THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

CCRES

Integrating coral reef ecosystem services into marine spatial planning

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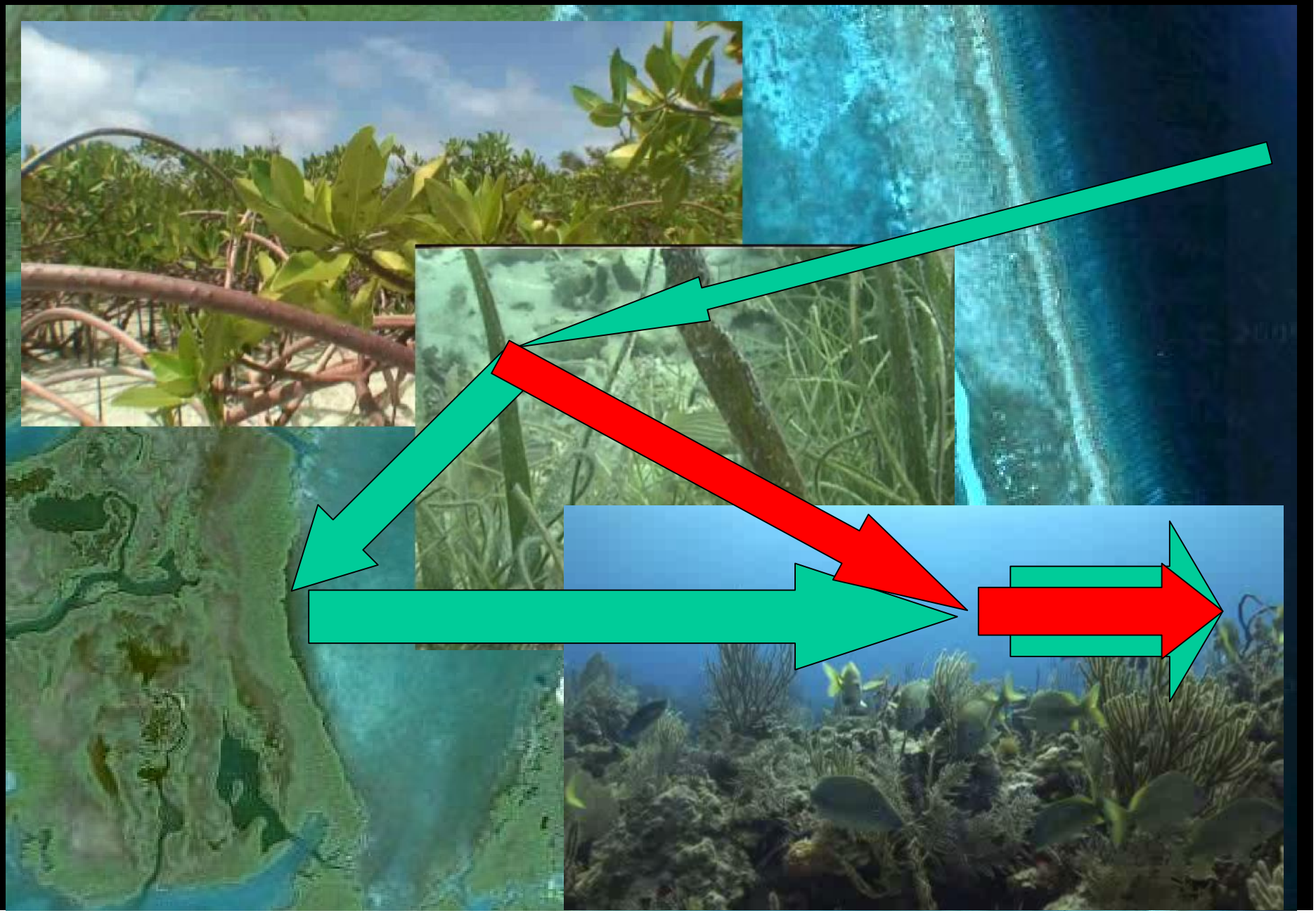
MSEL
Marine Spatial Ecology Lab

Scope

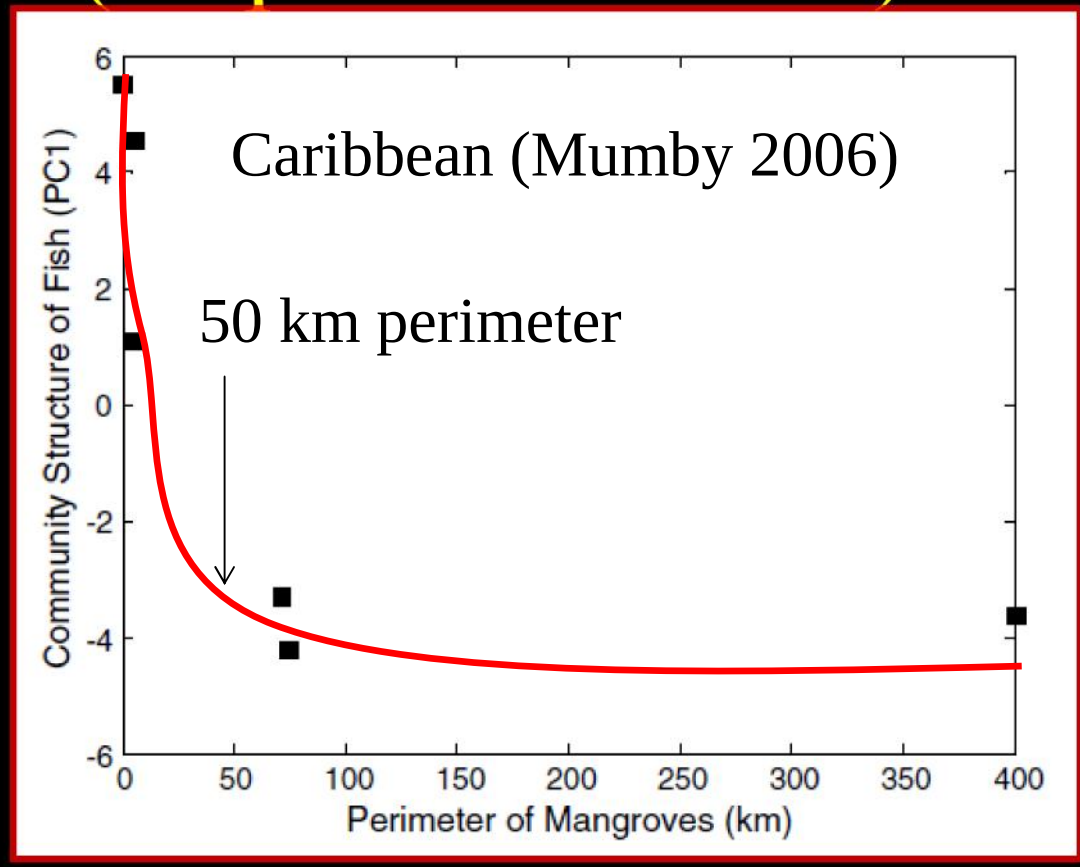
- Challenges and solutions to measuring ecosystem functioning (use examples from key services)
- Approach being taken by the World Bank / GEF Capturing Coral Reef Ecosystem Services project in the Philippines & Indonesia (CCRES.net)

Challenge 1: scale of ecosystem connectivity

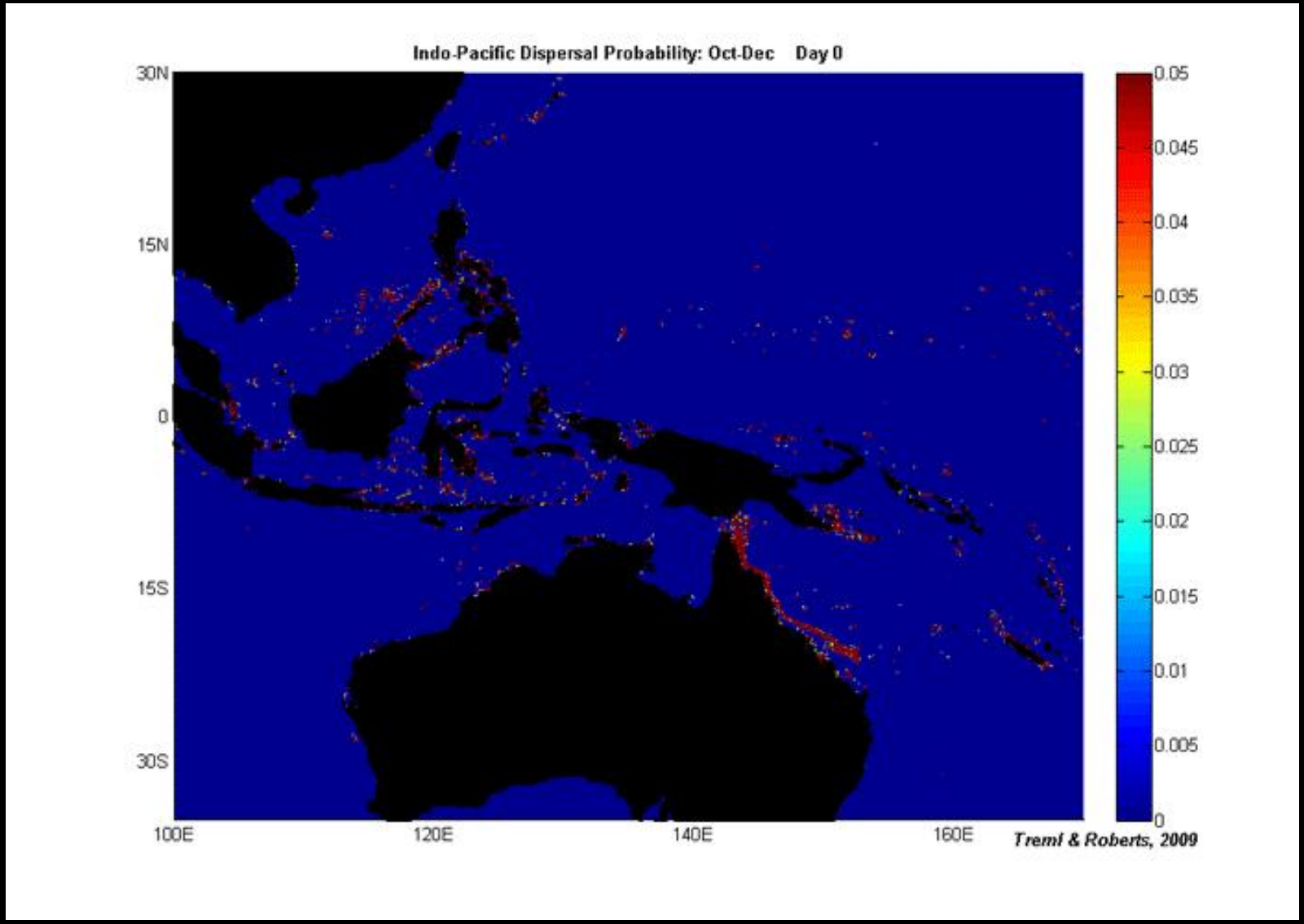


Regional adaptation difficult

- Marginal loss of fisheries production per hectare of mangrove loss?
- Very few studies (no perfect answer)
- Meta-analysis finds tidal-range to be major global driver (Igulu et al 2014)

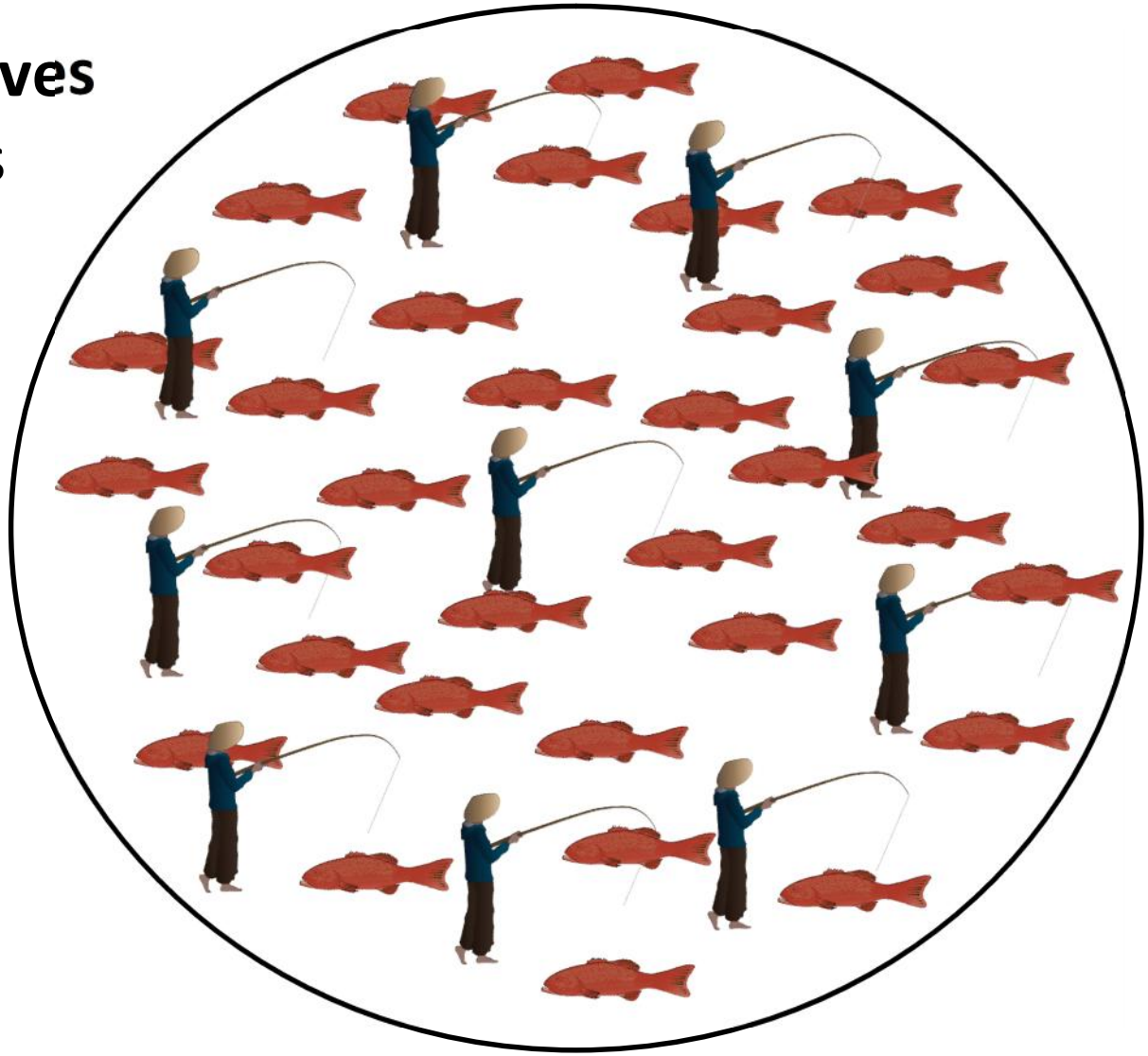


Challenge 2:
Complex connectivity across seascape



A hypothetical fishing ground

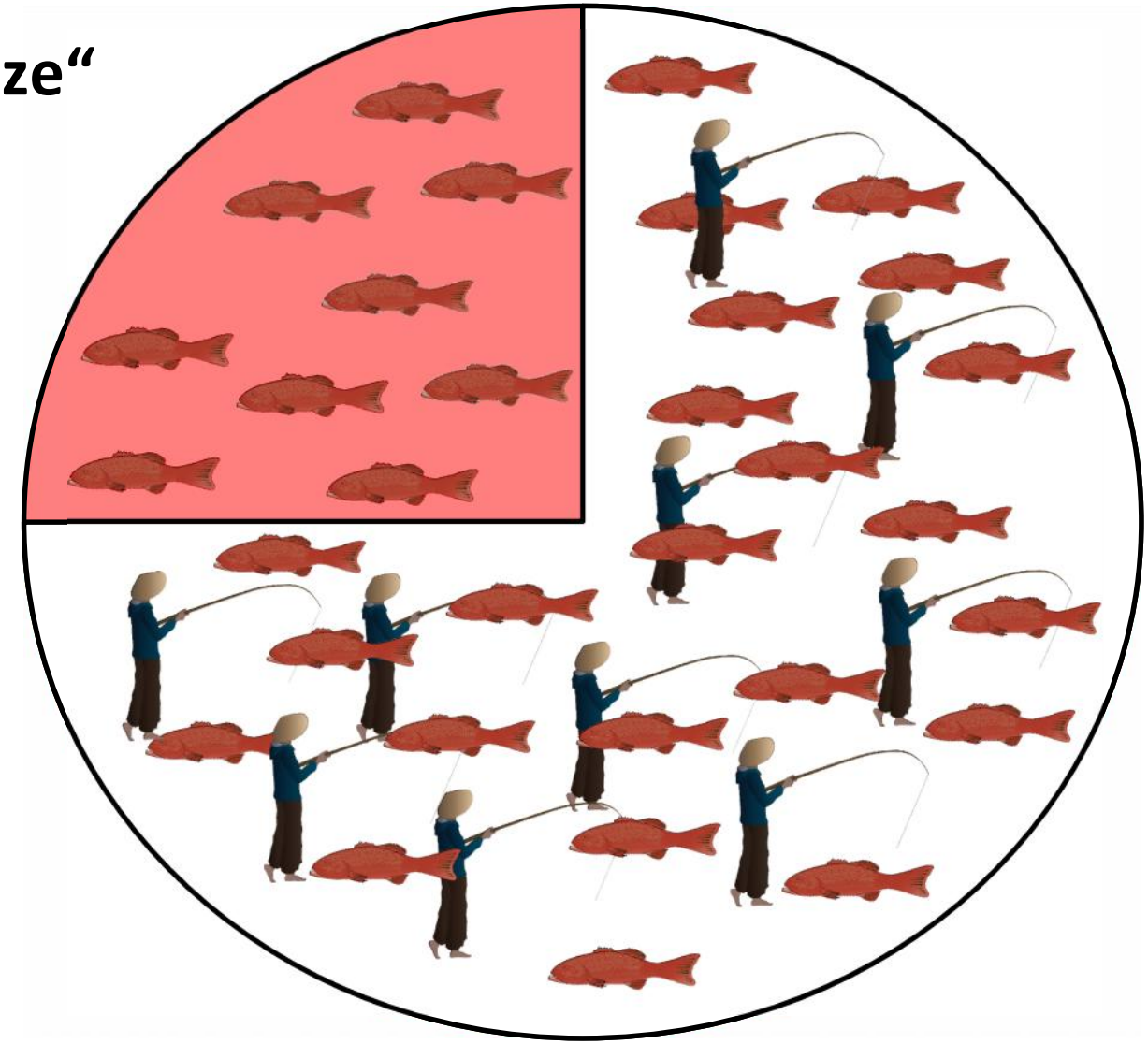
Enforcing reserves impacts species and fishers



Concentration of fishers

“Fishery squeeze“

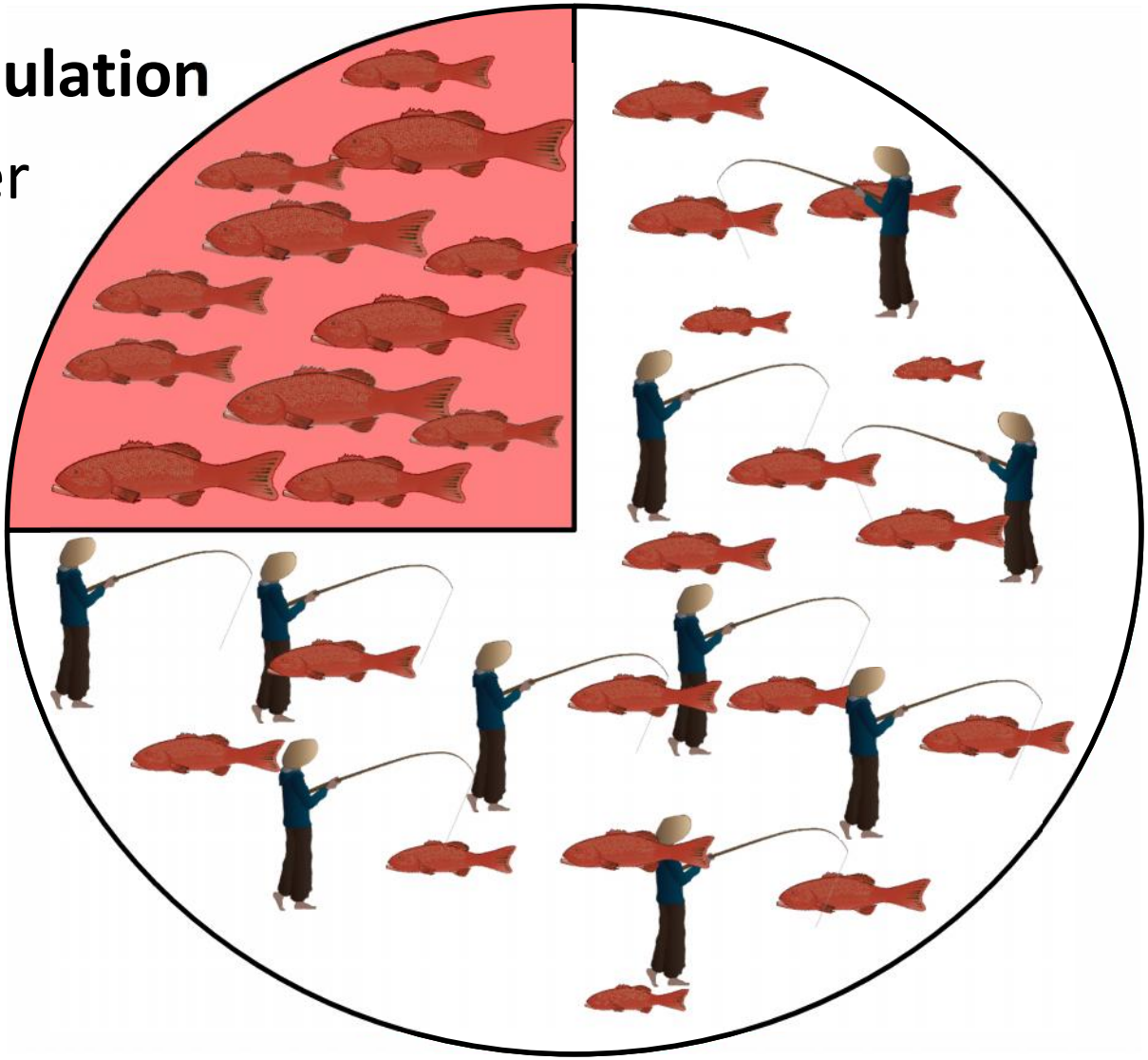
Smaller fishing arena



Conservation benefit almost certain

Biomass accumulation

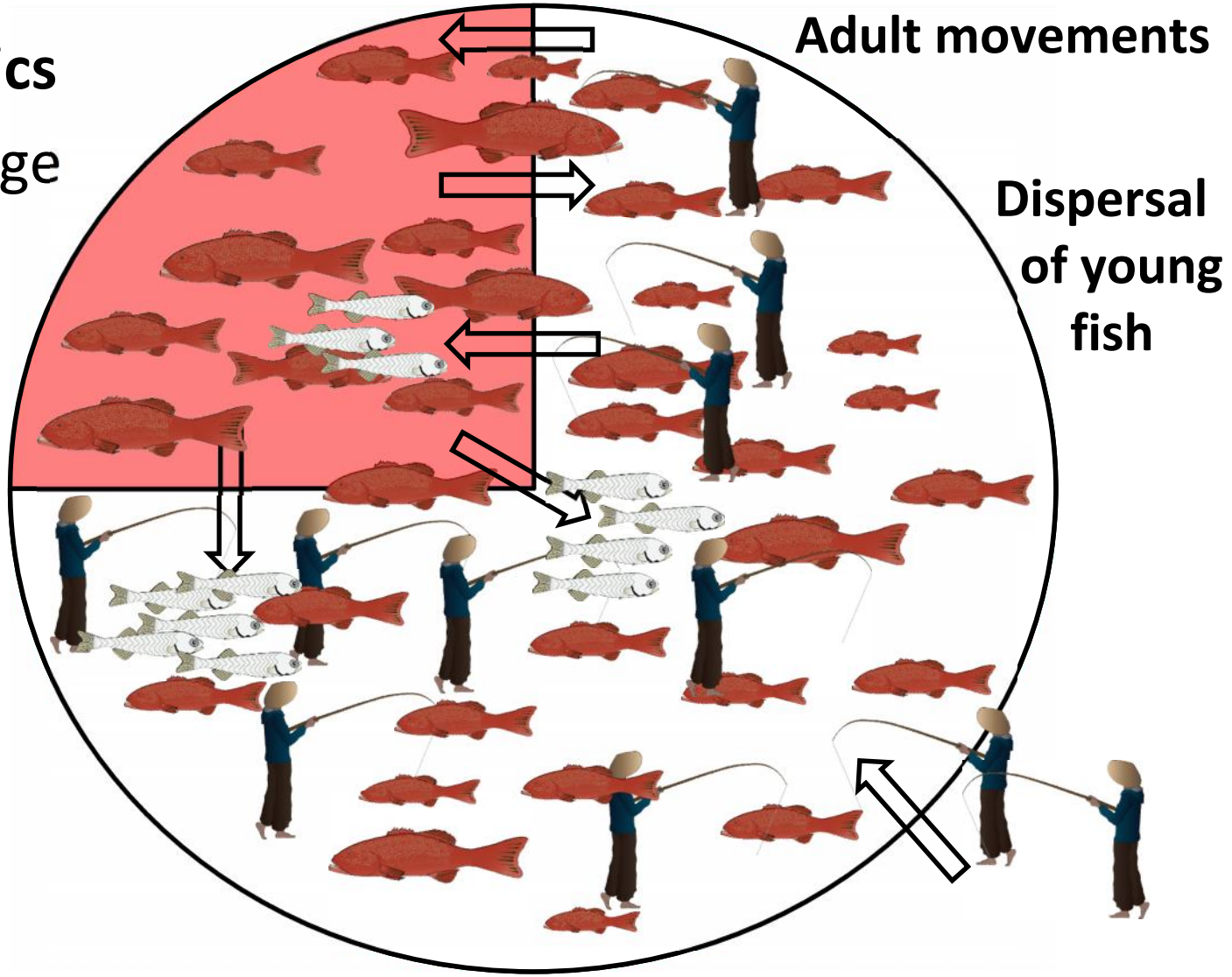
More and bigger fish in reserves



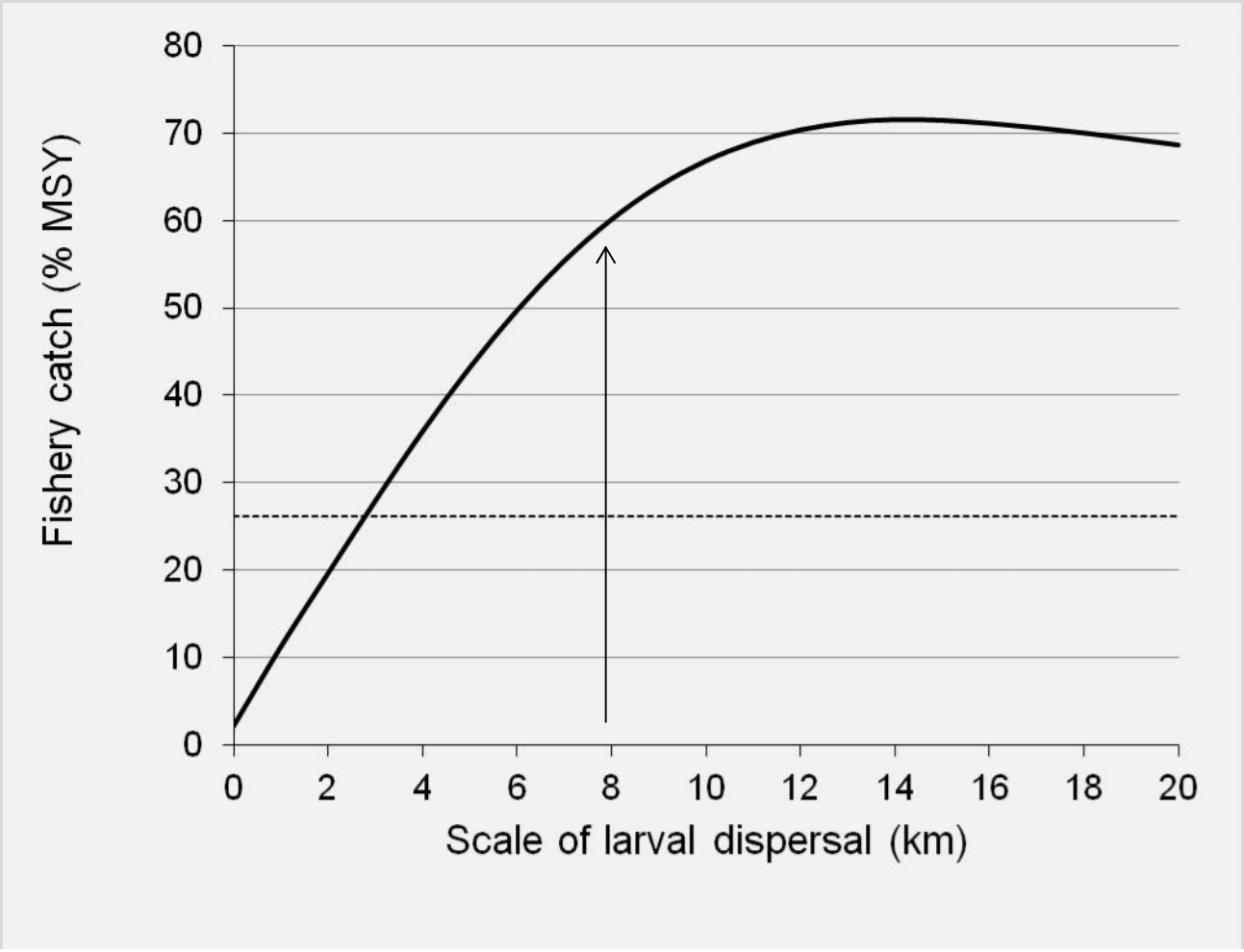
Feedback through fish and fisher movements

System dynamics

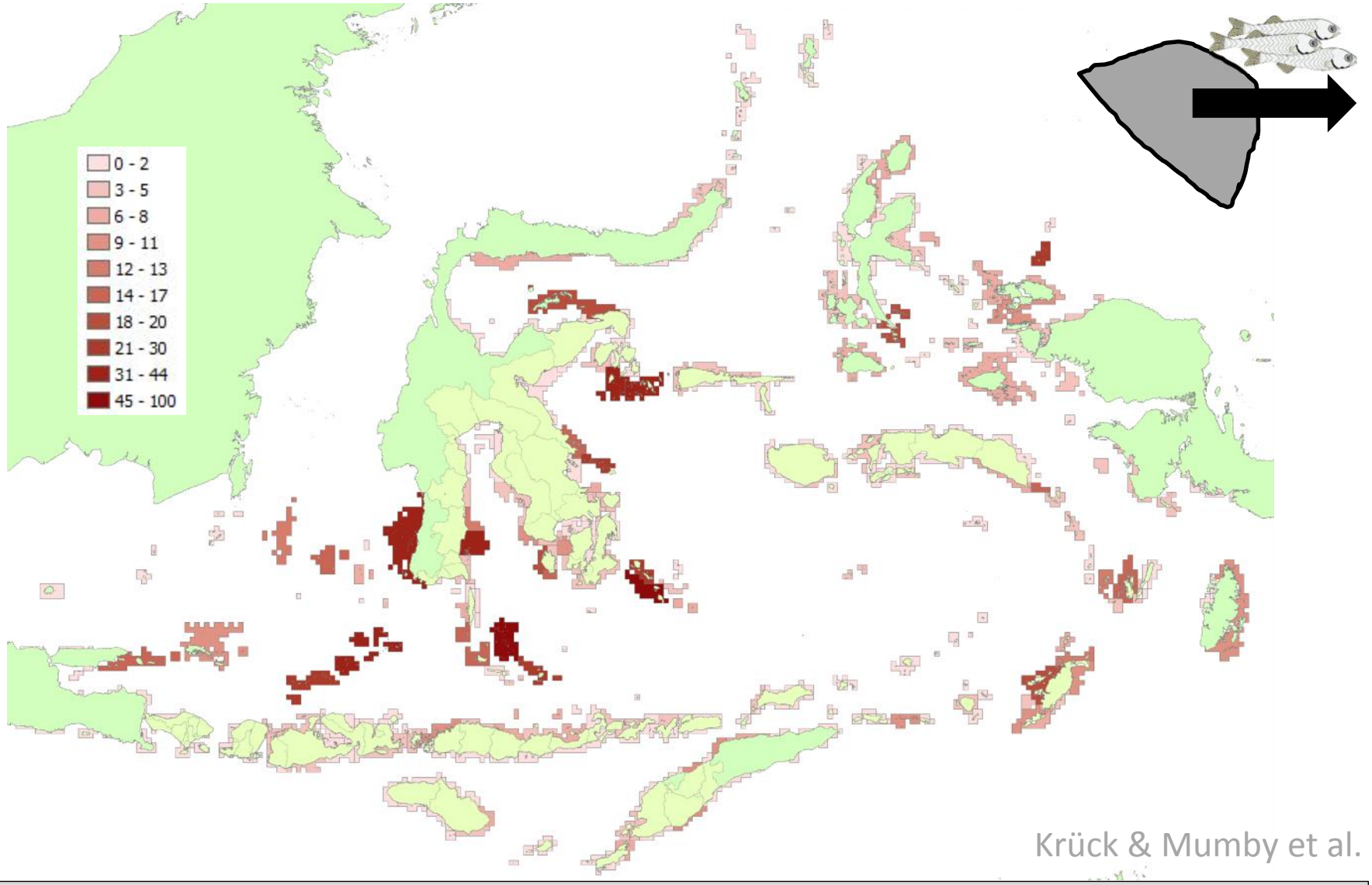
Level of exchange between areas is critical!



Fisheries benefits influenced by connectivity



Sunda Banda, Indonesia
Multi-species larval export ranks



Krück & Mumby et al.

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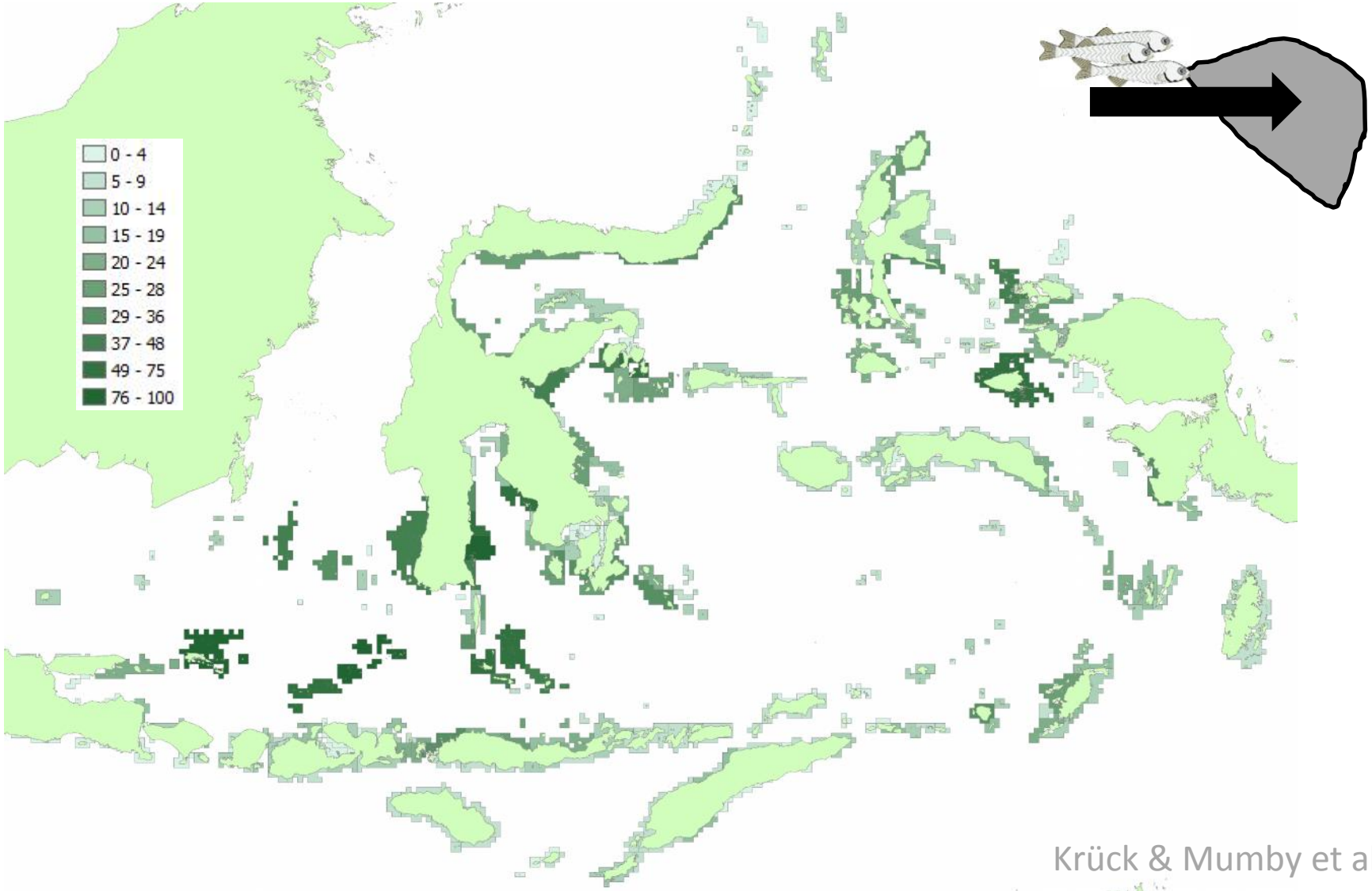
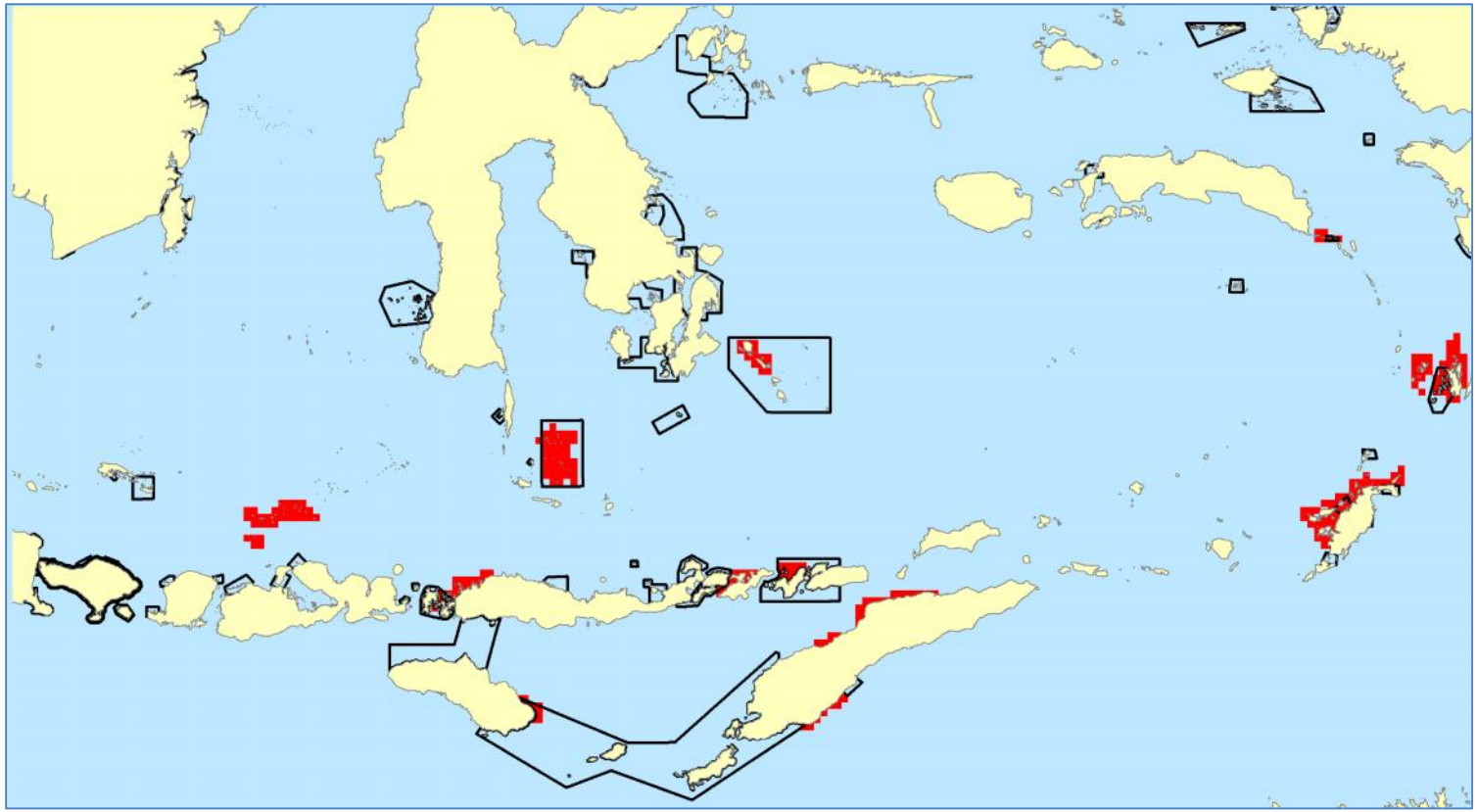


Krück & Mumby et al.

Decision making under uncertainty



Black polygons: Officially declared marine protected areas

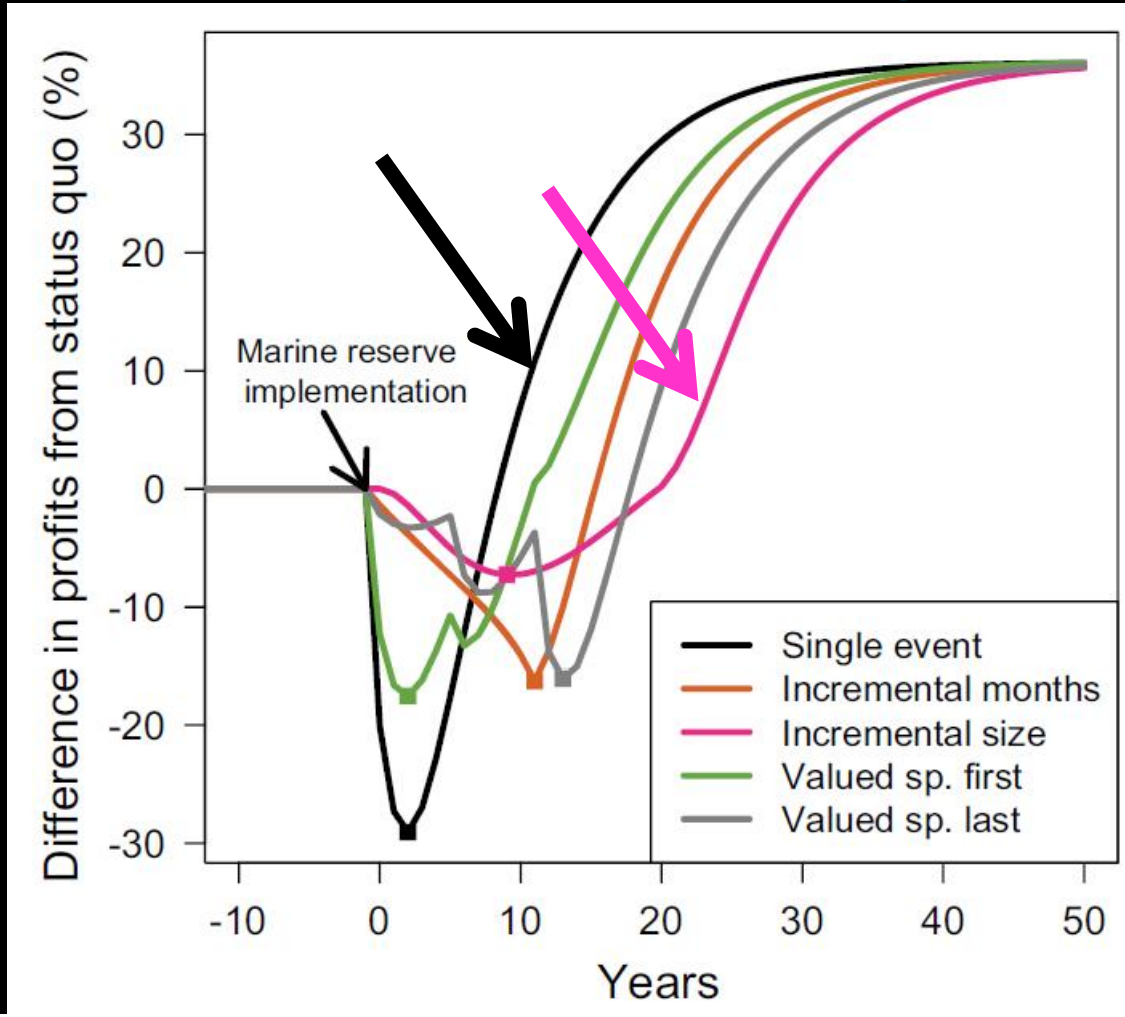
Red polygons: High priority reef areas for both conservation and fisheries

Krück & Mumby et al.

Challenge 3: Time scales

- Long-term benefits of reserves
- But short-term costs can be too high

- Trade-offs in design: gradually increase reserve area (Brown et al 2015)

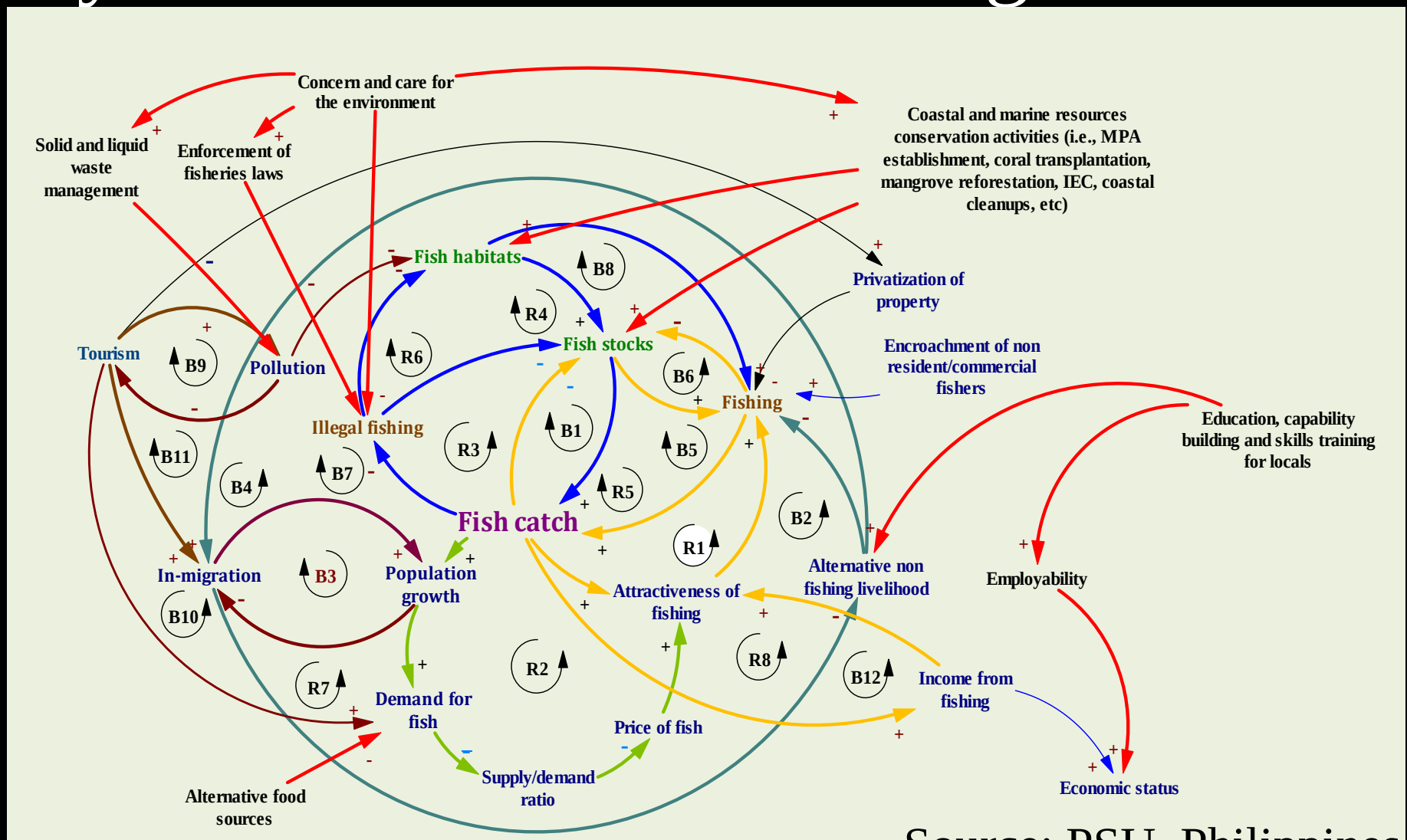


Challenge 4:
Absolute value or relative value?

	Advantages	Disadvantages
Absolute value (e.g., $)		
Relative value (rank #1,2)		

CCRES Approach

1) Stakeholder consultation to develop system-level understanding of issues

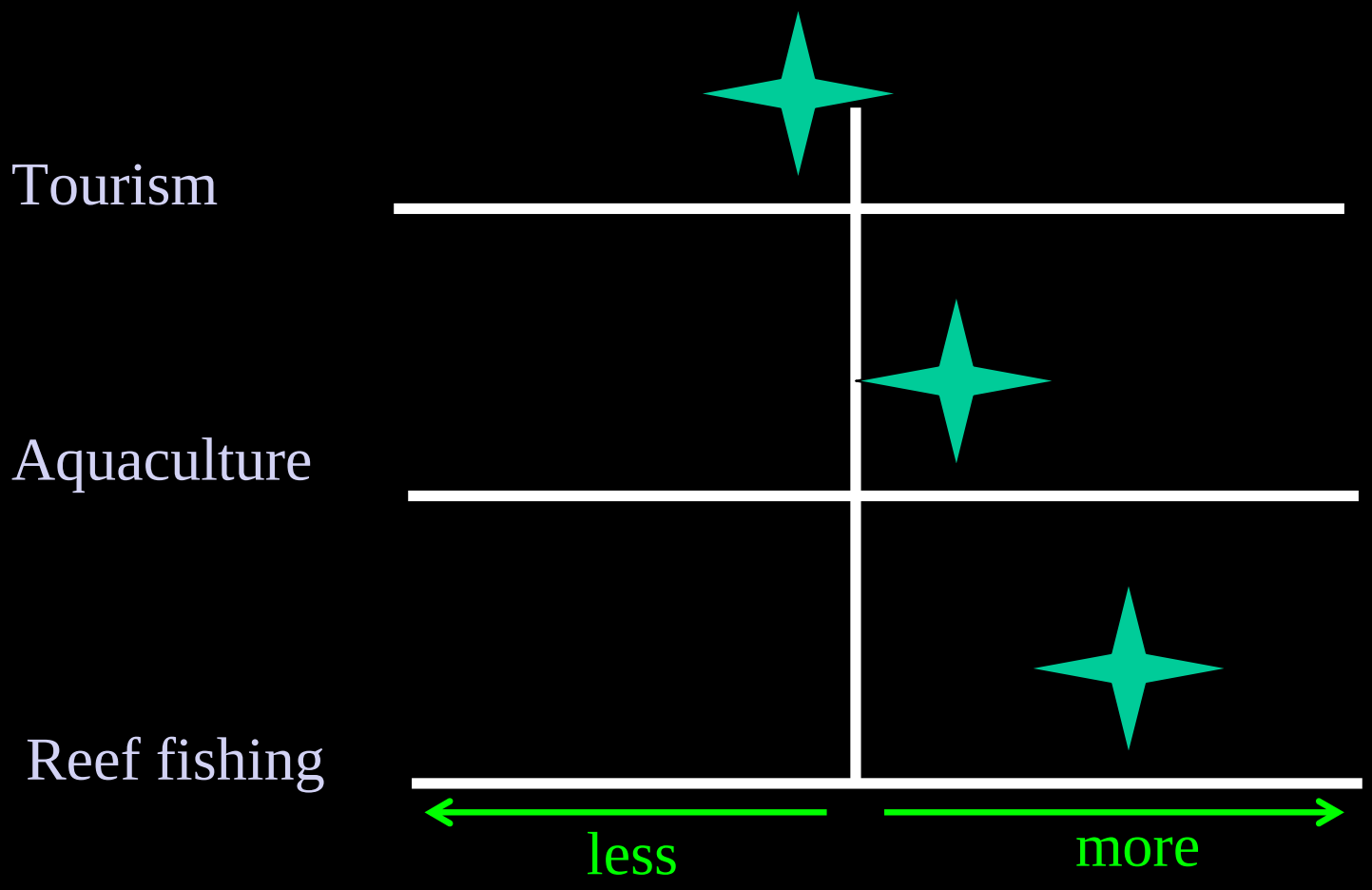


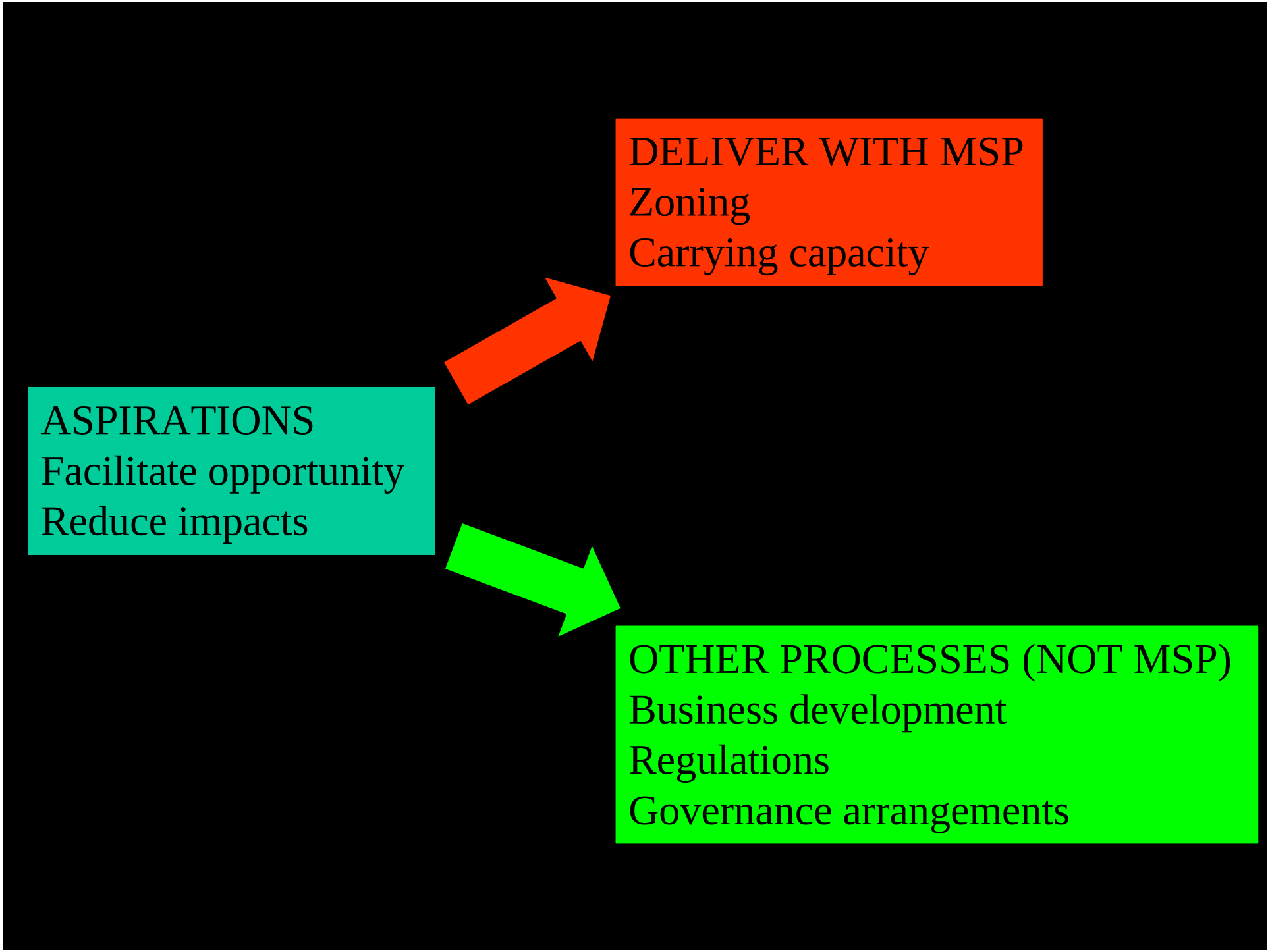
Source: PSU, Philippines

System analysis identifies...

- Major threats and concerns
- Anticipated changes and developments
- New opportunities for livelihoods
- Peoples' aspirations – what do they want to see more vs less of?

Peoples' aspirations




DELIVER WITH MSP
Zoning
Carrying capacity
ASPIRATIONS
Facilitate opportunity
Reduce impacts
OTHER PROCESSES (NOT MSP)
Business development
Regulations
Governance arrangements

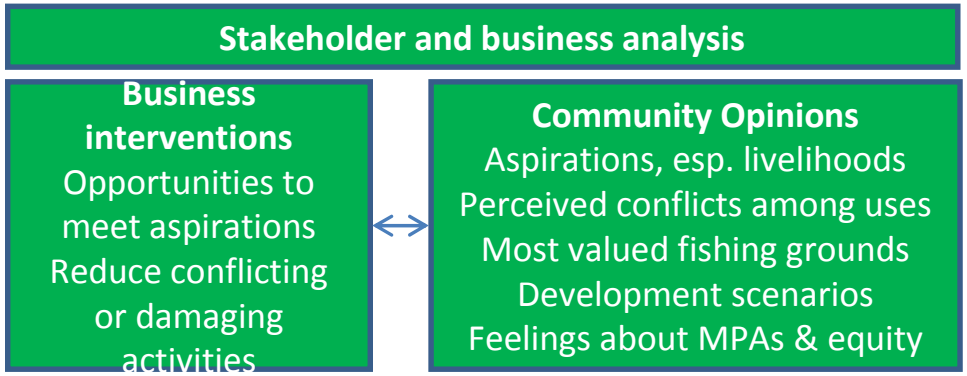
2. Evaluation of business models

- Key focus is whether businesses make profit (i.e., not necessarily about an environmental good)
- New opportunities require sound business model design. Identify opportunities for government and donor agencies
- Example – switch from slash/burn agriculture to agroforestry = economic and environmental benefits to watershed

3. Define MSP objectives

- Stakeholder analysis
- Business needs
- Government policy (e.g., Aichi targets)

4. Iterative approach to evaluate outcomes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Opportunities to meet aspirations
Reduce conflicting or damaging activities
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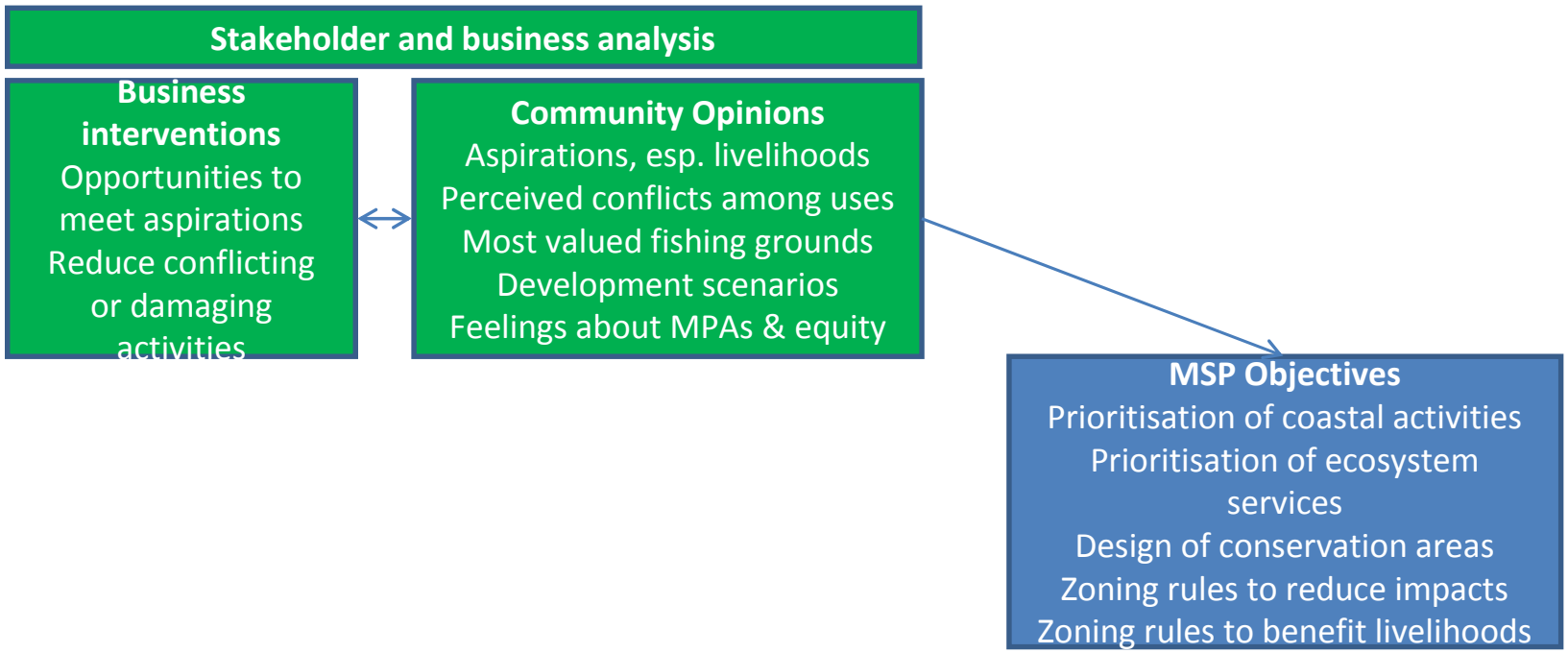
Aspirations, esp. livelihoods
Perceived conflicts among uses
Most valued fishing grounds
Development scenarios
Feelings about MPAs & equity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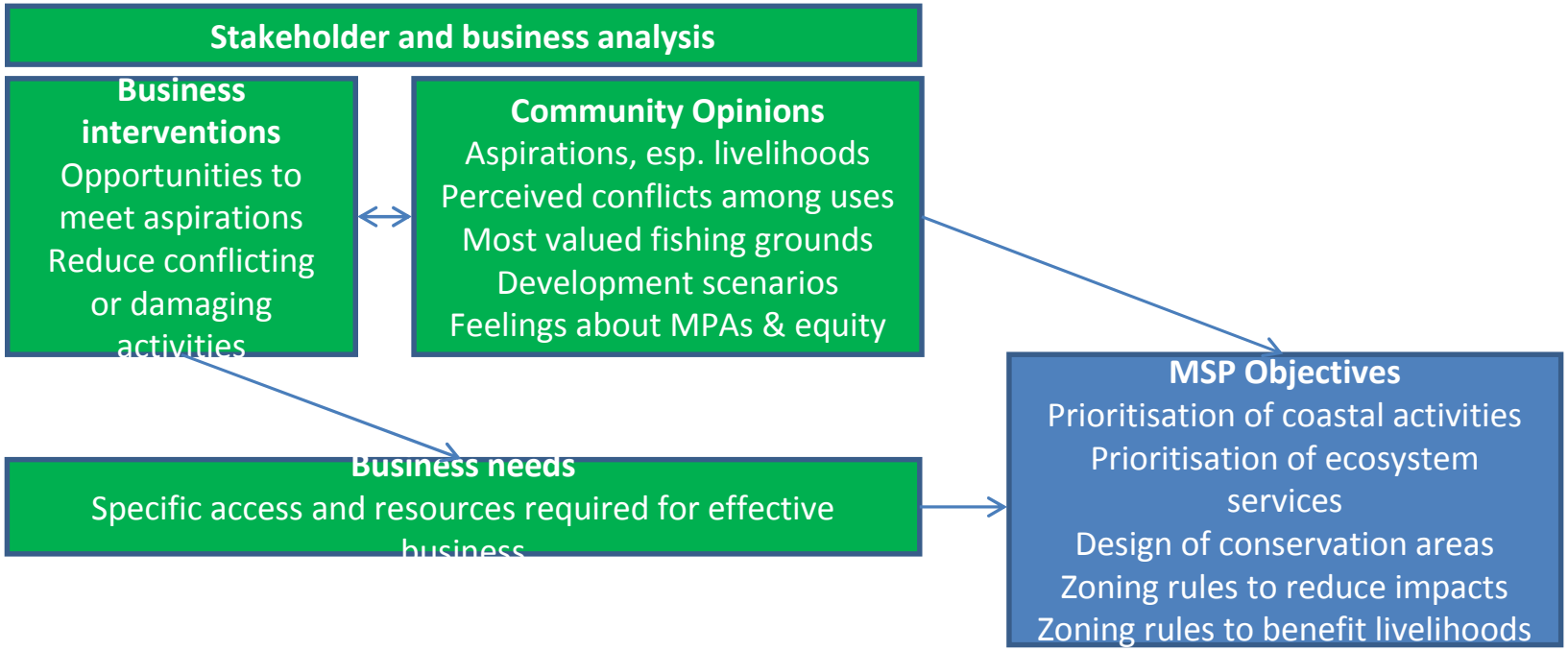
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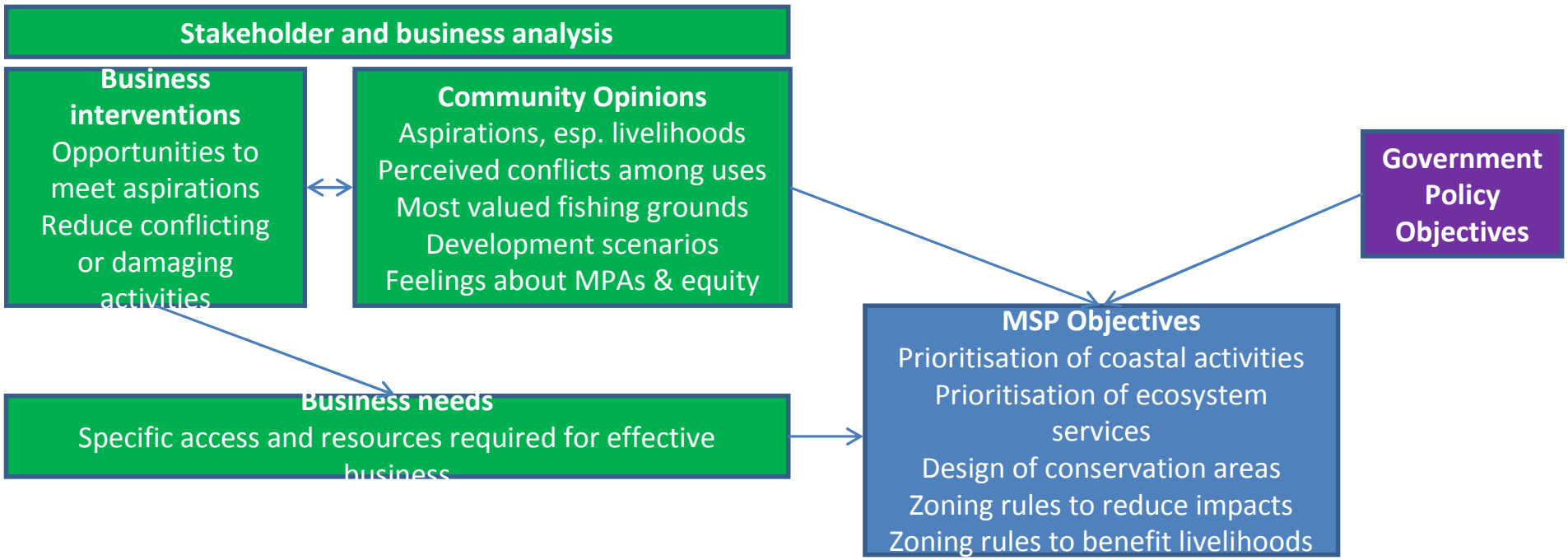
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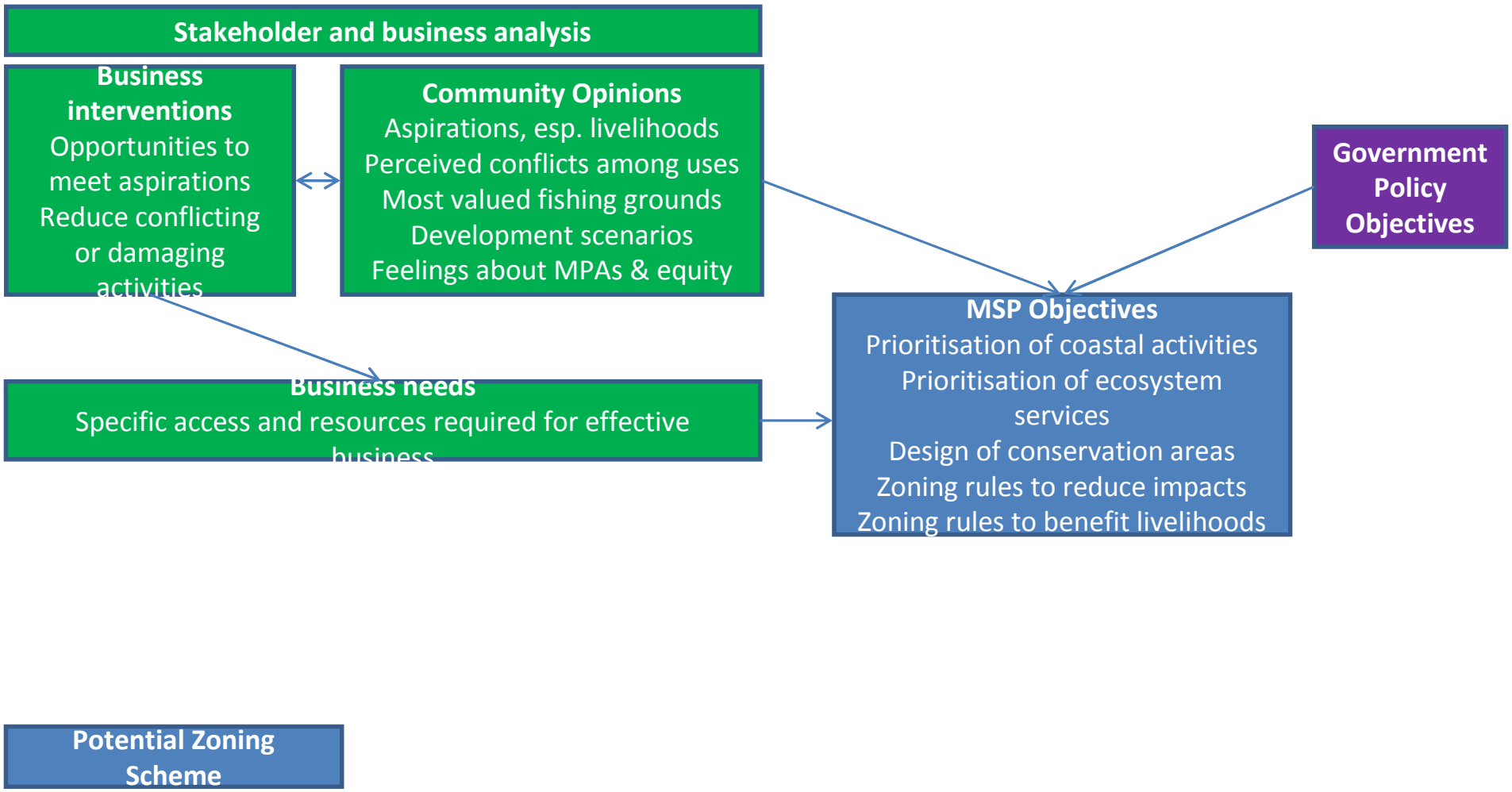
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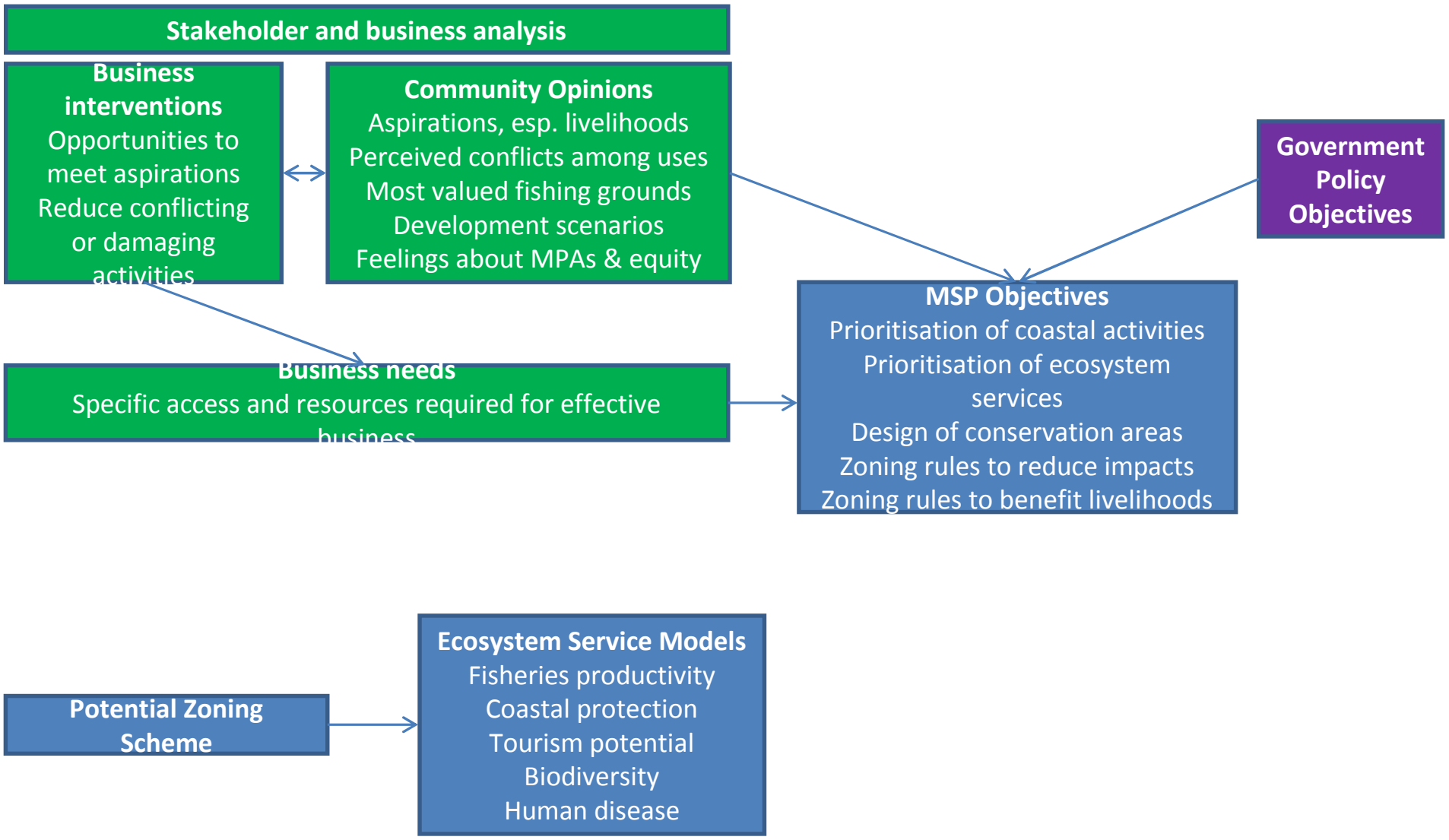
Potential Zoning Scheme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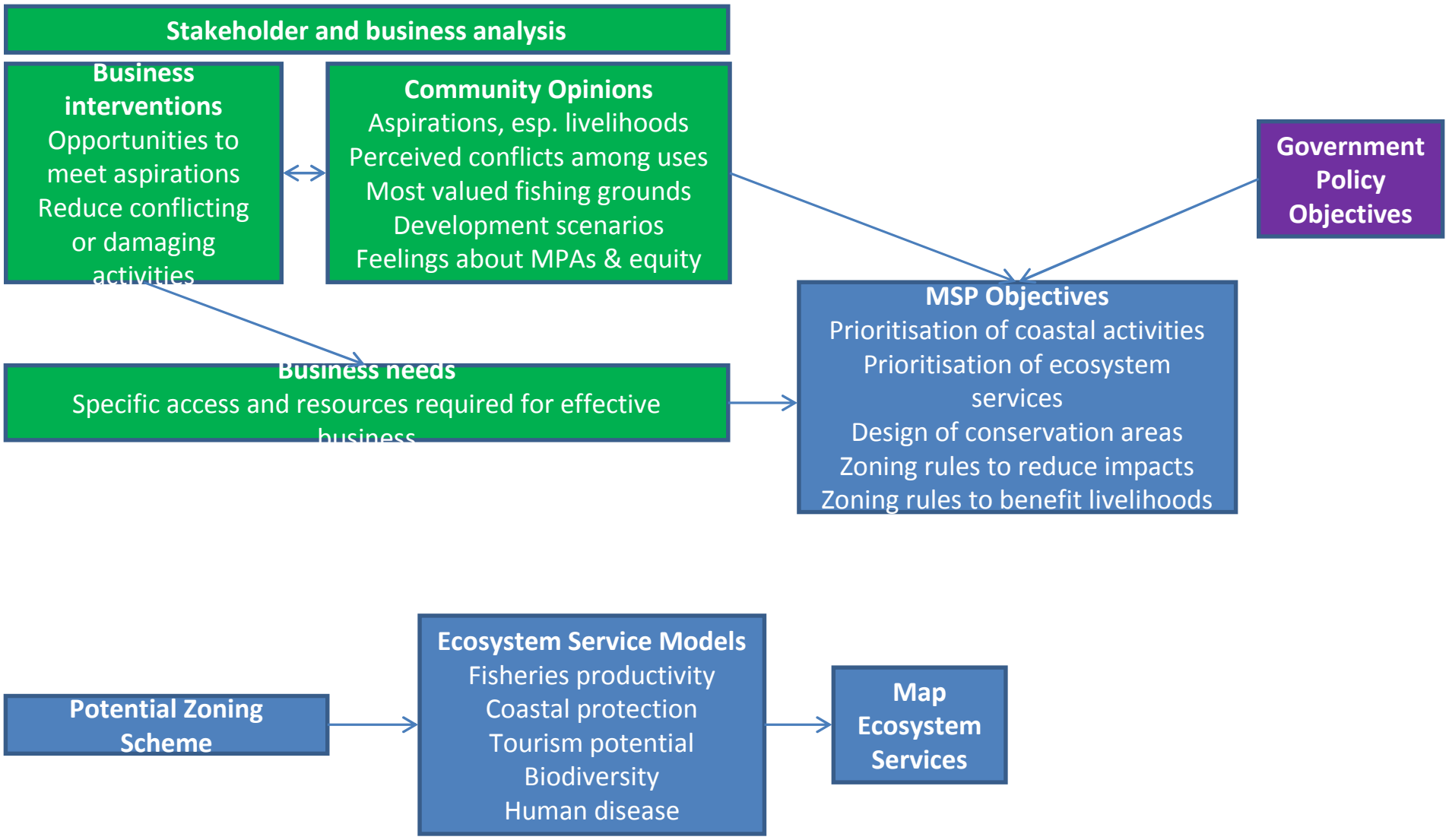
Coastal protection
Tourism potential
Biodiversity
Human disease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Map Ecosystem Services

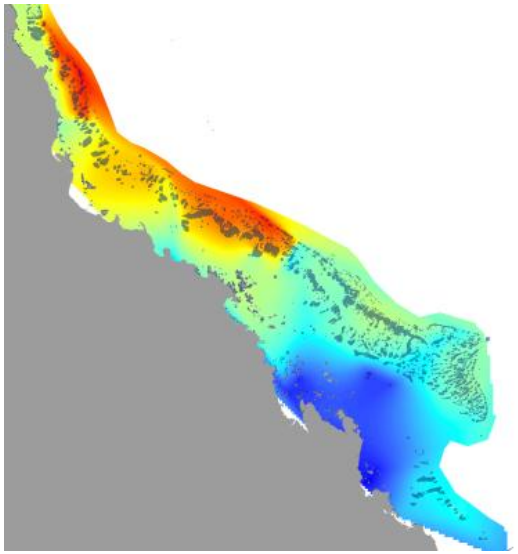
Ecosystem Service Models (example of coastal protection)

Inputs (maps)

1. Reef locations
2. Reef state
3. Bathymetry
4. Waves
5. Relative value / importance of coastal infrastructure
6. Anticipated development
7. Threats outside of MSP influence (e.g., climate change, runoff)
8. Threats within MSP influence (blasting, dredging)
9. Potential zoning scheme

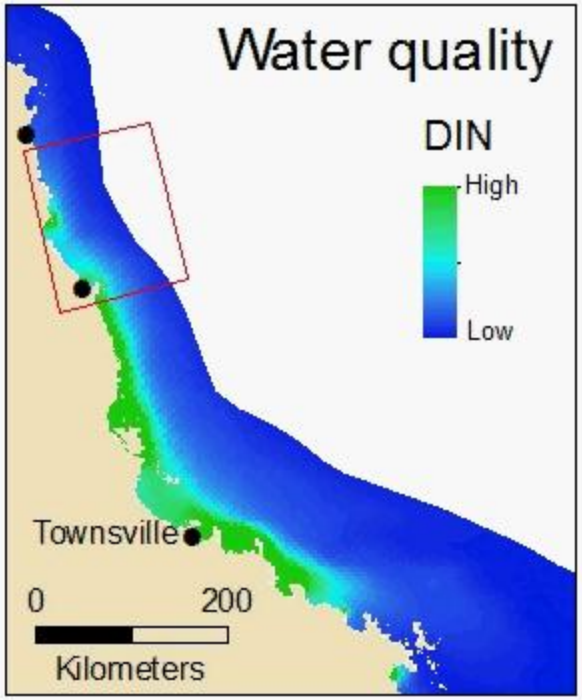
Model algorithm

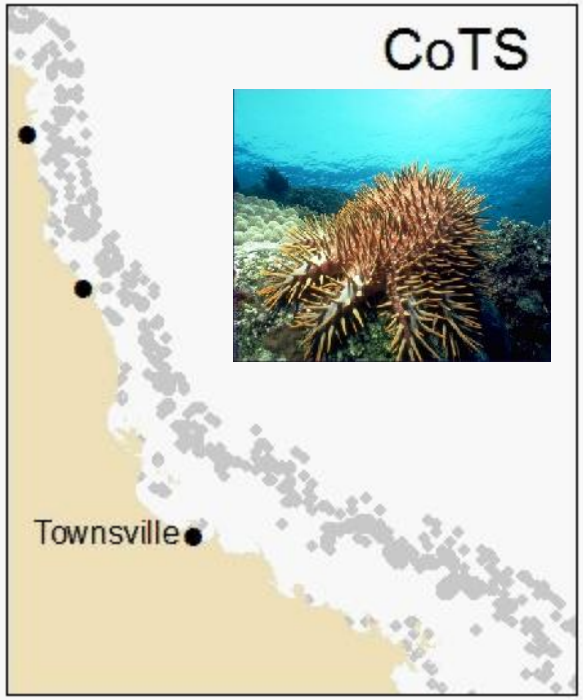
Map of Ecosystem Service

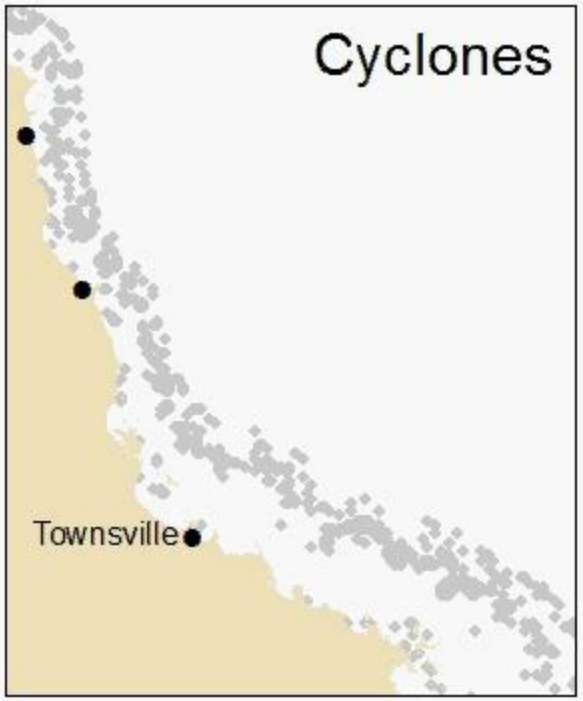


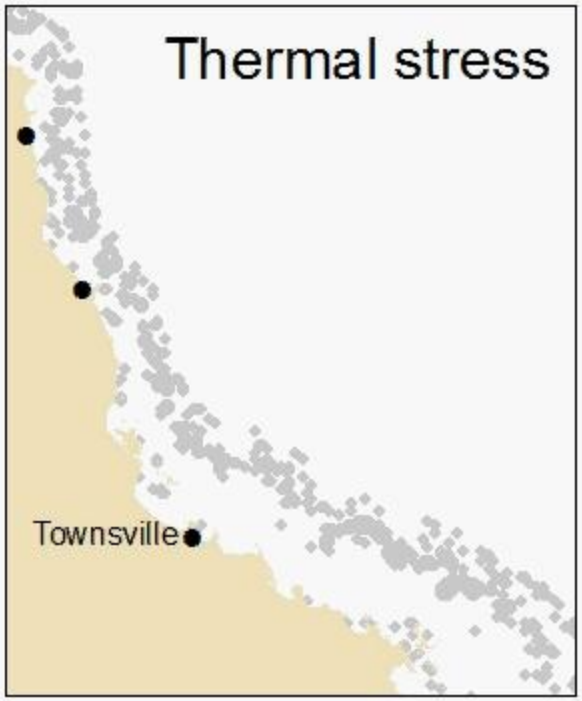
Mapping reef vulnerabilities

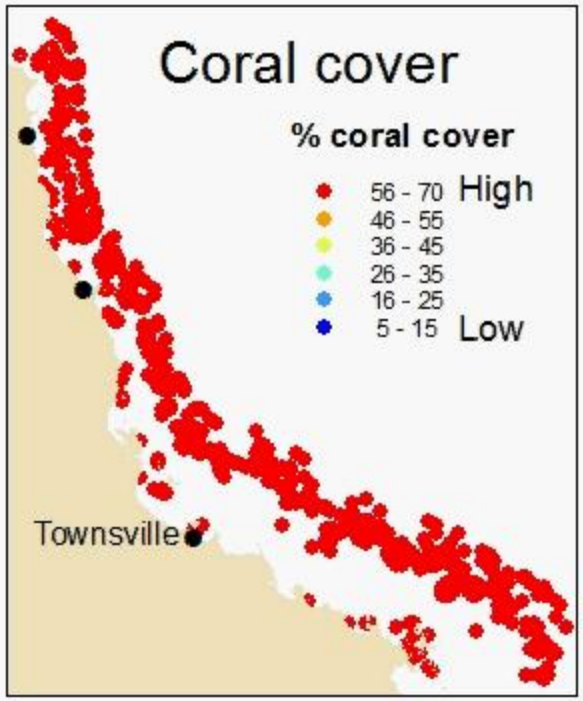
Sedimentation
Blasting likelihood
Fishing intensity
Climate change impacts on coral
Cyclones or major storms
Nutrient impacts on coral growth and crown-of-thorns starfish

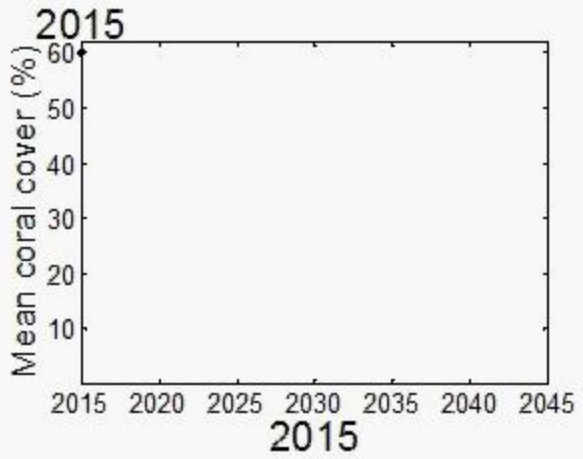

Water quality
DIN
High
Low
Townsville
0
200
Kilometers

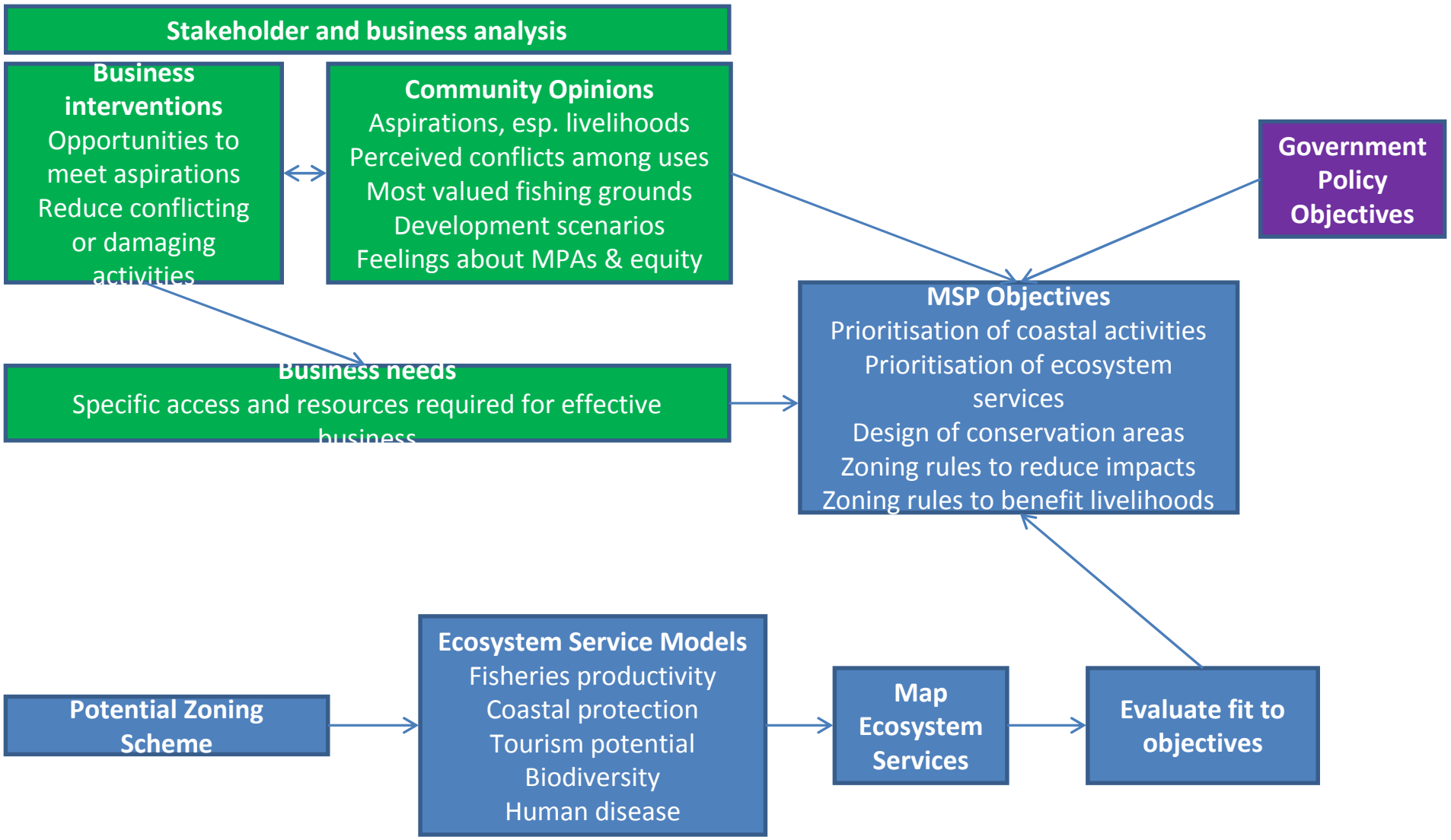

CoTS
Townsville


Cyclones
Townsville


Thermal stress
Townsville


Coral cover
% coral cover
56 - 70 High
46 - 55
36 - 45
26 - 35
16 - 25
5 - 15 Low
Townsville


2015
Mean coral cover (%)
60
50
40
30
20
10
2015
2020
2025
2030
2035
2040
2045
2015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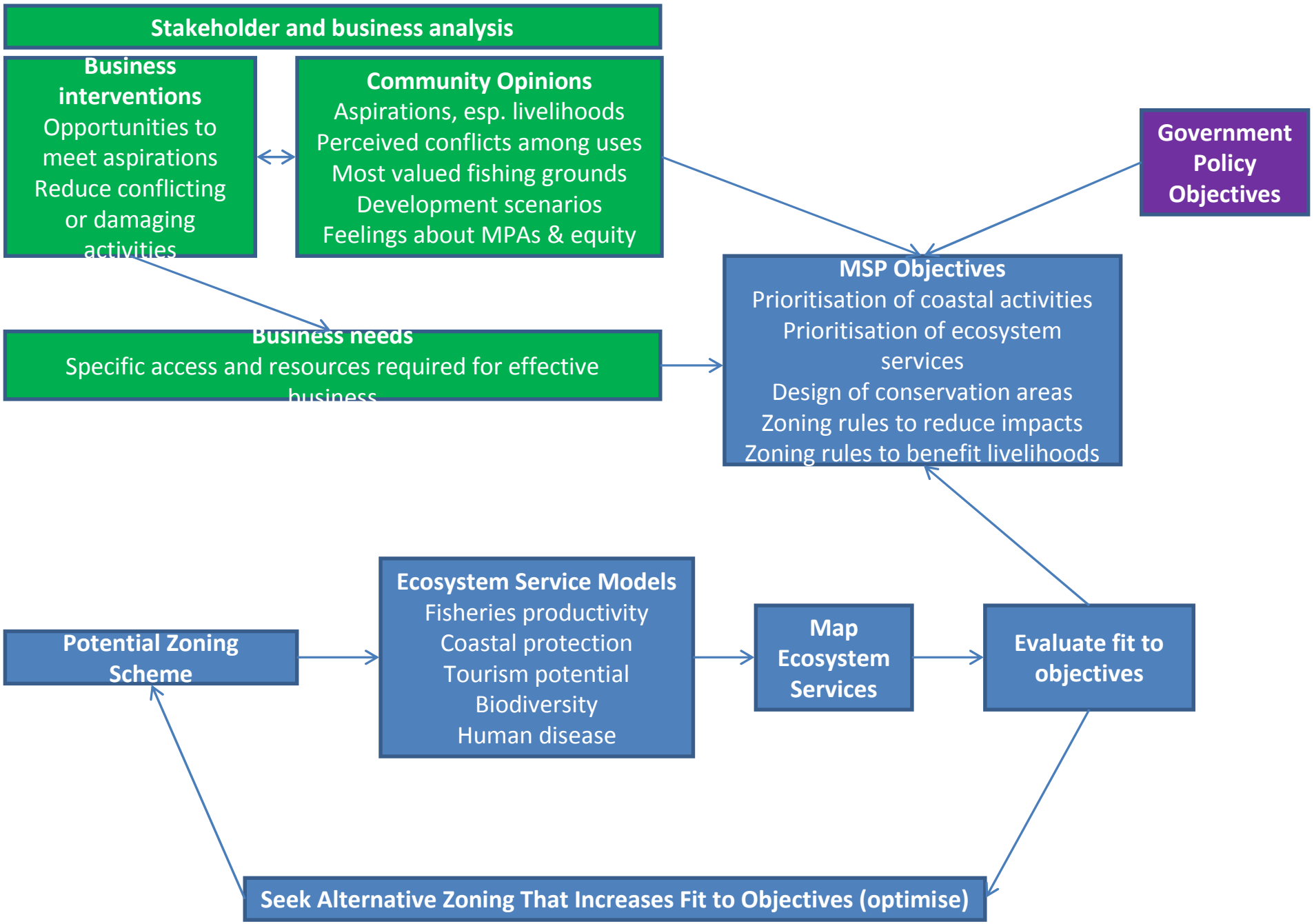
Evaluate fit to objectives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Map Ecosystem Services
Evaluate fit to objectives
Seek Alternative Zoning That Increases Fit to Objectives (optimise)

5. Analysis

- Is it feasible to meet aspirations?
- What trade-offs might need to be made?

Novelty

- Use of stakeholder analysis to identify objectives
- Considers role of business (e.g., forestry) in meeting objectives and knock-on implications for MSP
- Identifies intervention points for policy
- Dynamic approach, not just scenario-based
- Algorithms / approach available for incorporation within other tools (e.g., InVEST)

Major continuing challenges

- Tractability vs sophistication
- Use models of varying complexity (InVEST approach) or
- Categorise seascapes and pick model from closest library
- Sophistication will increase over time
- Requires critical review of data requirements for MSP (burden)
- Networking practitioners is vital