

Ecosystem Based Management What is it and how do we deliver it?

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This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 613571

Historical Perspective



China (2698 BC)



Hammurabi
(1750 BC)



Emperor Claudius
(50 AD)



Monarchs, Popes,
Governments

- No new tools in 4500+ years, so what needs to change?
- A system perspective?



How do we do it?

MareFrame



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How do we do it?

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How to achieve integration?

- **Desirable interconnection**



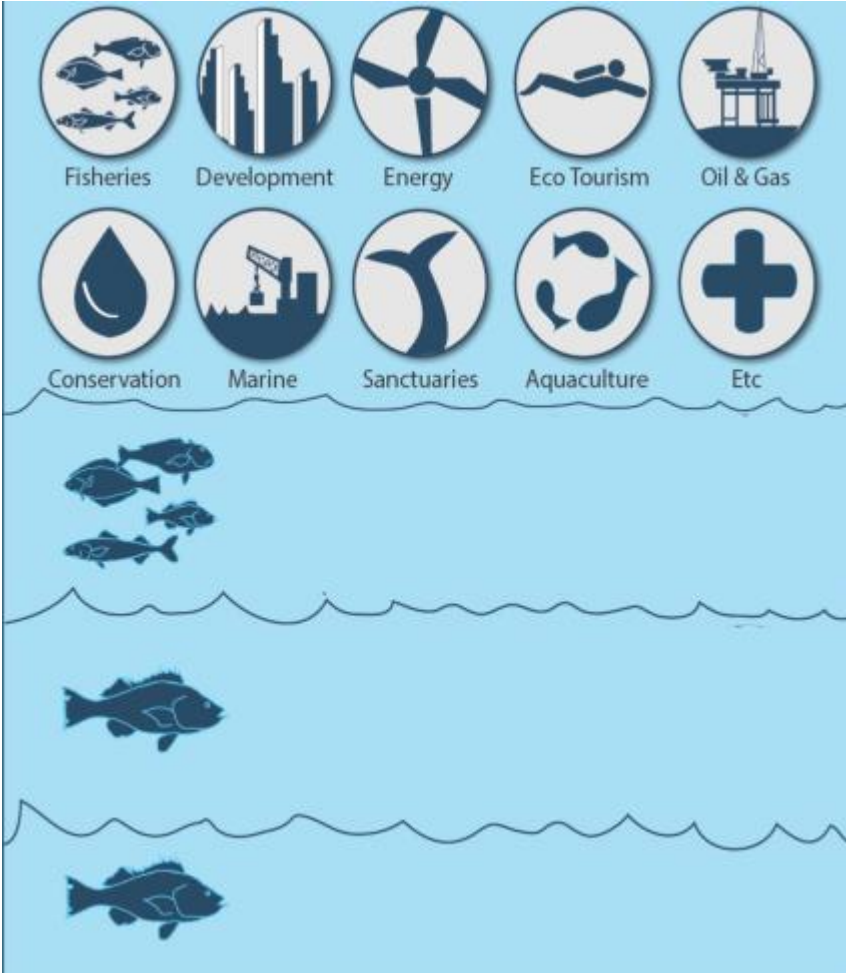
How to achieve integration?

- Usual experience

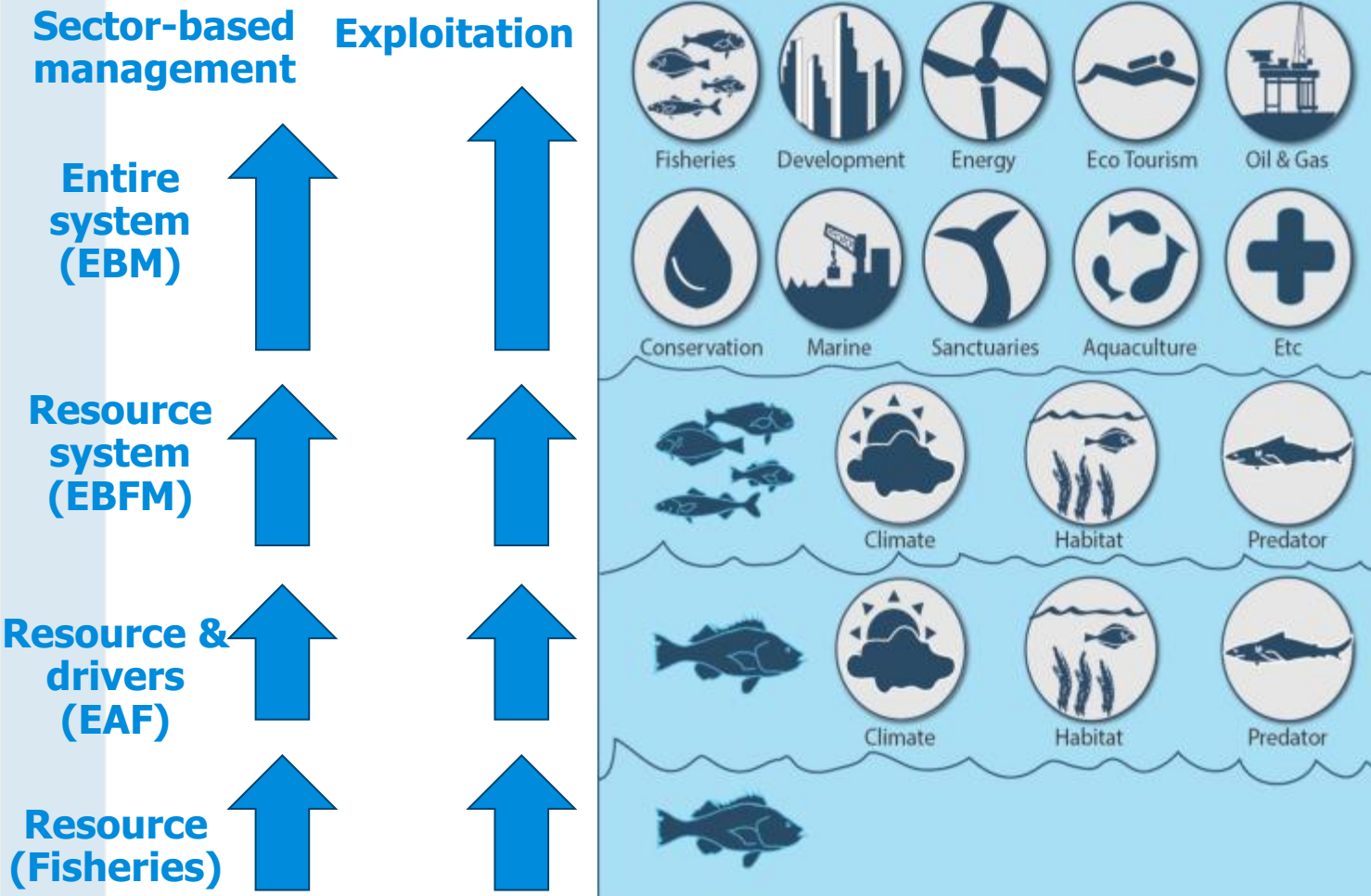


Use, management & modelling: similar patterns of evolution

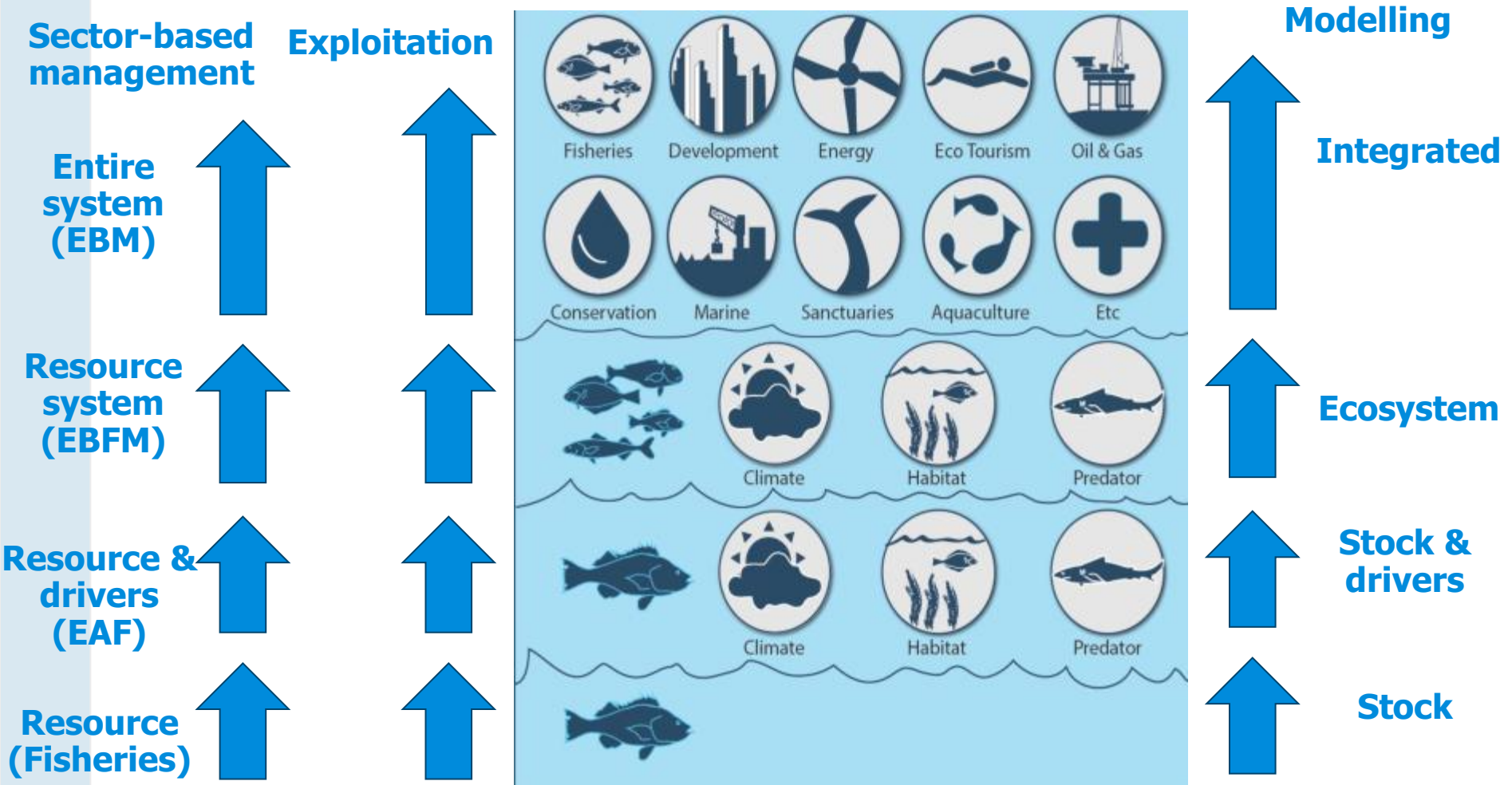
Exploitation



Use, management & modelling: similar patterns of evolution



Use, management & modelling: similar patterns of evolution



Management Objectives

Social and Economic

- **Convention on Biodiversity:**
“the objectives of management are a matter of societal choice”
- **Law of the Sea:**
“optimum utilization”

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Environmental

- **Convention on Biodiversity:**
“conservation of ecosystem structure and function”
- **Law of the Sea:**
“preserve rare or fragile ecosystems as well as the habitat of... marine life”

“associated and dependent species above levels at which their reproduction may become seriously threatened”



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Operational Objectives

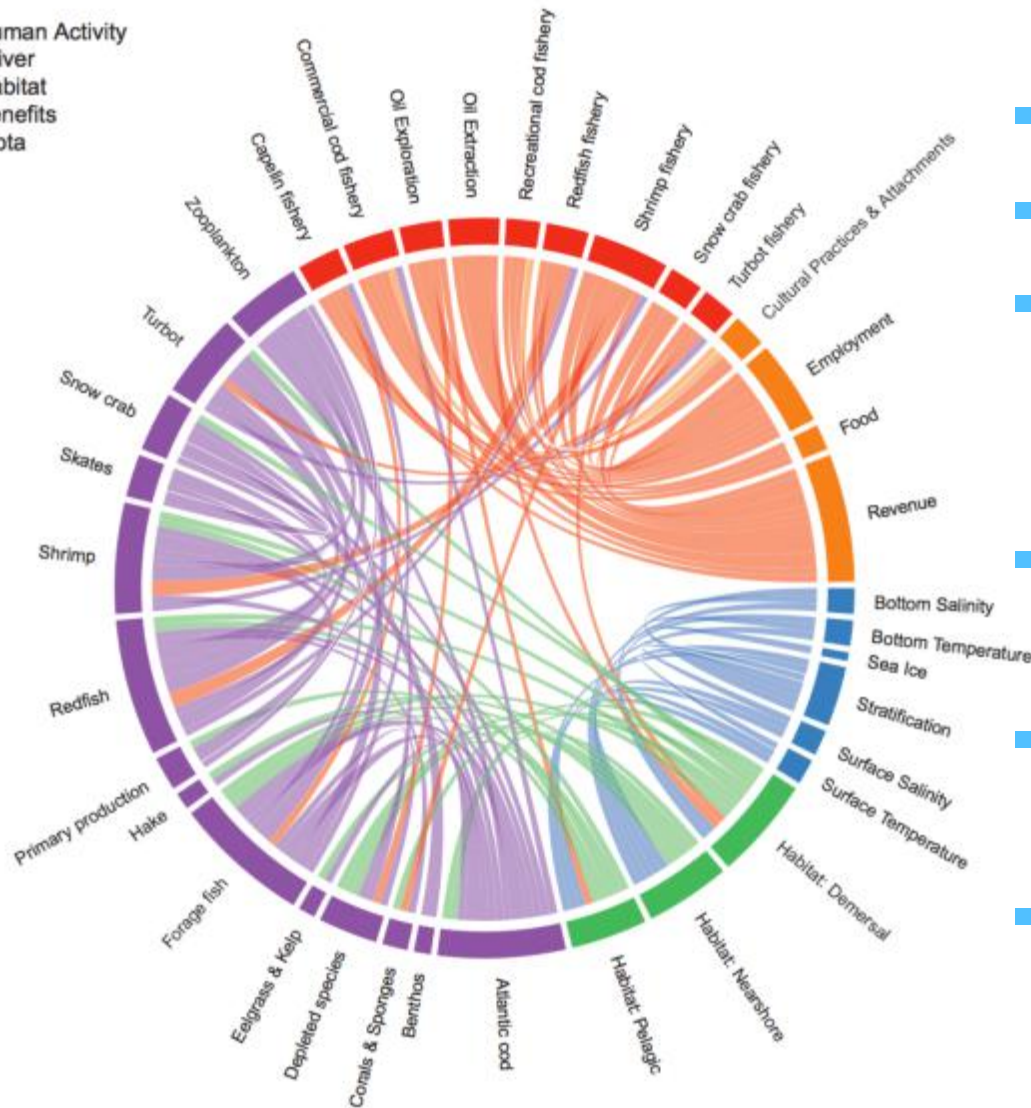
...restore fish stocks in the shortest time feasible at least to levels that can produce maximum sustainable yield...

UN Oceans Conference 2017 Call to Action

- **Multiple single species fisheries:** all species at B_{MSY} (basis of national & international agreements)
- **Mixed species fisheries:** caught together (manage for choke species or optimum output across all species; no species $< B_{LIM}$)
- **Multispecies fisheries:** biological & technological interactions (need new approaches; MMSY)
- Legal focus = MSY and avoiding recruitment overfishing
- All at MSY not possible (or desirable)

EU and US – EBM & IEA

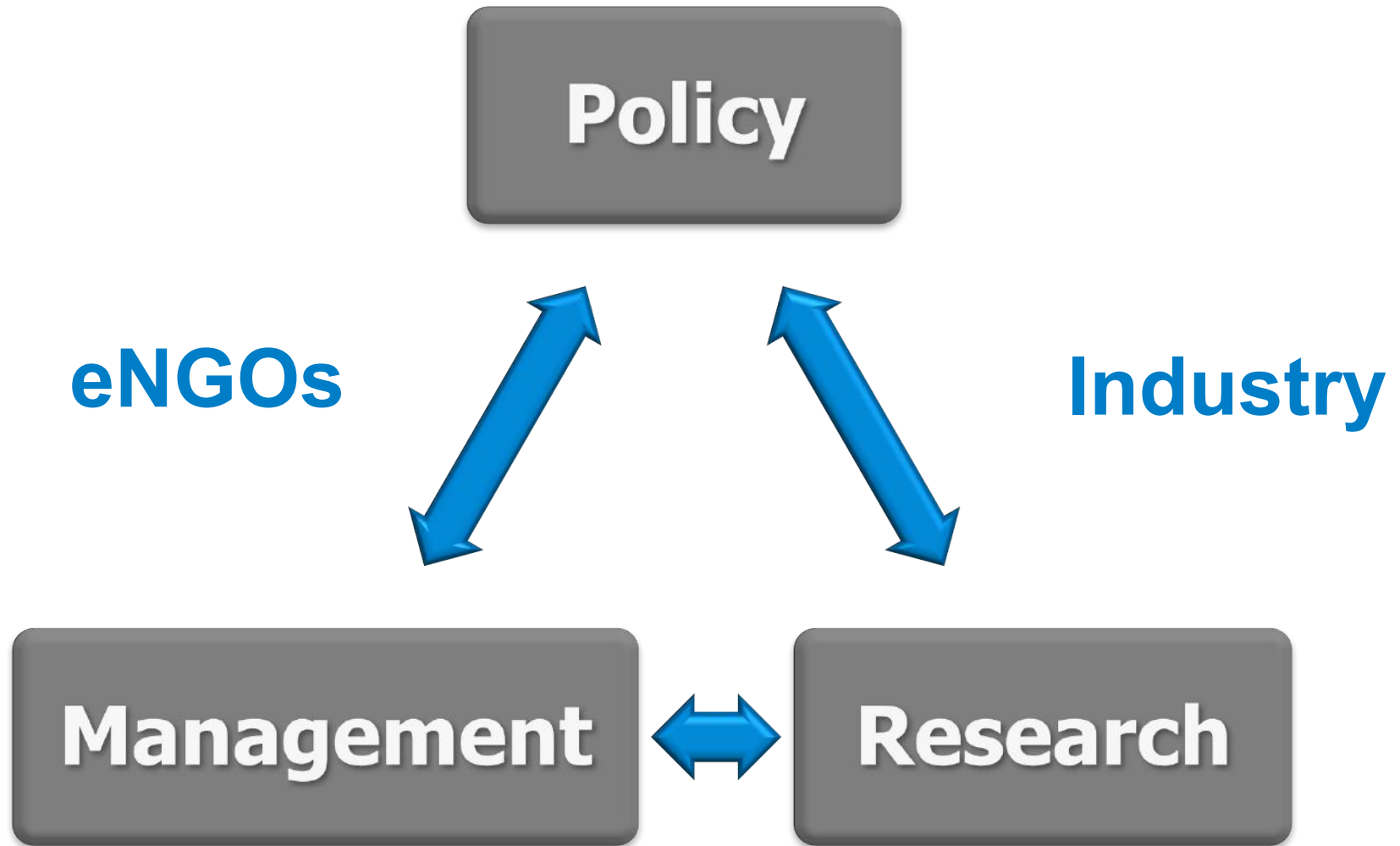
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- US and Europe
- Ecoregion scale
- Legislative mandates & management objectives
- Industries not all ready
- Transdisciplinary science lessons
- Triage risks & hierarchical analyses



The Australian approach



Australian Policy

- **Fisheries Act 1991:**
politically independent management authority,
Ecologically Sustainable Development,
maximise economic efficiency,
cost-recovery and accountable
- **Australia's Oceans Policy 1998**
- **EPBC Act 1999** environmental performance assessments
- **Securing Our Fishing Future 2005** \$220 million restructure
overfishing to cease and recovery required
adopt an explicit ecosystem based approach
~33% vessel buy out
- **Harvest Strategy Policy 2005-2006**
- **Strategy (harvest and bycatch reviews) 2017**
develop guidelines and climate robustness



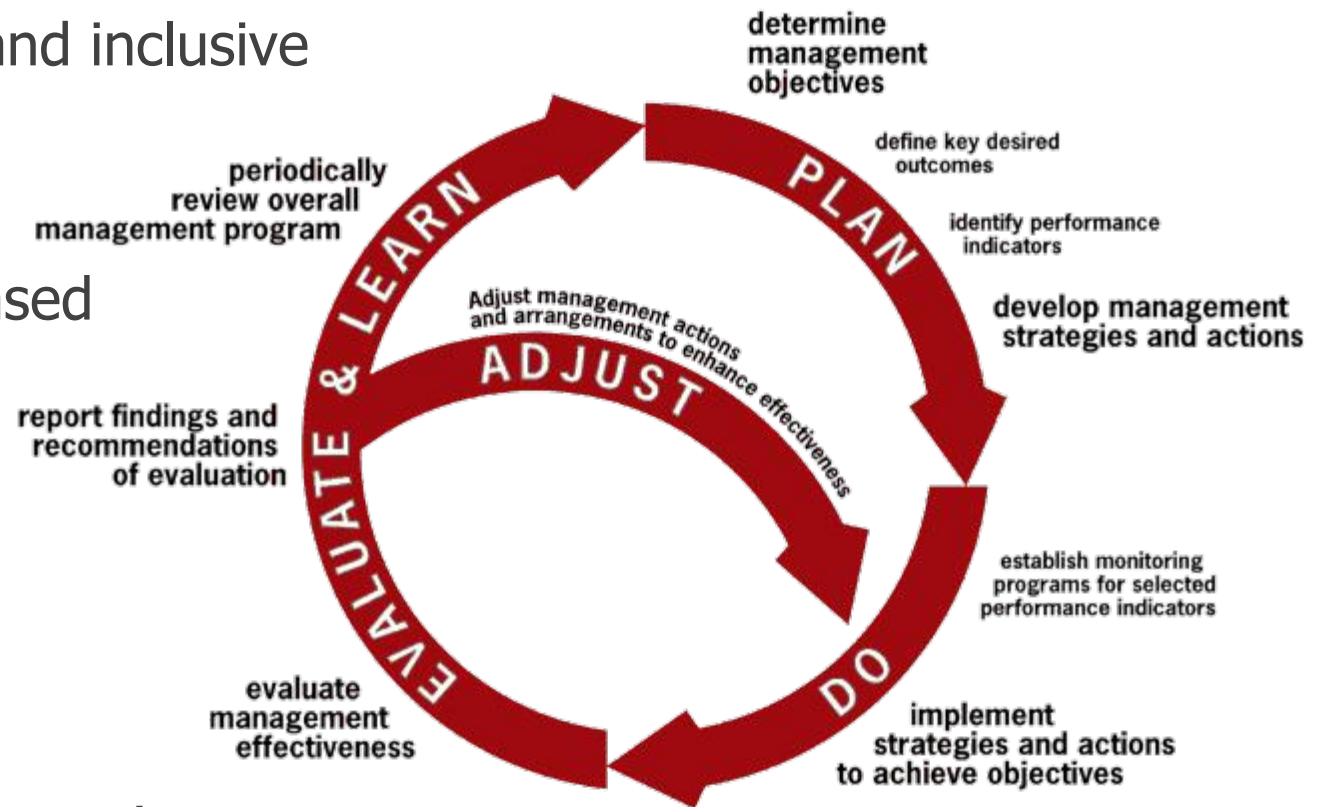
Management Objectives

- **Quadruple bottom line**
 - ❖ Environmental
 - ❖ Economic
 - ❖ Social
 - ❖ Governance



Design Principles

- Consistent with ESD
- Pragmatic and easy to understand
- Cost effective
- Transparent and inclusive
- Precautionary
- Adaptive
- Ecosystem-based



- Assume good species management can't hurt EBFM

Harvest Strategy Policy

Harvest strategy = monitoring + assessment + harvest control rule

- Objective + indicators
- Reference points

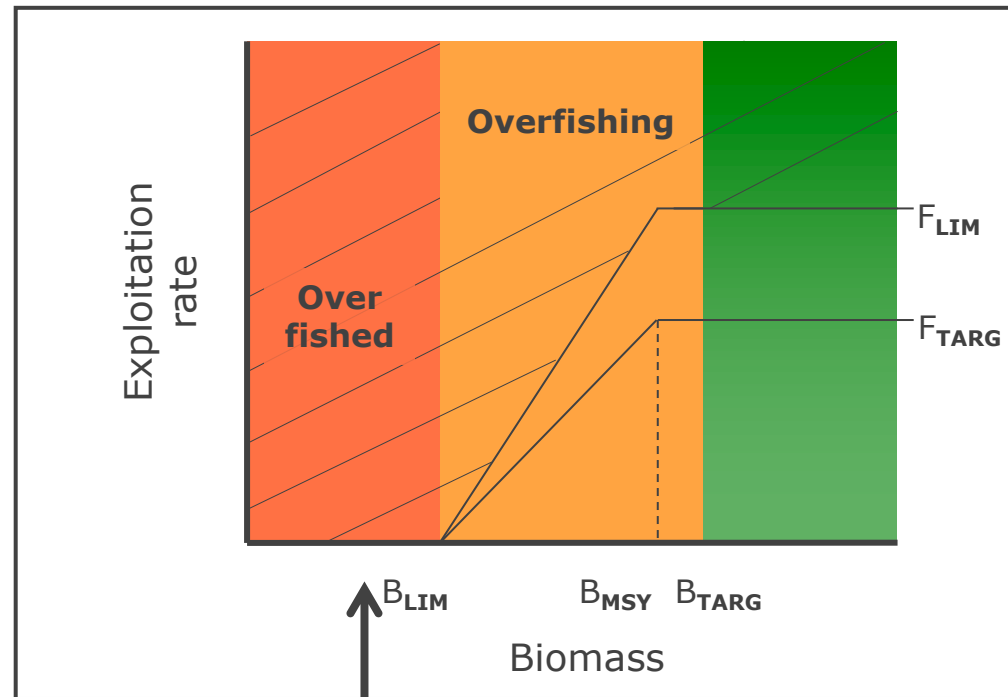
B_{MSY} = rebuilding target
(default $0.4 B_0$)

B_{MEY} = economic target
(default $0.48 B_0, 1.2 B_{MSY}$)

B_{LIM} = $0.5 B_{MSY}$
(default $0.20 B_0$)

- Risk criterion = maximum 10% chance of falling below B_{LIM} long term
- MSE testing required
- Tiers (aiming for risk equivalency) to make it multispp practical

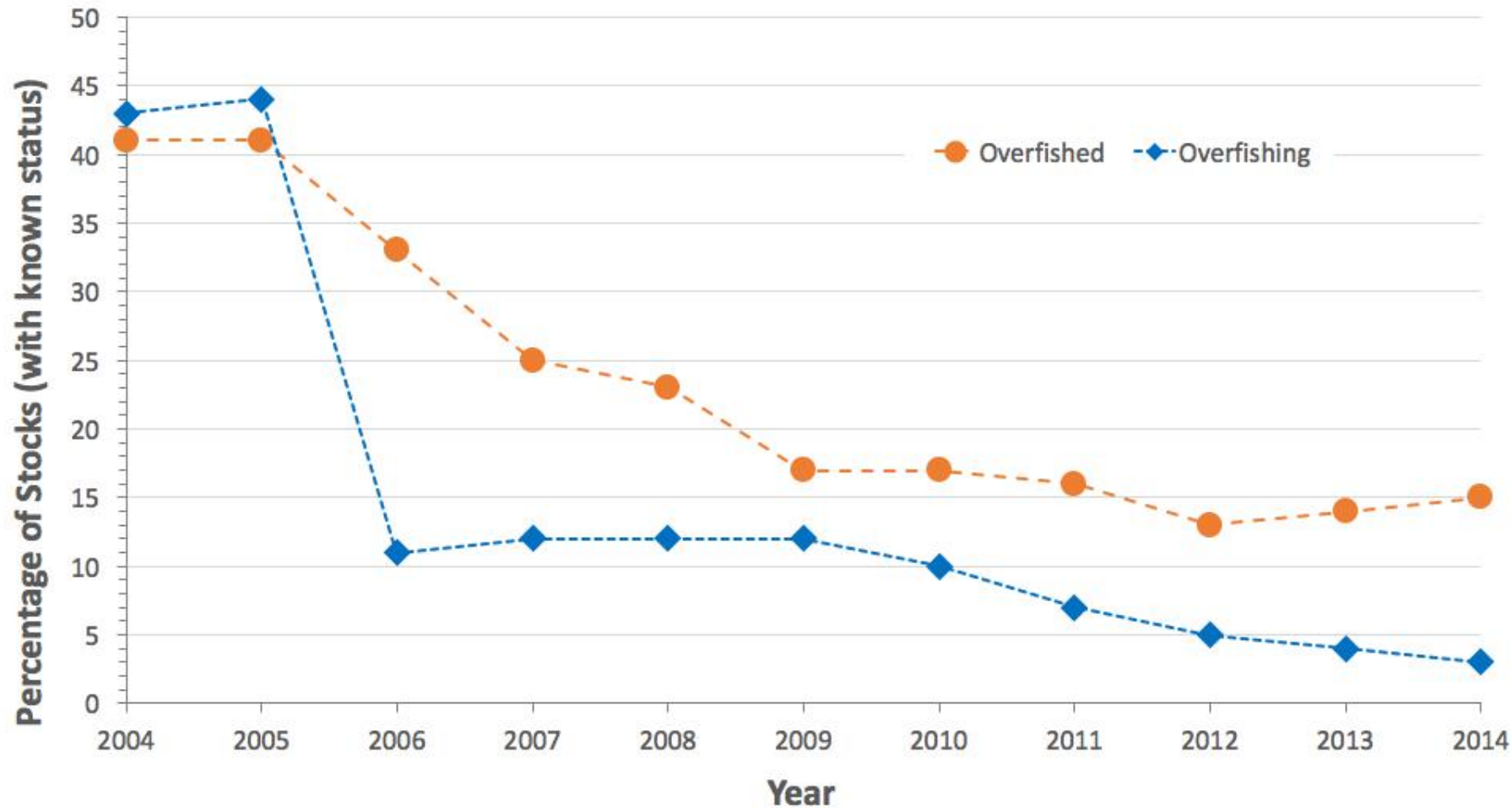
Default harvest control rule



No targeted fishing below B_{LIM}



Reasonable Success



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- **Social licence to operate**
 - ❖ Implications for industry and management
 - ❖ What are acceptable impacts?
- **Implications of changing governance and regulatory frameworks on economic, social and ecological outcomes**
- **Supporting Management of Marine Biodiversity**
 - ❖ Divide in marine research community
 - ❖ Methods and tools for managing in multiple use context
 - ❖ Making the system climate robust



Using observations

Ecological Risk Assessment

**Spatial management
(mitigate impacts of fishing)**

Management strategy evaluation

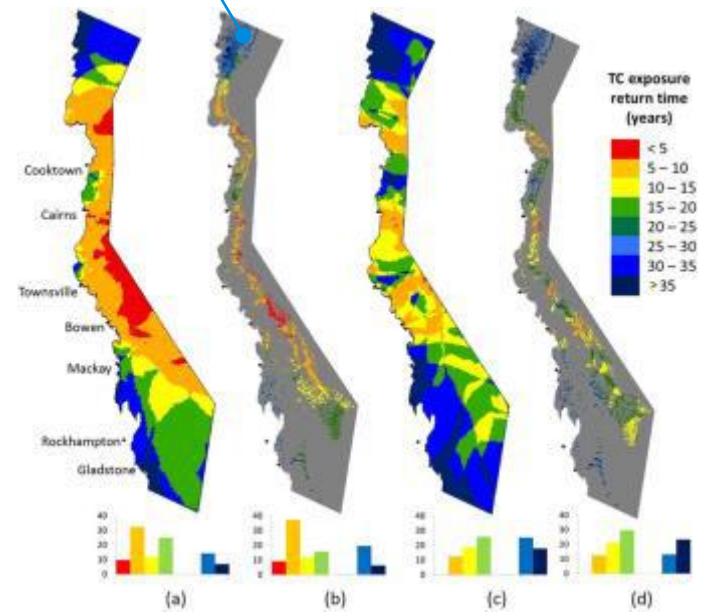
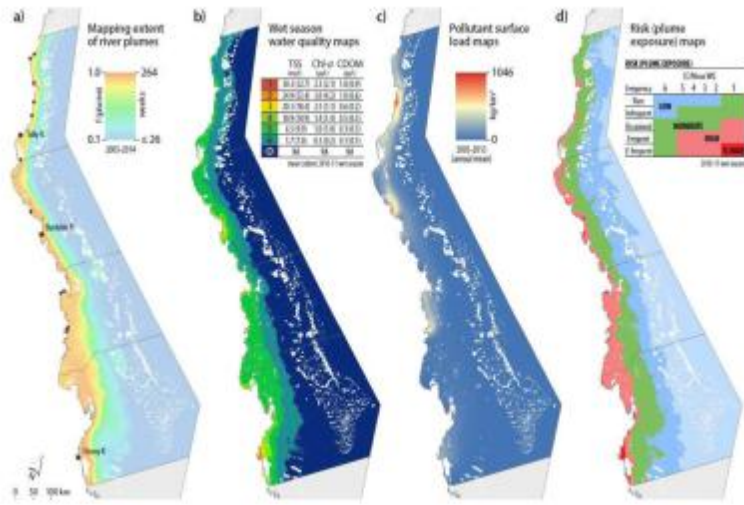
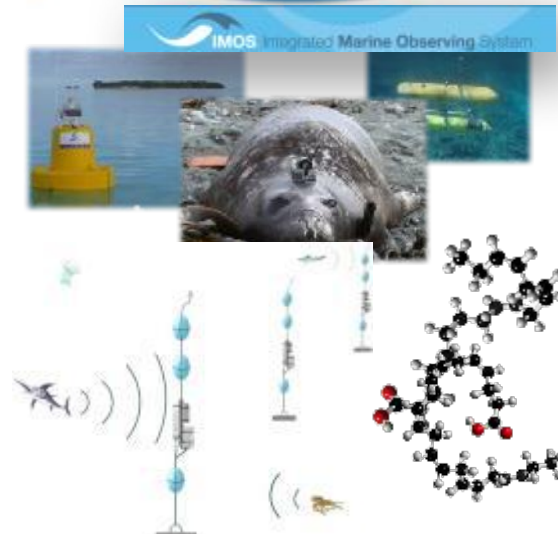
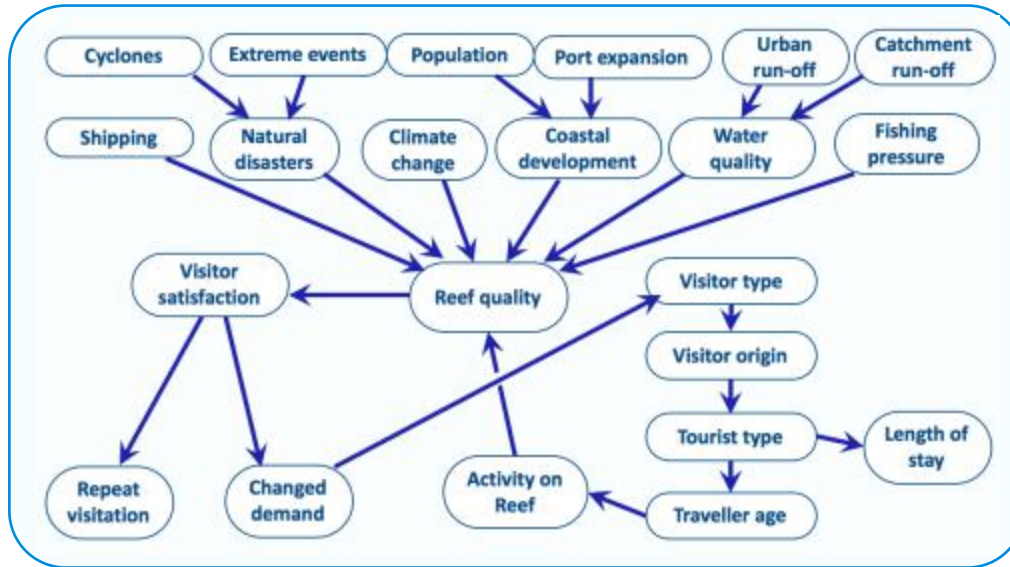
Implementing harvest strategies

Multiple use management

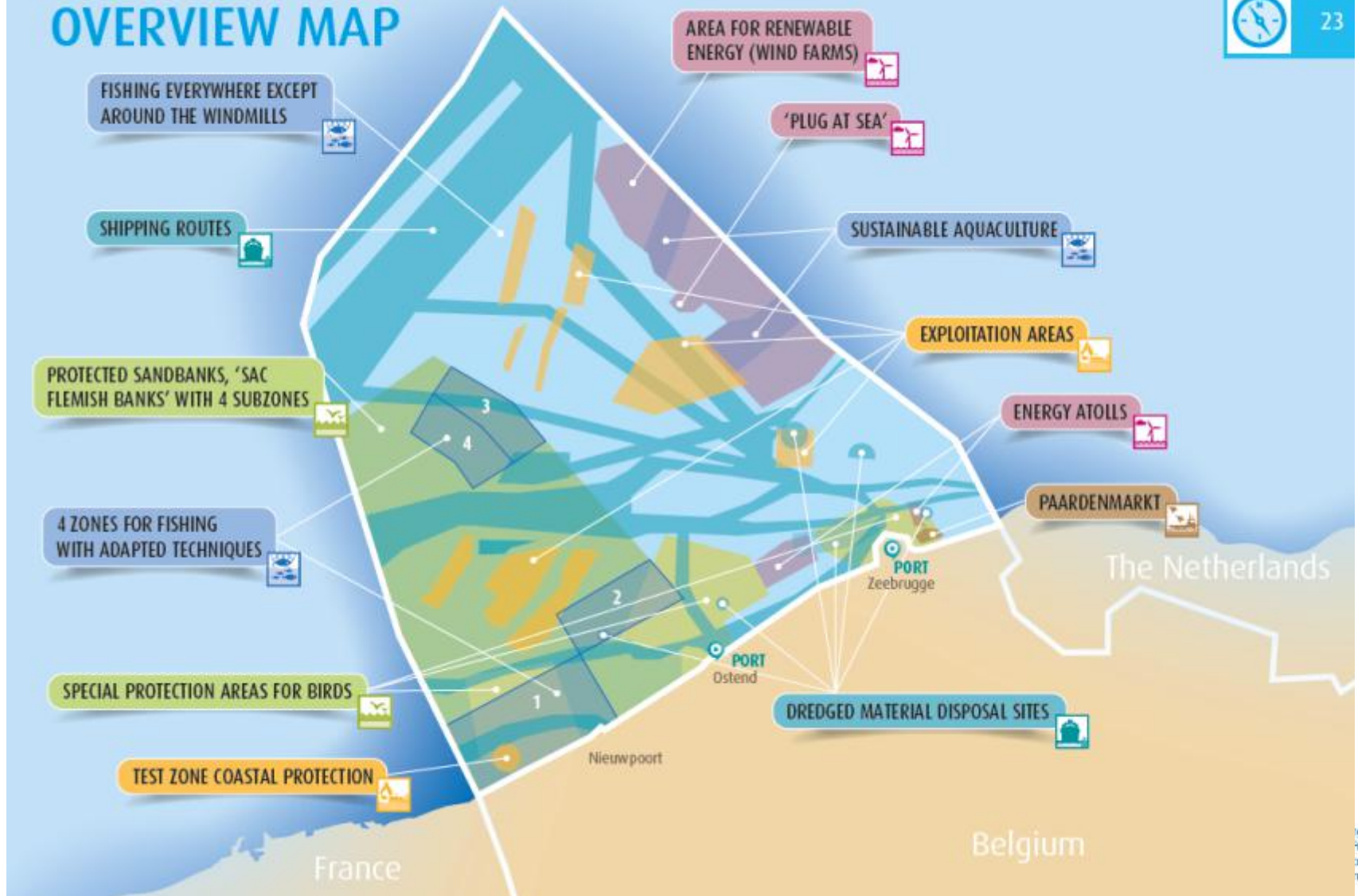
New tools (e.g. close kin)



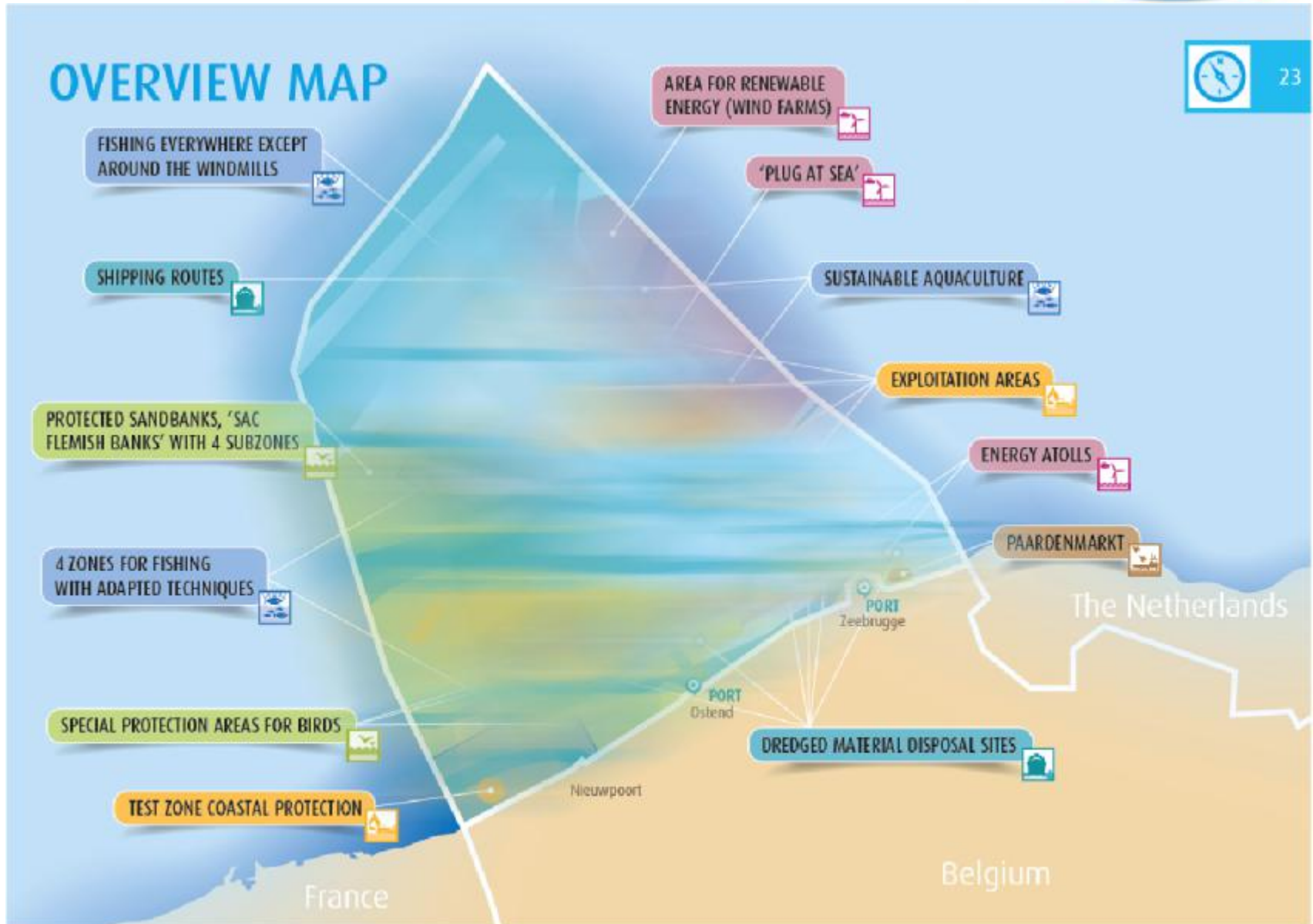
Synthesising Information



OVERVIEW MAP



OVERVIEW MAP



Staged Approach to Considering Risk MareFrame

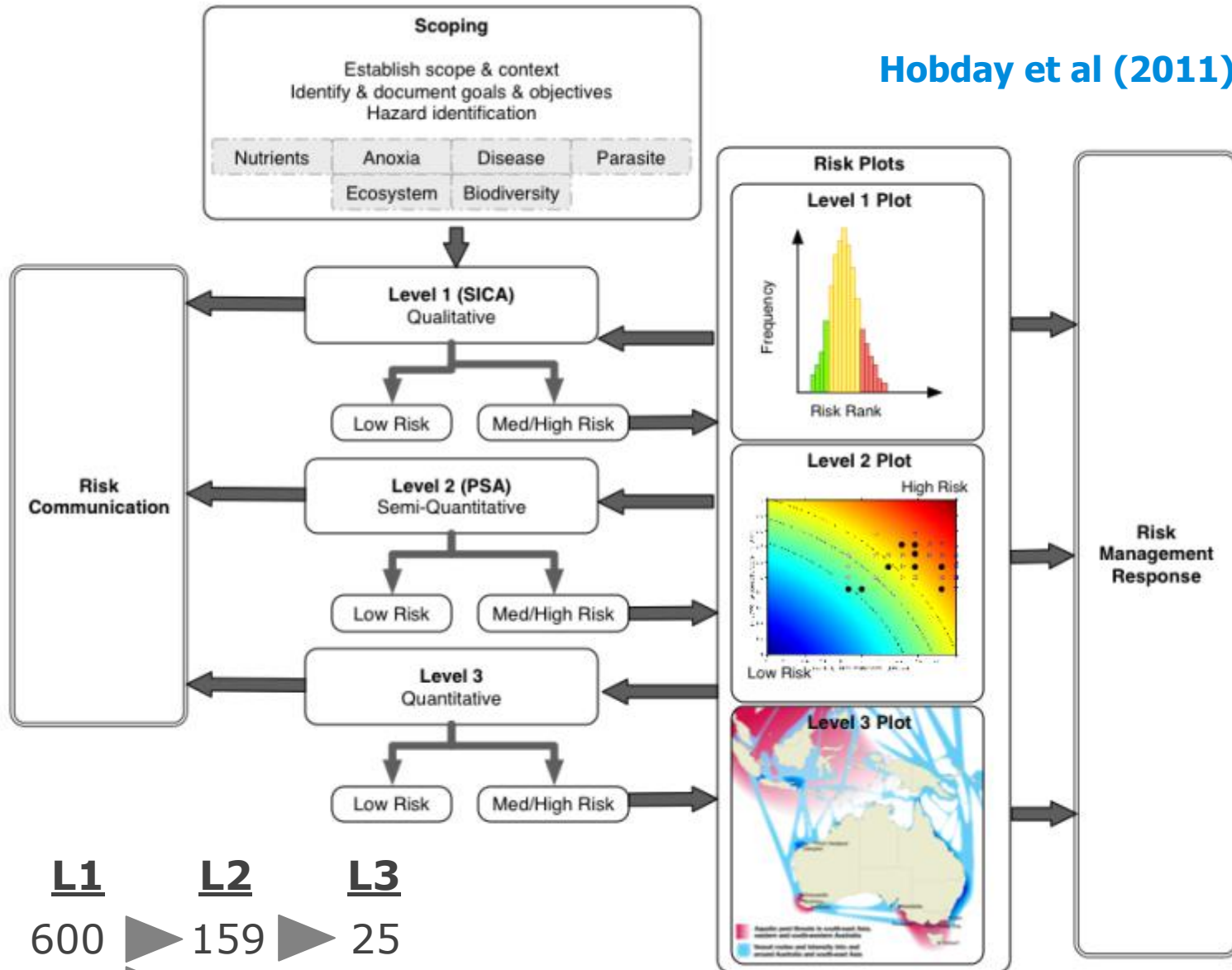
Hobday et al (2011)

Problem Formulation:
Scoping
 (Goals, Objectives, Values)

SICA-like Analyses:
Qualitative
Expert Scoring & Ranking
 (Scale, Hazards, Impacts, Likelihood & Consequences)

PSA-like Analyses:
Semi-Quantitative
Parameter Evaluation
 (Productivity, Susceptibility, Biodiversity Score (UdCh))

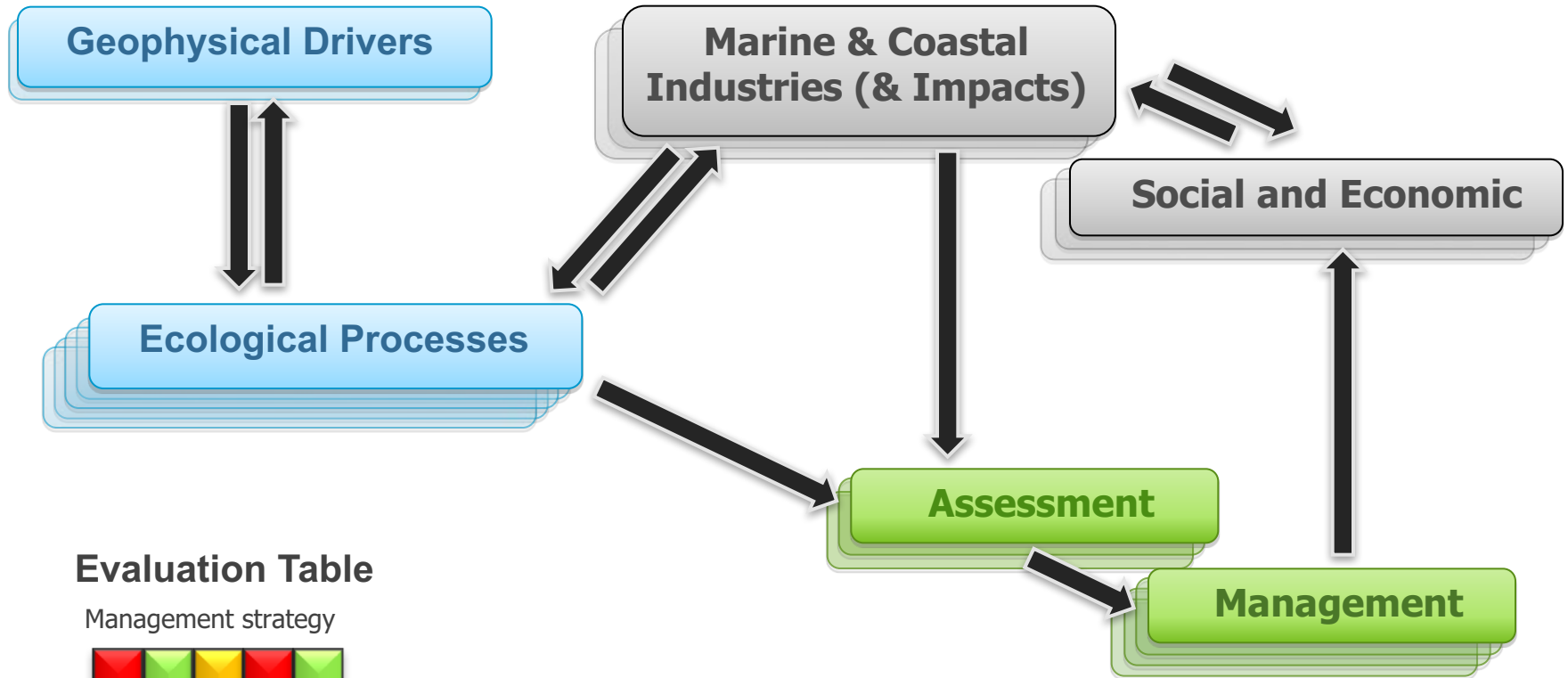
Dynamic Analyses:
Quantitative
Predictive & Dynamic Models
 (Epidemiology, Spatial & Biophysical Connectivity)



L1 **L2** **L3**

Species: 600 ► 159 ► 25
Habitats: 158 ► 46

Management Strategy Evaluation



Evaluation Table

Management strategy

Objectives

Red	Green	Yellow	Red	Green
Red	Red	Yellow	Red	Red
Yellow	Yellow	Yellow	Red	Red
Green	Yellow	Yellow	Red	Green

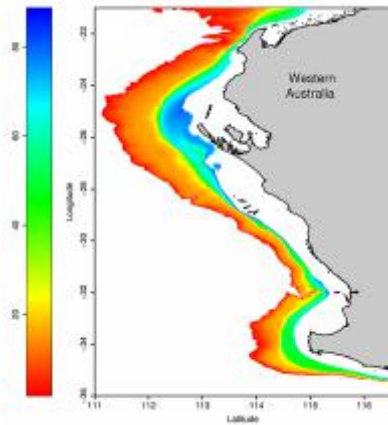


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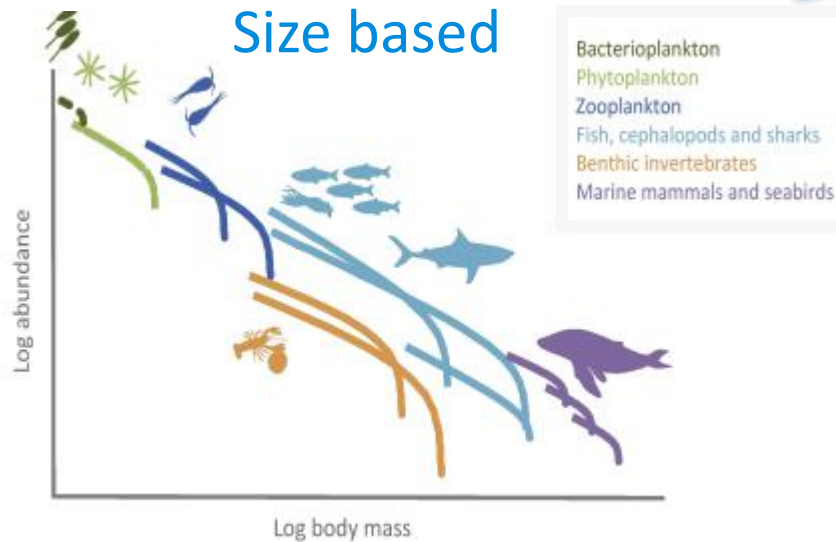
Diversity of model approaches

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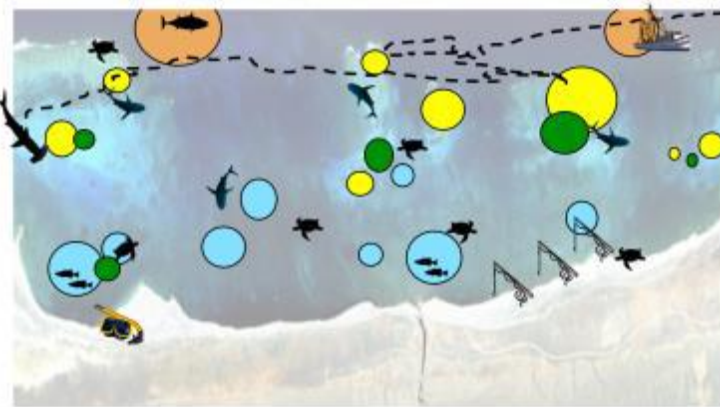
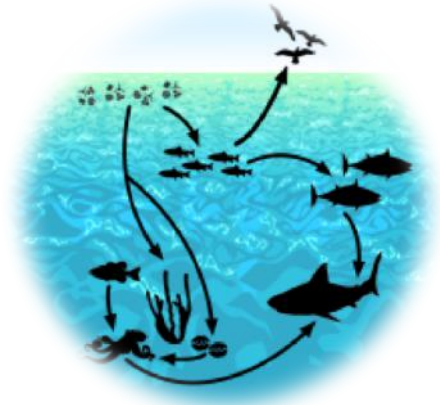
Species distributions



Size based



Trophic



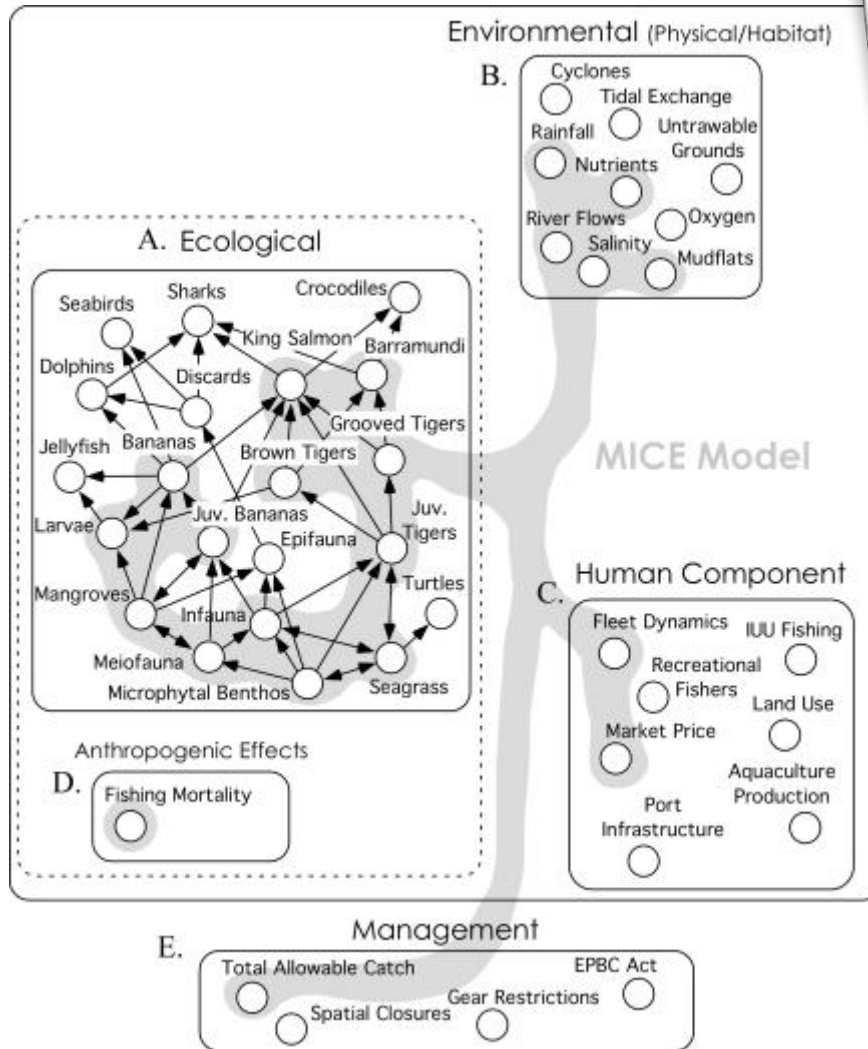
Bayesian networks



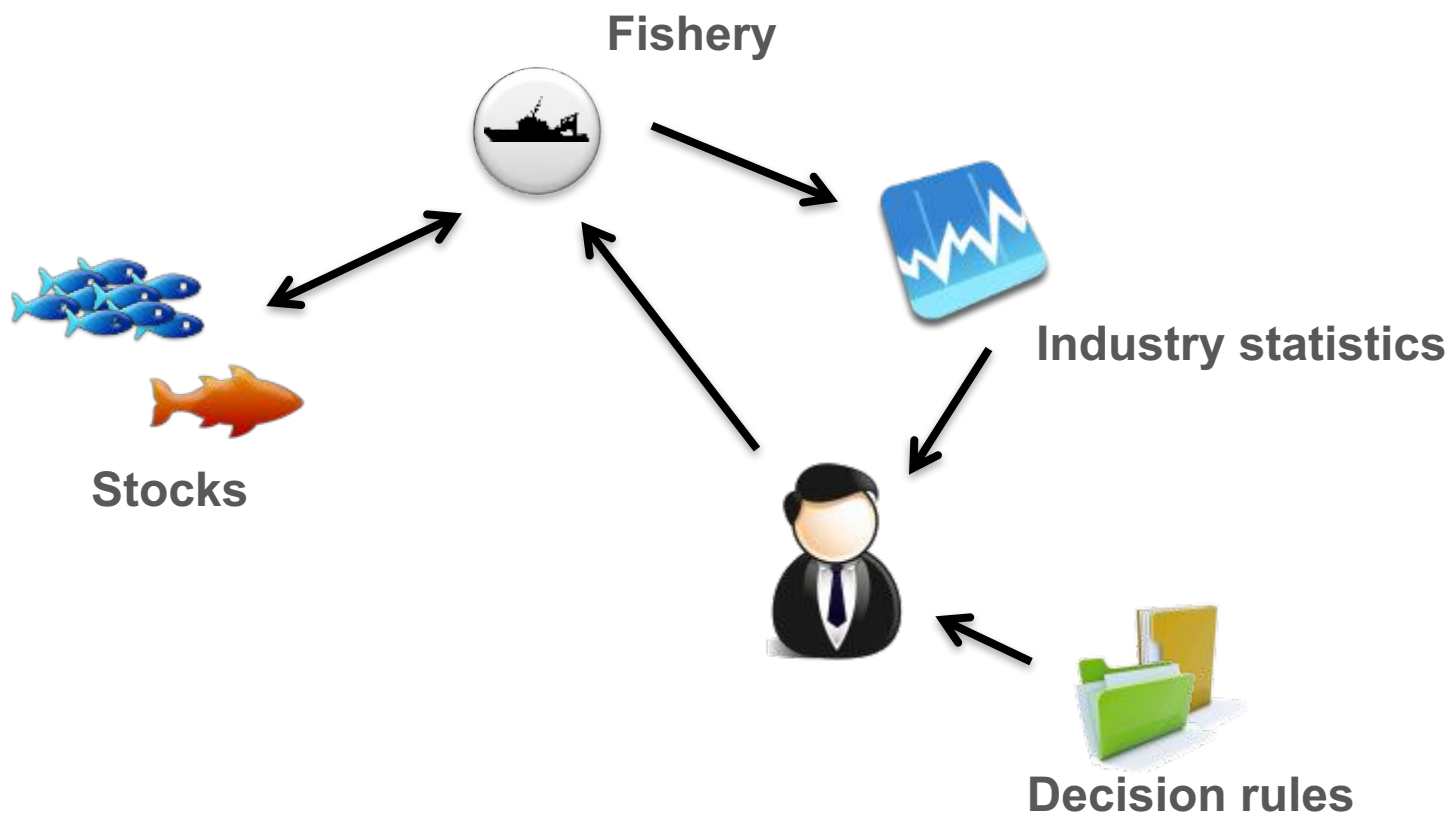
Qualitative

Agent based & hybrid models

MICE – Minimum Realistic



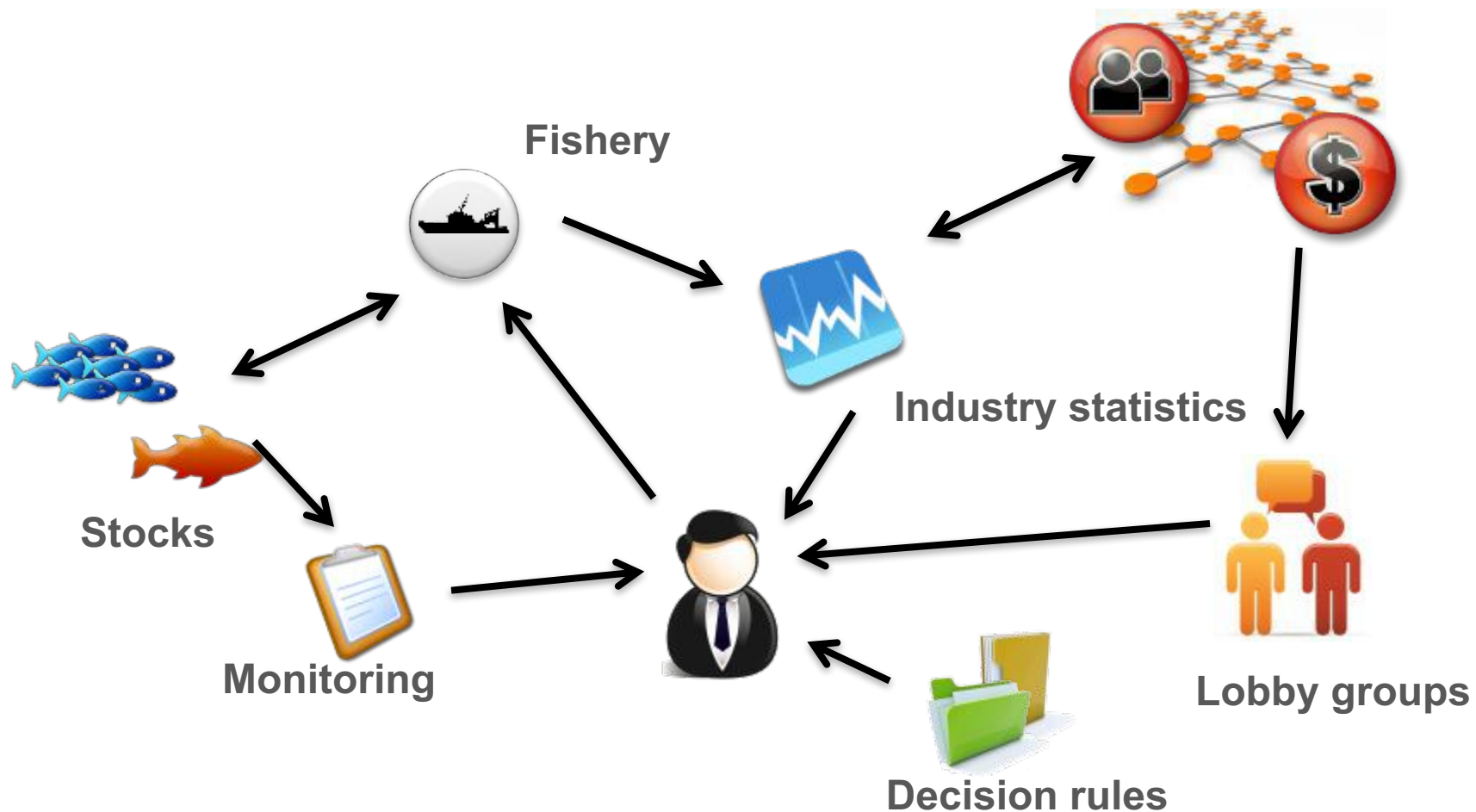
- Think broadly
- Only include key players
- Statistically fit
- Tactical & strategic models



- Best management = quotas or economic levers (mostly)

Linking sub-systems shows need integration

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- Best management = quotas + spatial + gear (+ social)

New challenges

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Struggling snapper taken off the table

Fisherman snap at looming bans

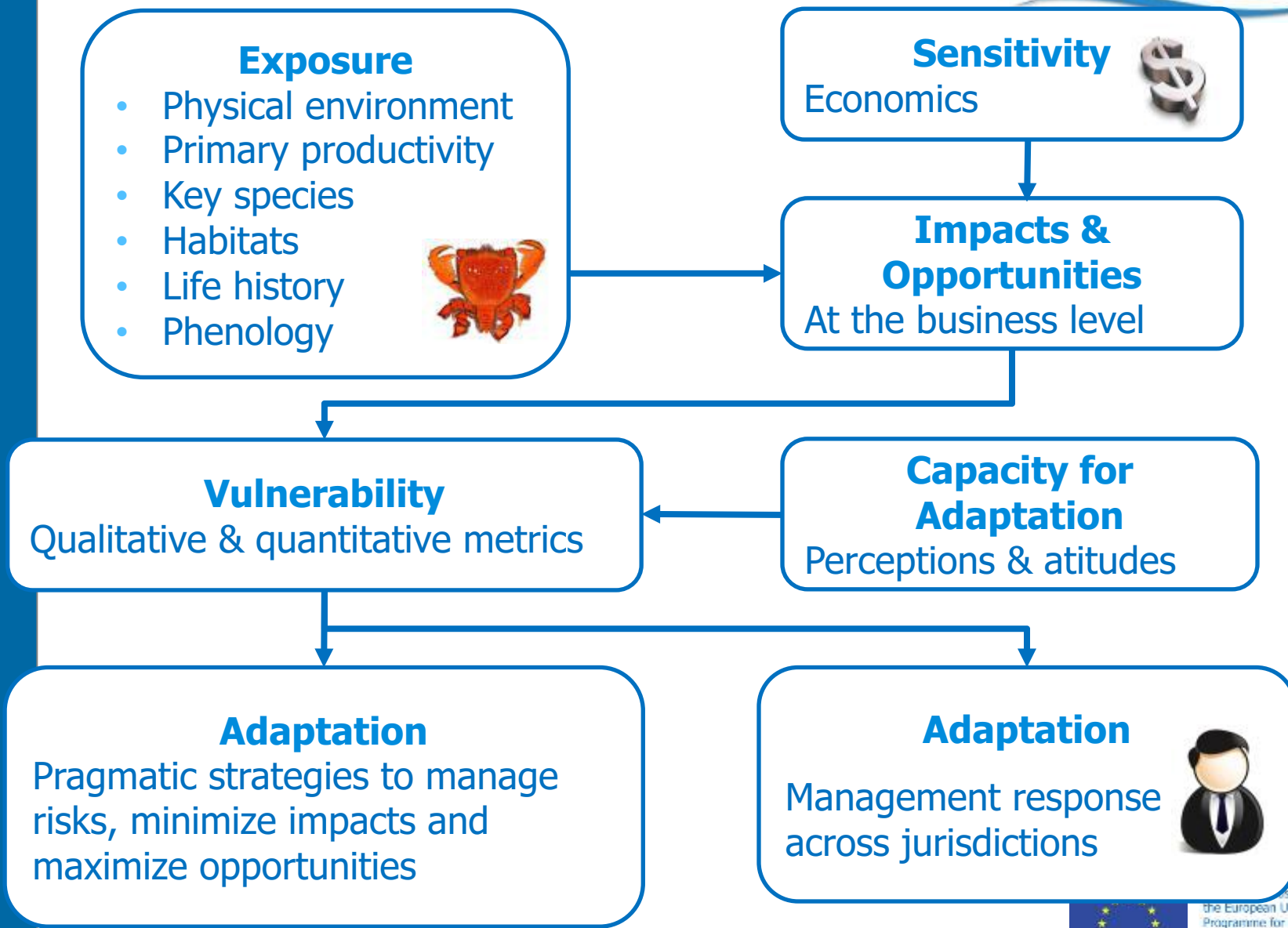
- Climate impacts on fisheries management already exist



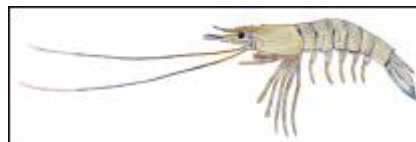
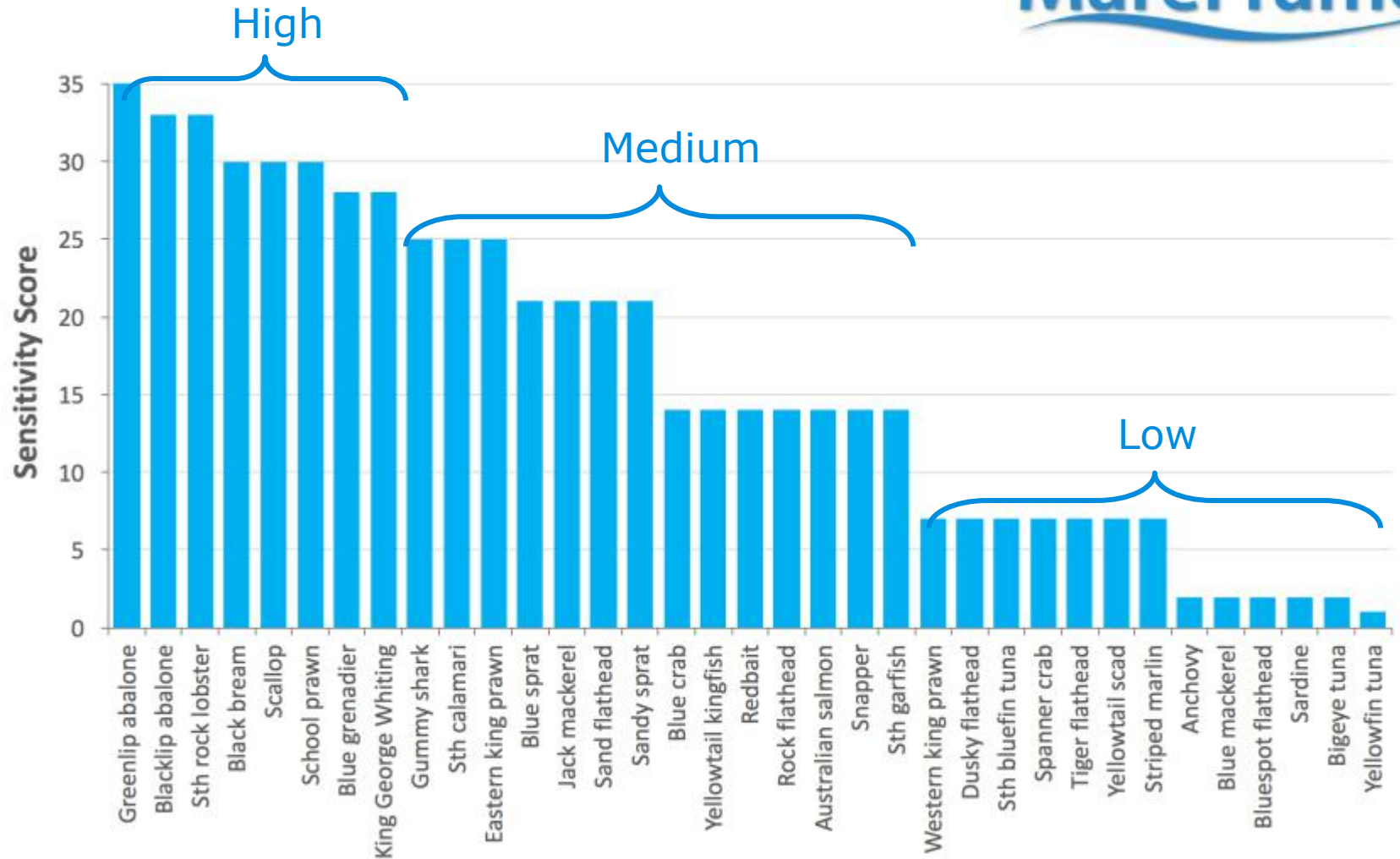
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Vulnerability Analysis

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Vulnerability Analysis

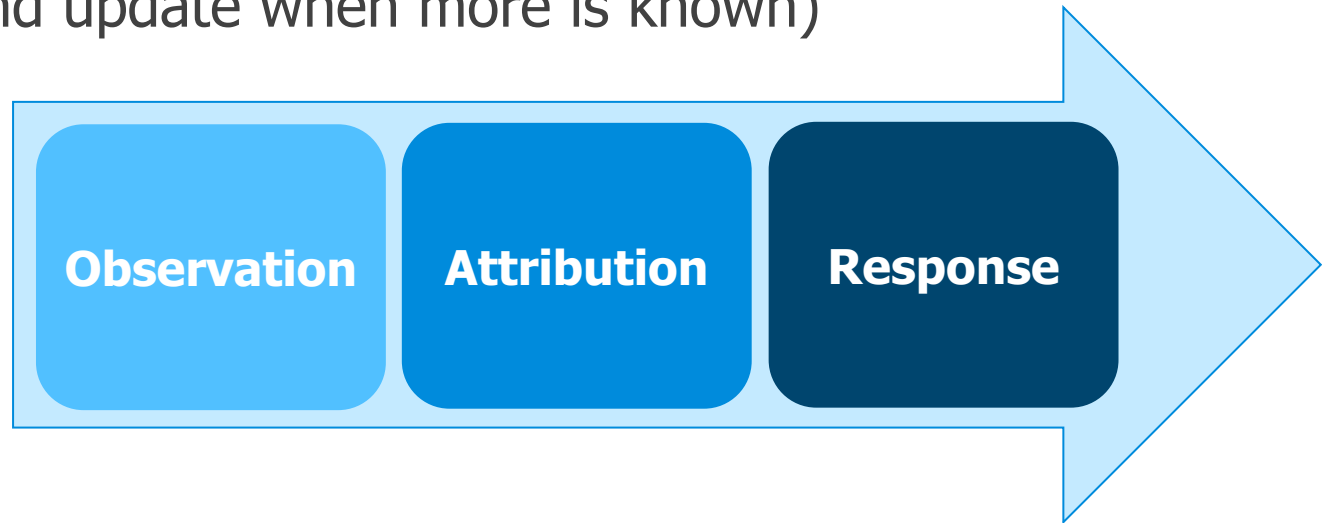


New way of Thinking

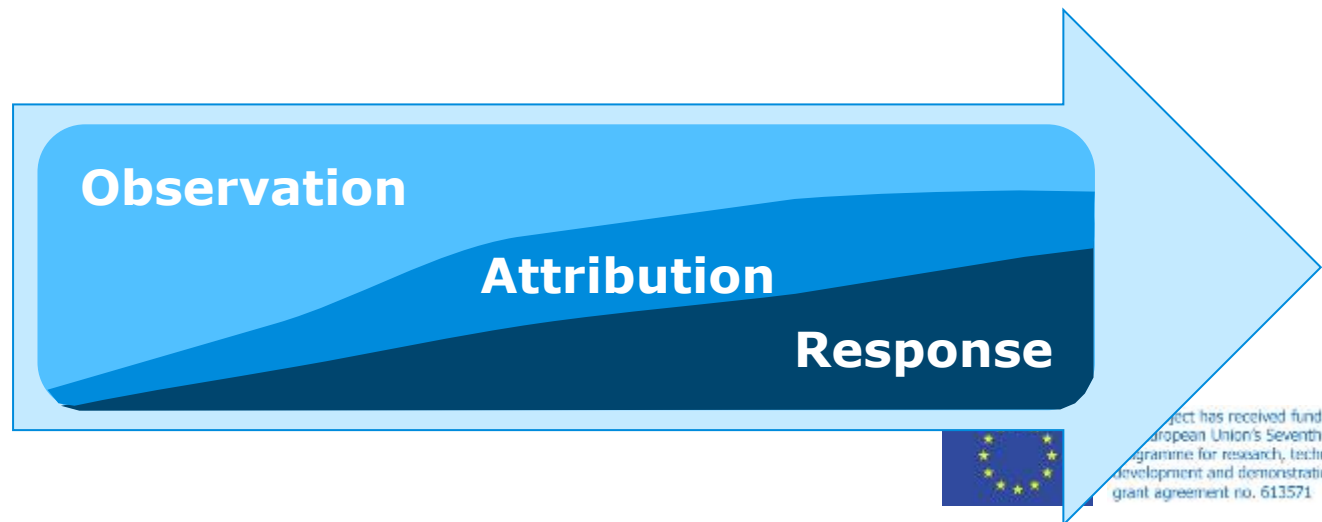
- **Flexible regulations**

(no regrets and update when more is known)

Old approach



New approach



Forecast for Fisheries & Management **MareFrame**

Aerators
Feed
Synchronization
Operations
Jobs
Equipment
Location
Infrastructure
Change
species

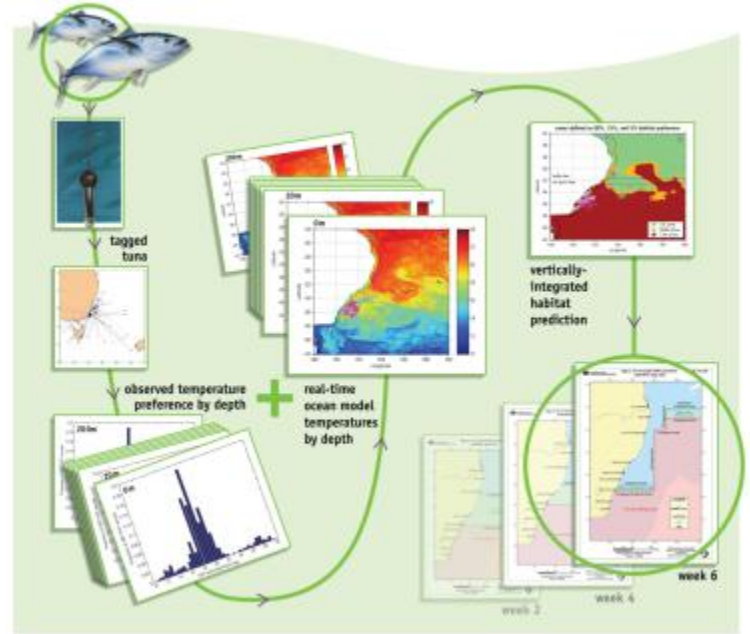
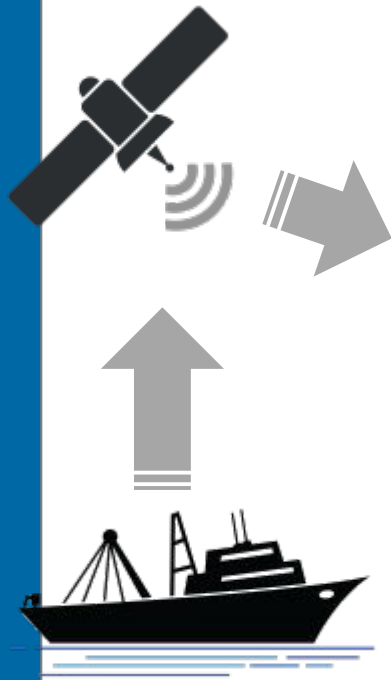
Days **Weeks** **Months** **Years**

Reactive

Seasonal

New methods
& Projections

- **Help industry & managers** efficiency, planning & investment



Hobday et al 2010



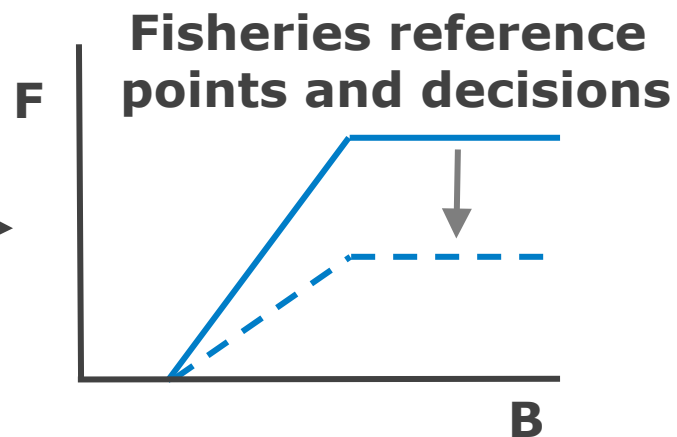
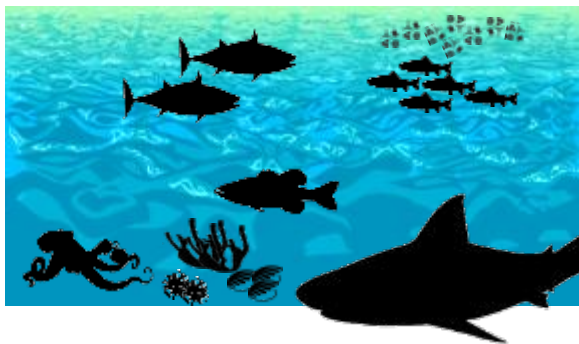
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Multippecies Management

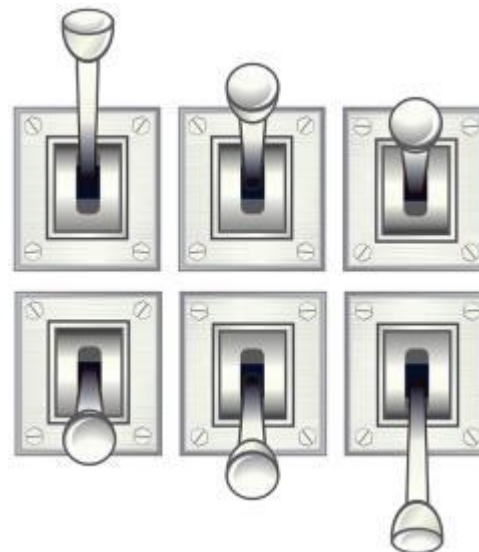
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- Find indicators to give EBFM context to single species management

Ecosystem as Context

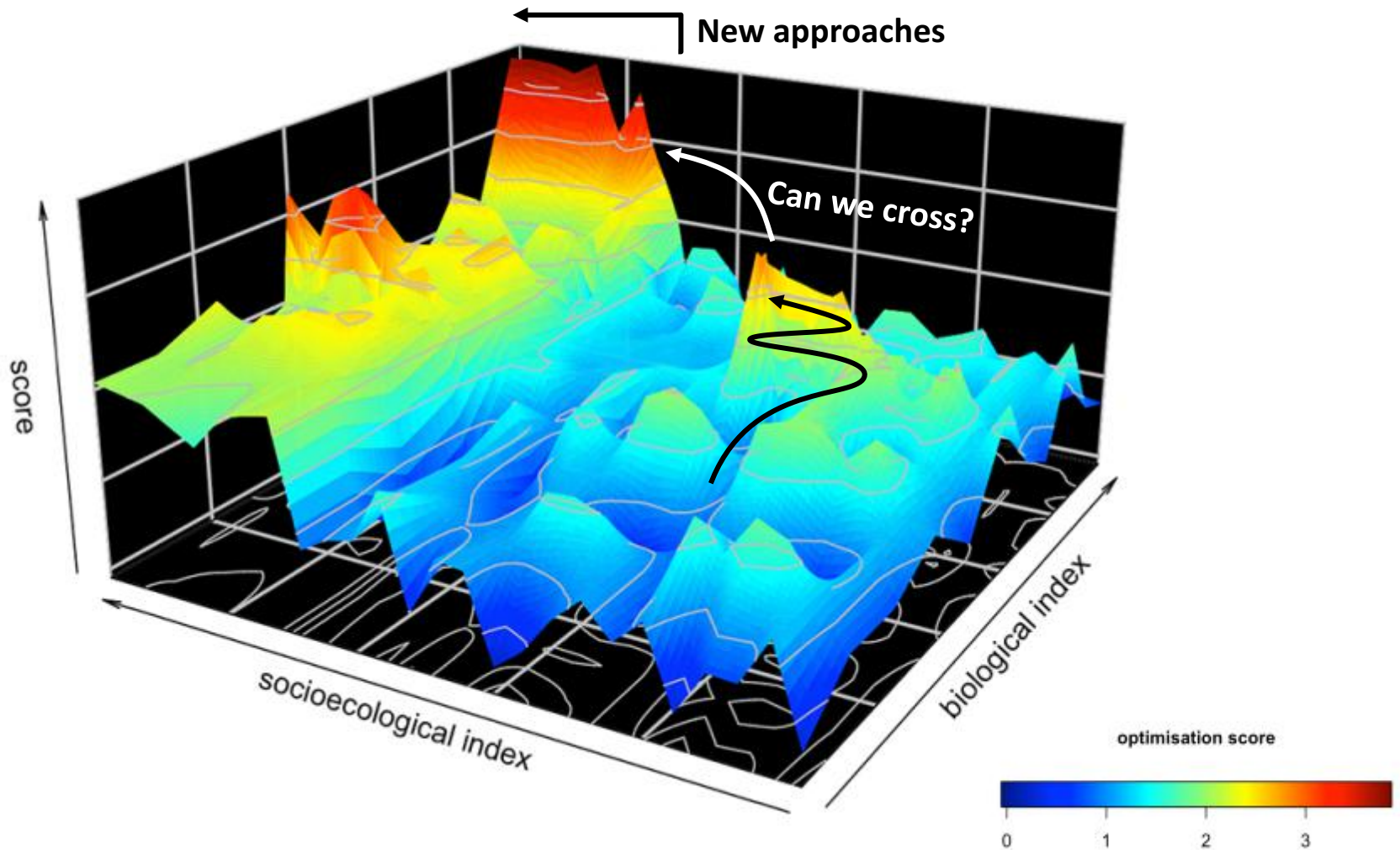


- Use métiers (fleet-gear combos) to “guide” the ecosystem








Future management options

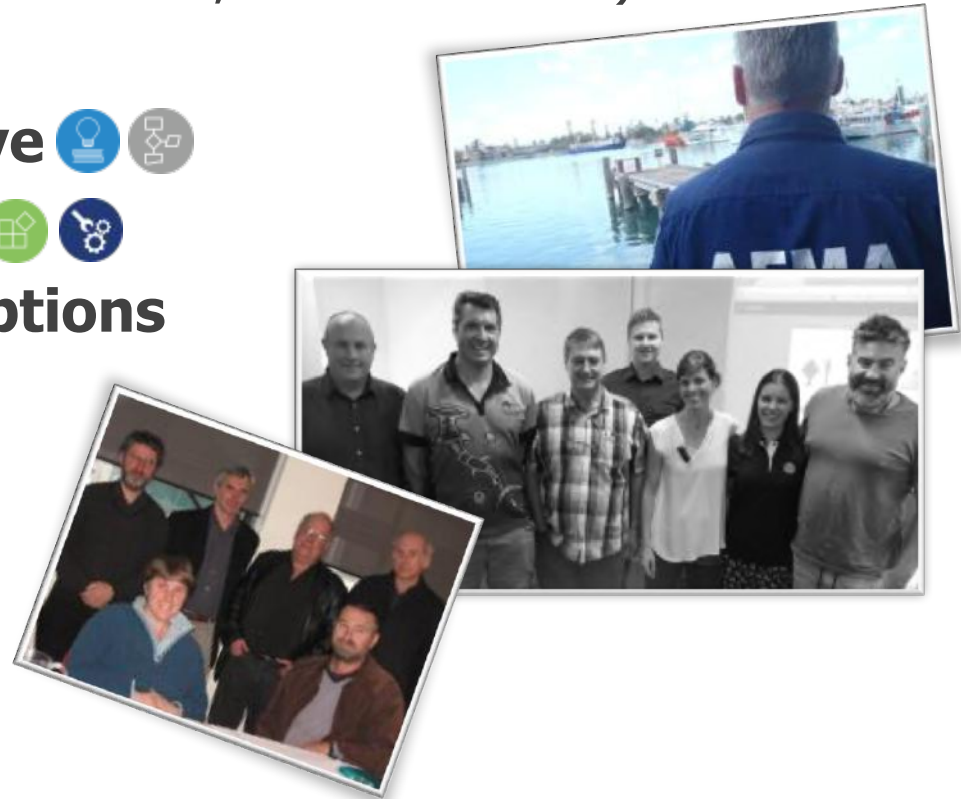
- Theory vs reality - historical legacy constrains options



Summary

- Lots of theory
- Operationalisation not as clear cut
- **Integrated** (quadruple bottom line, across sectors)
- **Cost effective**
- **Transparent and inclusive**  
- Science-based **toolbox**   
- **Multiple management options**
- **Adaptive**

- **Vision + luck**
- **Scaleable?**



Photos: AFMA, @FRDCAustralia



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Thank you

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Photo: Peter-Godfrey Smith

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