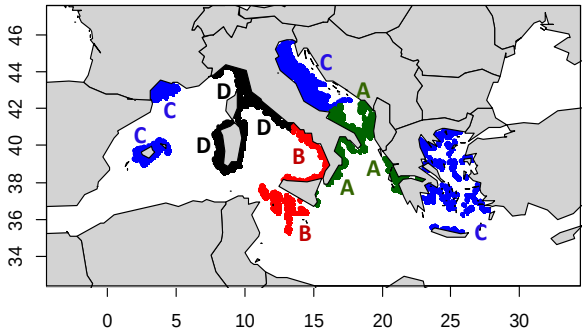
Hazard warning: model misuse ahead

Mark Dickey-Collas[1]*, Mark R. Payne[2], Verena M. Trenkel[3], and Richard D. M. Nash[4]



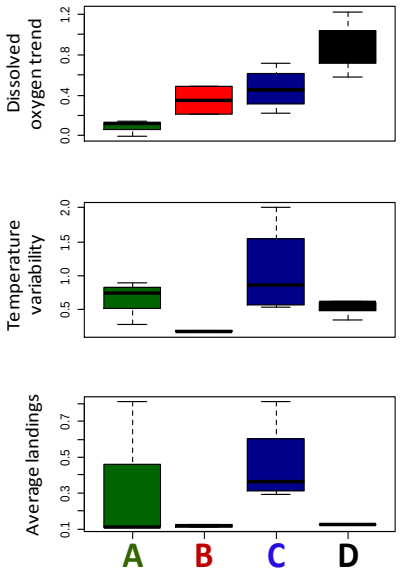
Modelling approaches & data to assess status

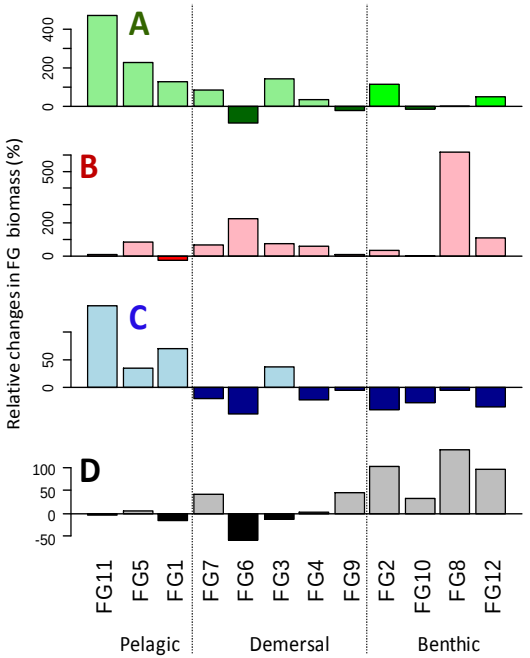




Brind'Amour et al. (2016)

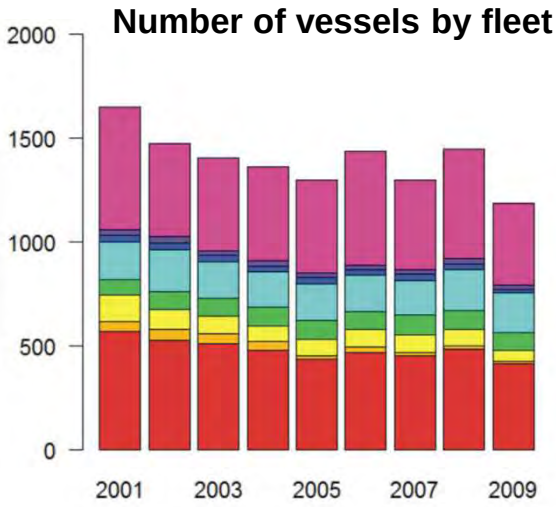
Survey data to assess changes in FG biomass

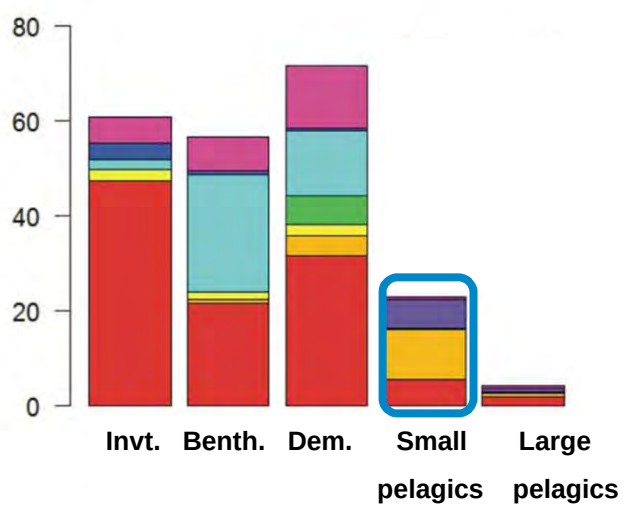


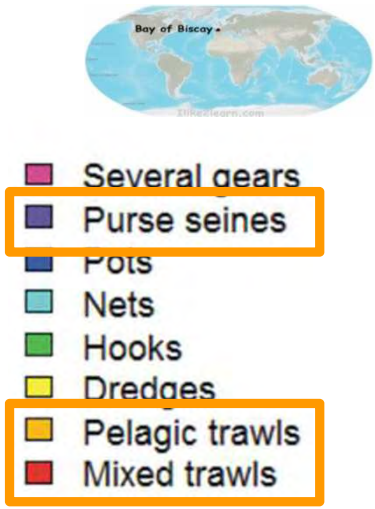


Modelling approaches & data to assess status

Questionnaire data to assess changes in fishing fleets







Trenkel et al. (2013)

small pelagics

pelagic fisheries

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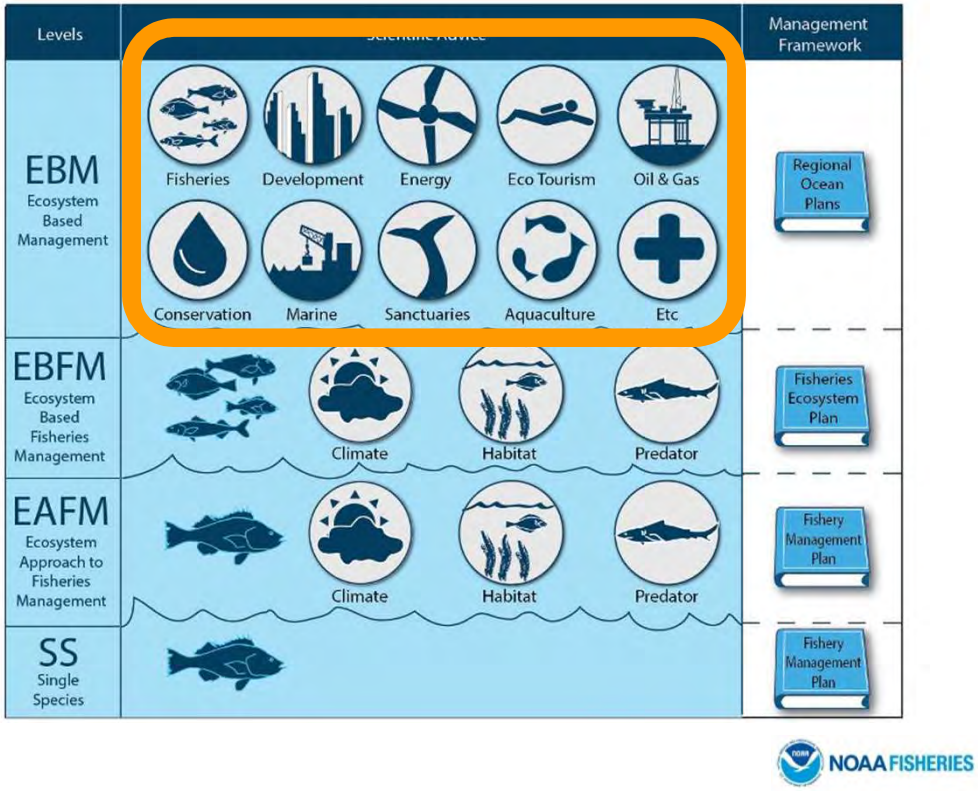
Management process evaluation

Identifying interacting anthropogenic activities

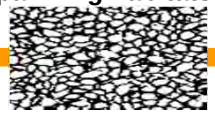


Management process evaluation

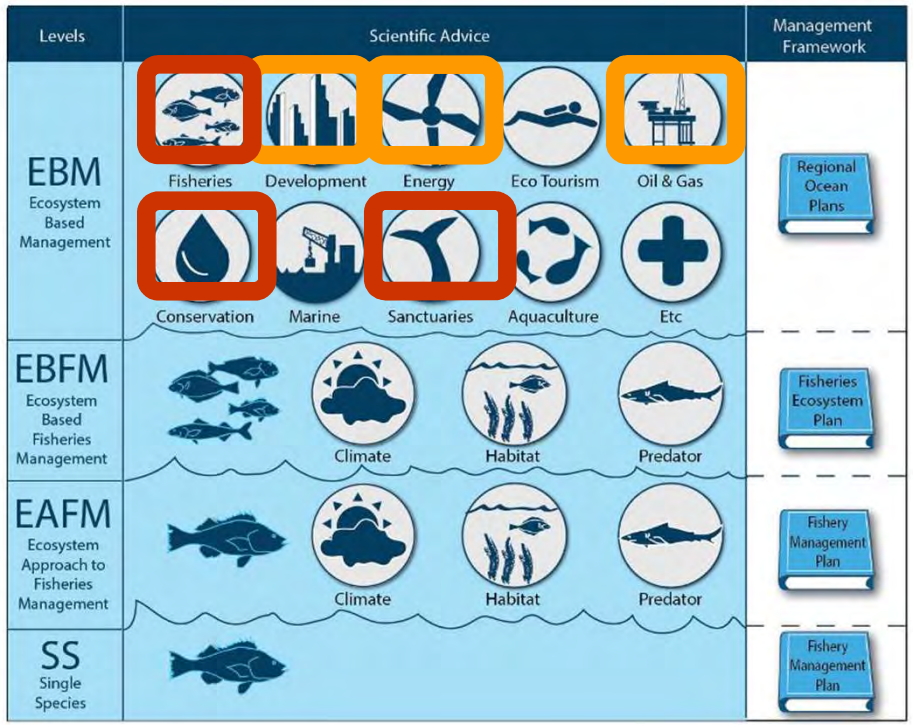
Literature review for NE Atlantic small pelagics

migration pathways

spawning habitats



mammal & bird bycatch



Trenkel et al (2015)

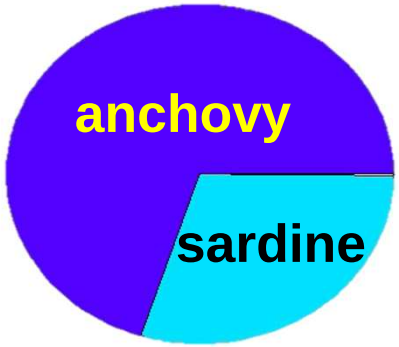
Challenge: need knowledge of effects of all actvities

Management process evaluation

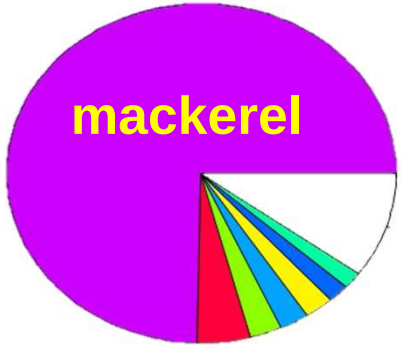
Issue bycatch

Target species sardine

anchovy



mackerel



Cornou et al (2016)

Challenge: need to account for mixed fisheries

Management process evaluation

Selecting management measures to be evaluated

- Catch quotas
- Spatio-temporally closed **pelagic** (fishing) areas
- Fishing effort and limitations of other activities
- Technical measures
- …

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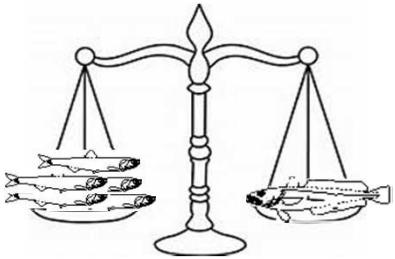
Management trade-offs

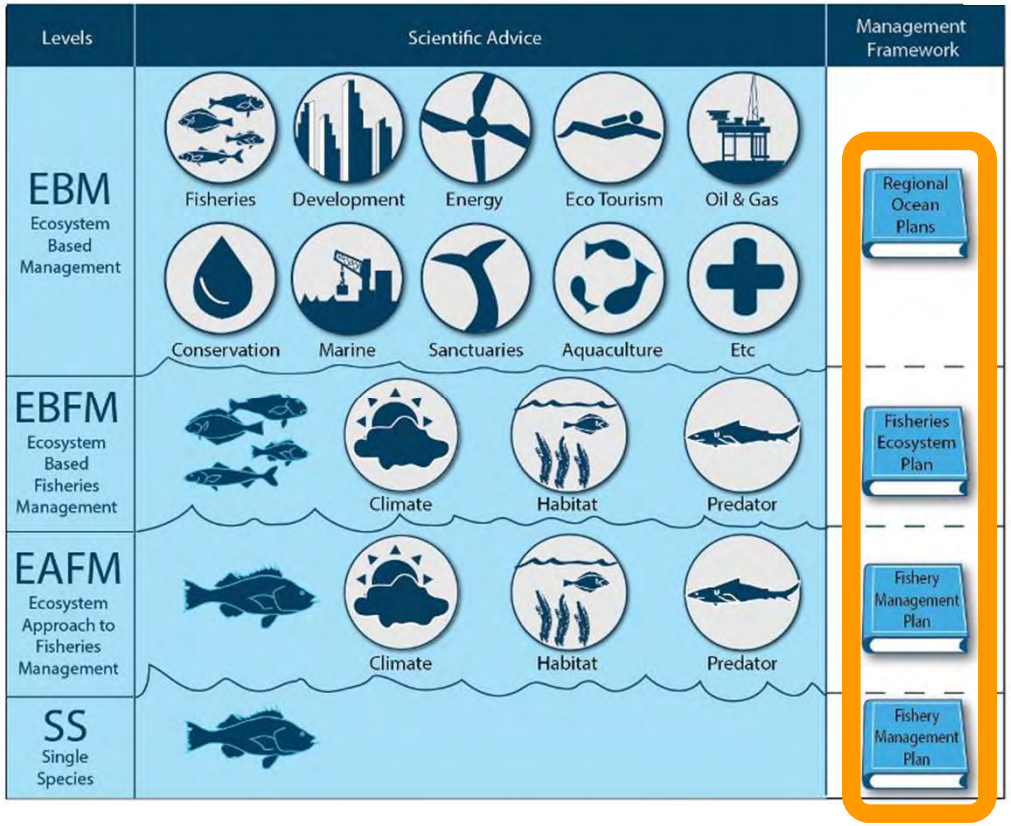
Trade-offs involving small pelagics



- Forage fisheries vs demersal fisheries
- Forage fisheries vs predators (fish, birds, marine mammals)
- Stable yields vs optimal exploitation
- Gravel extraction vs spawning grounds (e.g. herring)
- Renewable energies vs hydrology of pelagic habitat
- ....

Challenge: how to balance trade-offs?

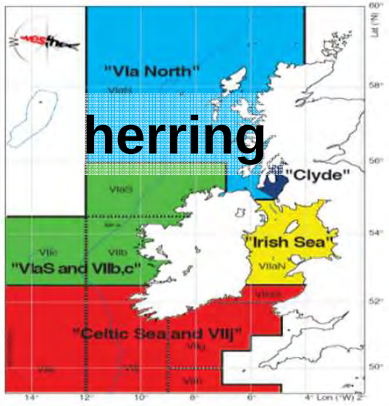
Management plans



Management plans

Currently ten official EU wide plans for demersal species, plus

- **Herring west of Scotland**
- **Baltic Sea plan: cod (2), herring (4) & sprat (2)**



ICES 2015

Challenge: How to incorporate spatio-temporal variability into management plans?

Conclusions

Elements for ecosystem-based management of small pelagics are available, but challenges remain, including

- **Definition of spatio-temporal units**
- **Identifying trade-offs and compromises**
- **Handling variability in management plans**

Solution: Hierarchical approach for ecosystem-based management of small pelagics

EB(F)M for highly variable fish populations is feasible!


Thank you for your attention
Many thanks to the organisers