SAC-08-07a

Ecosystem considerations in the eastern Pacific Ocean

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CIAT
IATTC

8ª Reunión del Comité Científico Asesor
8th Meeting of the Scientific Advisory Committee

Ecosystem Group papers

1) **Ecosystem considerations**

- Addressing ecosystem-related mandates now and in the future
- Strategic direction for the ecosystems group

2) **Metadata analysis of the EPO Large-scale Tuna Longline Fishery**

- Type and quality of data available for ERA (SAC-08-07b)

3) **Ecological risk assessment method development**

- Establishing scientifically defensible ERA standards using PSA (SAC-08-07c)

4) **Preliminary PSA for the EPO longline fishery**

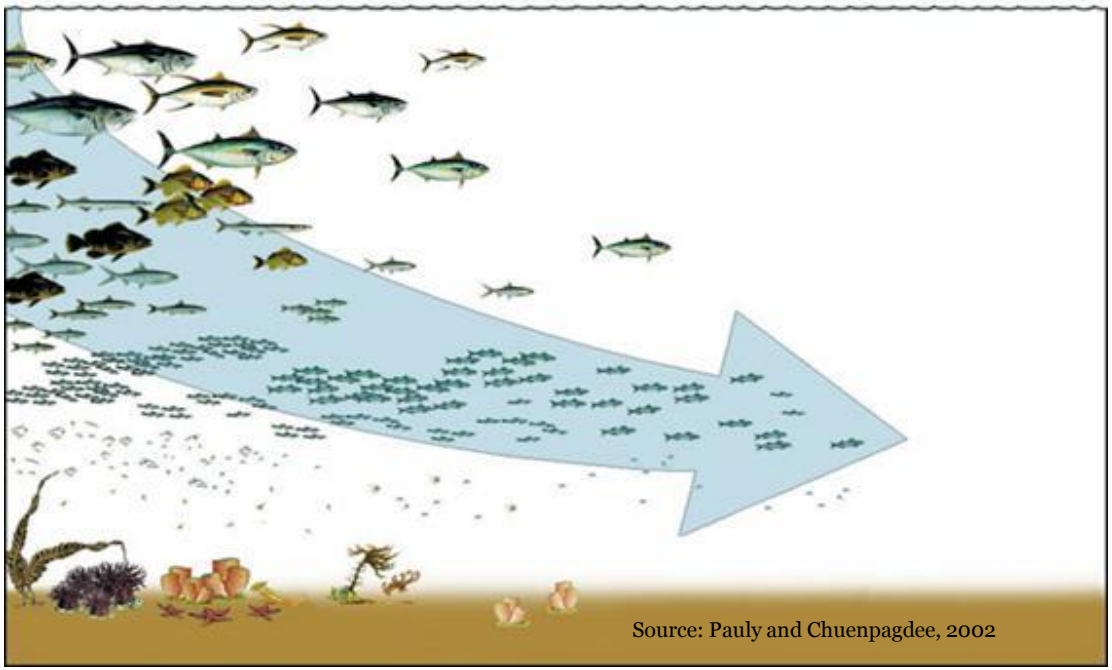
- Identify vulnerable species and prioritize research (SAC-08-07d)

5) **Status of data reporting from longline observer programs**

- Proposal of observer data fields to support IATTC research & assessments (SAC-08-03d)

Fishing on Ecosystems

- Over the past decade there have been concerns that apex predators worldwide are being depleted by fishing.
- “Fishing down the food web” changes the structure and function of marine ecosystems.
- Even if fishing of target species is biologically sustainable, large biomass removals may still upset ecosystem function (e.g. Polivina et al. 2009).



EBFM

- Ecosystem Based Fisheries Management (EBFM) attempts to address such concerns by placing fishing in a broader ecological perspective
- IATTC proactive in pursuing EBFM and ecological sustainability of EPO fisheries through the Antigua Convention and recent resolutions
  - DMLs
  - Monitoring catches on incidentally caught species (purse seine)
  - Resolutions pertaining to bycatch species (e.g. silky shark, Mobulid rays)
  - Supporting research on trophic ecology (Olson and Duffy)
  - Development of ecosystem model of the ETP (Olson and Watters)
  - Exploring ecological risk assessment

IATTC Mandates

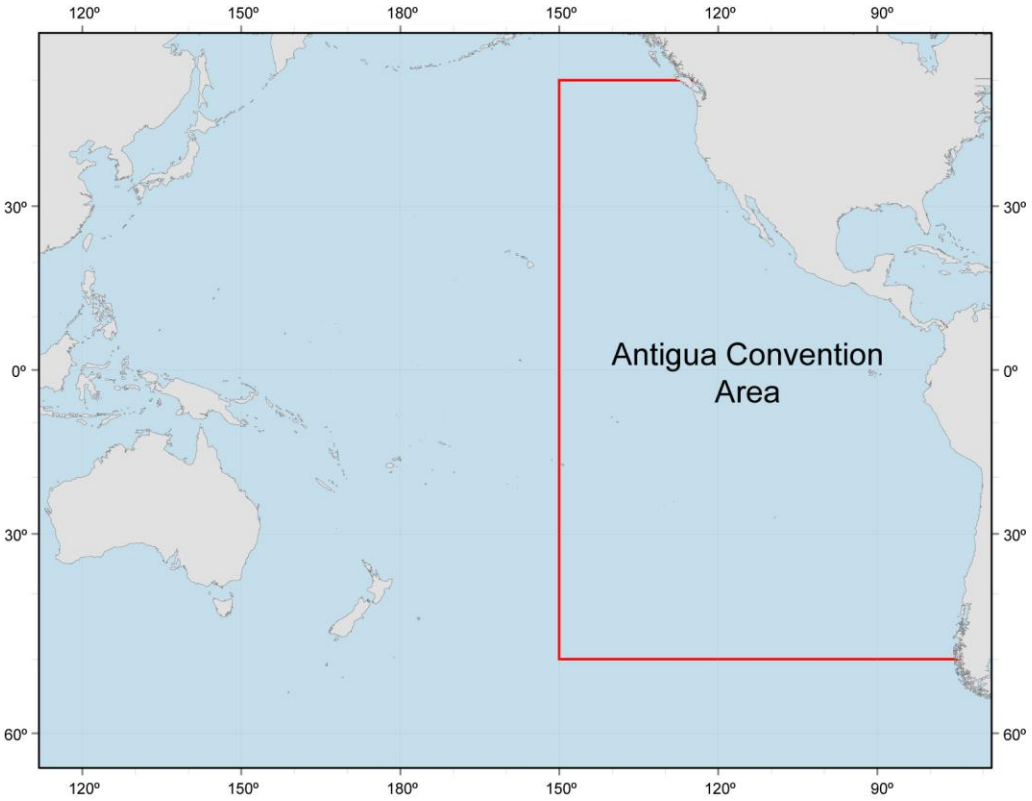
- Under the Antigua convention, the IATTC is responsible for ensuring the "*long-term conservation and sustainable use of the stocks of tunas and tuna-like species and other associated species of fish taken by vessels fishing for tunas and tuna-like species in the eastern Pacific Ocean (EPO)*"

- Article IV. "*Where the status of target stocks or non-target or associated or dependent species is of concern, the members of the Commission shall subject such stocks and species to enhanced monitoring in order to review their status and the efficacy of conservation and management measures. They shall revise those measures regularly in the light of new scientific information available.*"

- Article VII. "*adopt, as necessary, conservation and management measures and recommendations for species belonging to the same ecosystem and that are affected by fishing for, or dependent on or associated with, the fish stocks covered by this Convention, with a view to maintaining or restoring populations of such species above levels at which their reproduction may become seriously threatened*"

Ecological sustainability

- **But**, ecological sustainability is difficult and expensive to demonstrate.
- IATTC Convention Area covers ~55 million km^2
- Temperate, sub-tropical and tropical ecosystems
- Coastal, sea mount and oceanic (epipelagic and mesopelagic) habitats
- National jurisdictions and ABNJ

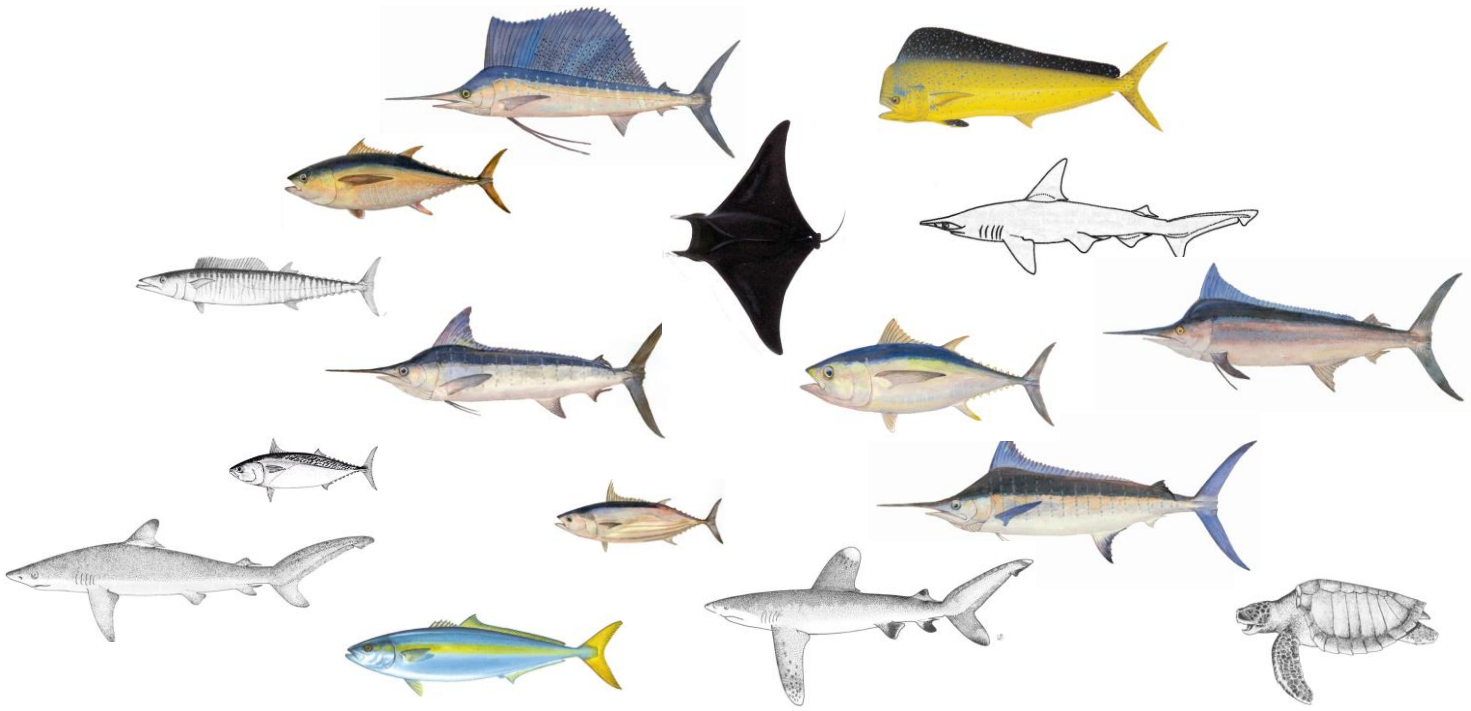


Ecological sustainability

- EPO fisheries are diverse:
  - Purse seine (Class 6; Class 1-5)
  - Large scale tuna longline (“high-seas”, “distant-water”)
  - Artisanal (longline, gillnet)
  - Troll
  - Harpoon
  - Recreational

Ecological sustainability

- A large number of species interactions across EPO fisheries
- Many species caught incidentally - “byproduct” & “bycatch” (discards)
- Many species caught infrequently, have little economic value, poor reporting, or recorded in broad taxonomic groups (e.g. “sharks”).
- Lack basic biological and ecological data for quantitative assessment



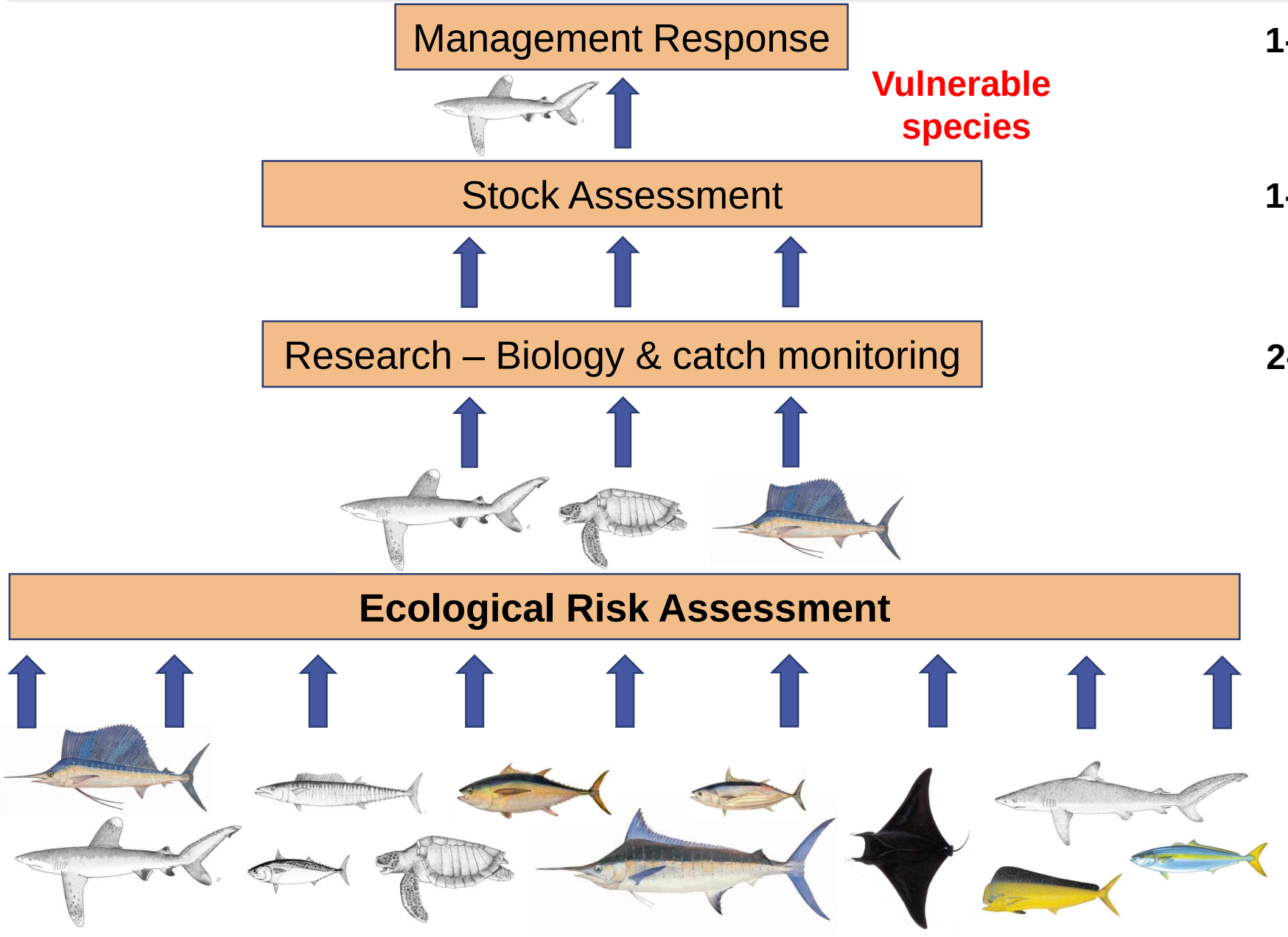
Assessing ecological sustainability

Management Responses — 1-3 yrs — $$$

Stock Assessment — 3-5 yrs — $$$

Research – Biology & catch monitoring — 5-10 yrs — $$$$

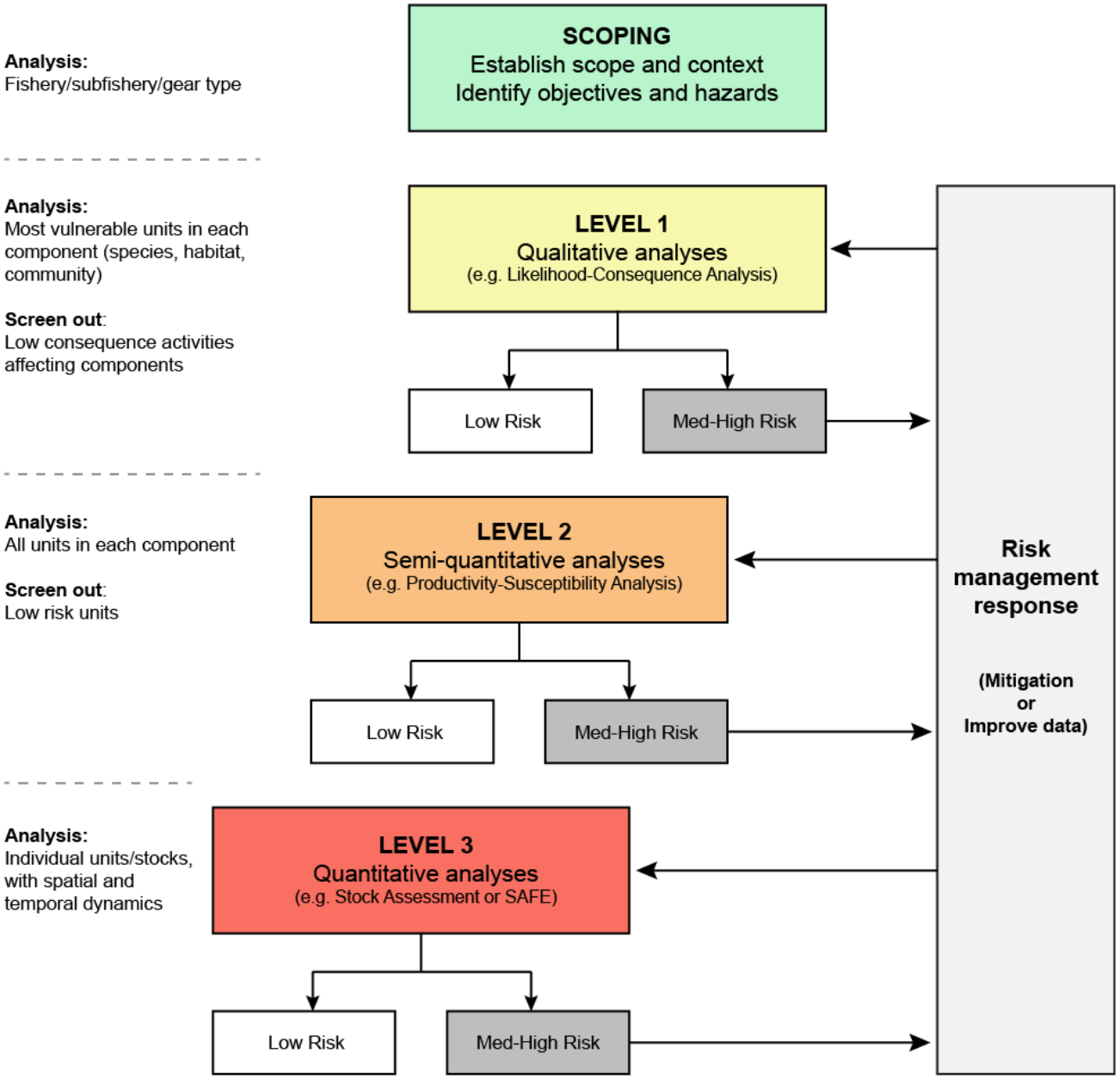
Assessing ecological sustainability



Strategic direction for Ecosystem Group

- Pursuing EBFM is necessary, but a long and expensive process
- IATTC staff cannot study/monitor everything with existing resources
- But, IATTC needs a long-term strategy to fill data gaps and develop methods to assess and monitor the ecosystem both now and in future.
- 5 year IATTC research strategic plan in development
- As a starting point, the ecosystems group plans to adopt the *Ecological Risk Assessment for the Effects of Fishing* (ERAEF) framework, proposed by Hobday et al. (2011)

ERAEF Framework



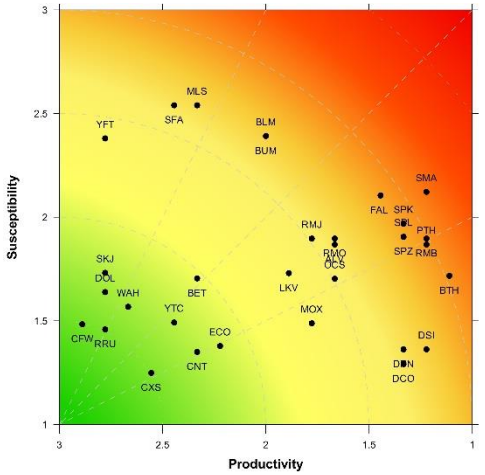
Methods for assessing ecological sustainability

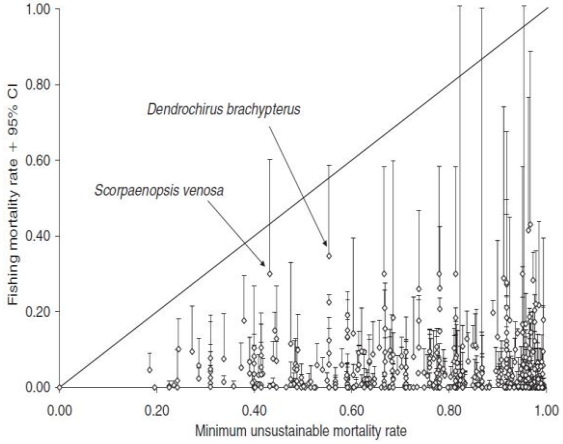
- Likelihood-Consequence Analysis (t-RMFO FAO ABNJ)
- Qualitative risk matrices
- Fuzzy-logic expert systems
- **Productivity-Susceptibility Analysis**
  - Rapid, inexpensive, minimal data required
  - Can assess many species
  - Used worldwide – esp. tuna fisheries (e.g. WCPFC, IOTC, ICCAT)
- Sustainability Assessment for Fishing Effects (SAFE)

Qualitative

Quantitative

		Consequence					
		Negligible	Minor	Moderate	Severe	Major	Catastrophic
Likelihood		0	1	2	3	4	5
Remote	1	0	1	2	3	4	5
Rare	2	0	2	4	6	8	10
Unlikely	3	0	3	6	9	12	15
Possible	4	0	4	8	12	16	20
Occasional	5	0	5	10	15	20	25
Likely	6	0	6	12	18	24	30





Productivity-Susceptibility Analysis (PSA)

- **Vulnerability** – potential for the productivity of a stock to be diminished by direct and indirect fishing pressure. A combination of a stock's productivity and its susceptibility to capture in a fishery.

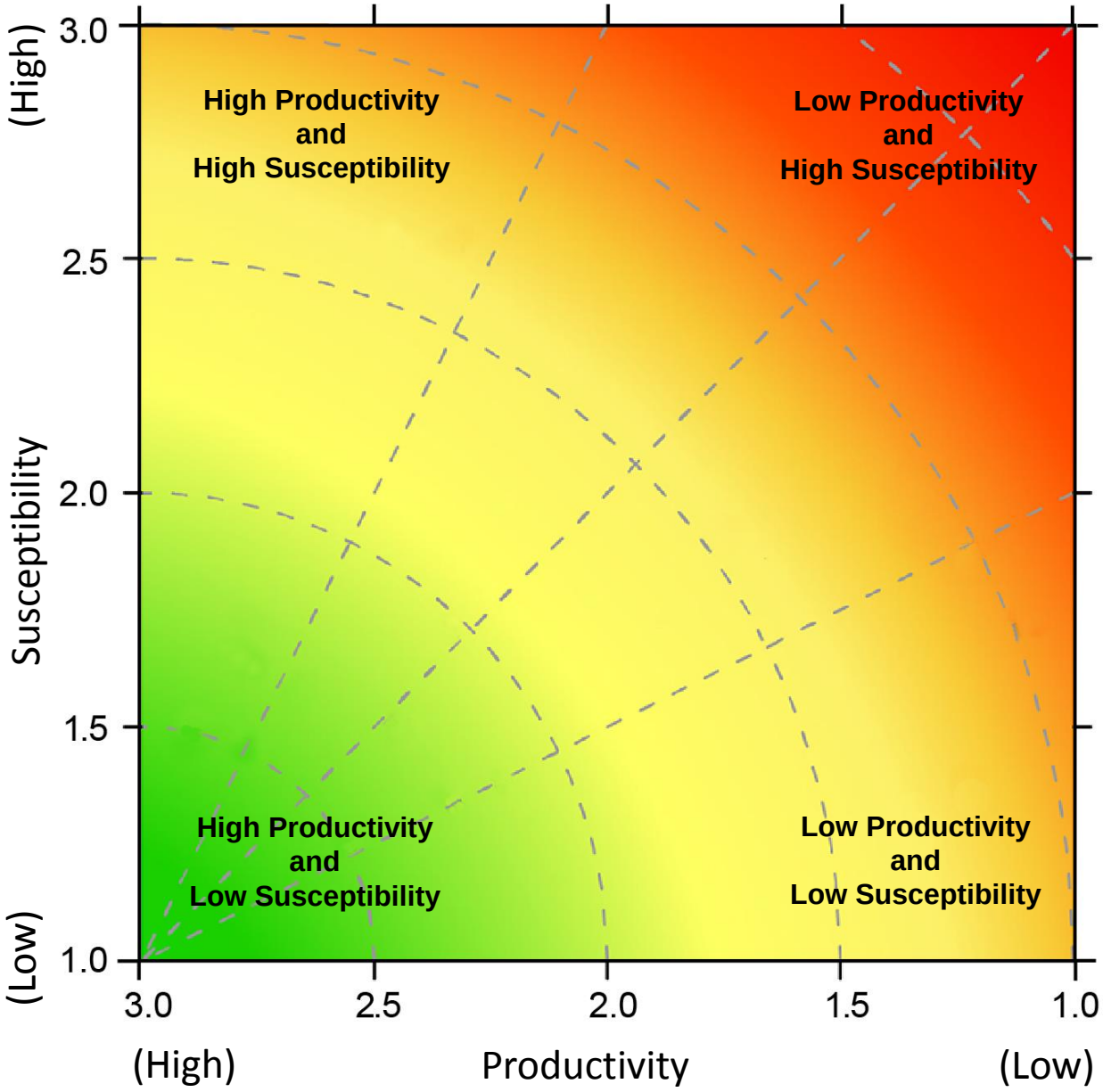
- **Productivity** – capacity to recover if stock is depleted - function of life history characteristics (e.g. longevity, growth rate)

- **Susceptibility** – propensity of species to be captured by, and incur mortality from, a fishery (e.g. gear encounterability, selectivity)

Stobutzki, I.C., Miller, M.J., and Brewer, D.T. 2001. Sustainability of fishery bycatch: a process for assessing highly diverse and numerous bycatch. Environmental Conservation 28: 167-181.

Patrick, W.S., P. Spencer, J. Link, J. Cope, J. Field, D. Kobayashi, P. Lawson, T. Gedamke, E. Cortés, O. Ormseth, K. Bigelow, and W. Overholtz. 2010. Using productivity and susceptibility indices to assess the vulnerability of United States fish stocks to overfishing. Fish. Bull. 108: 305-322.

Example PSA results plot



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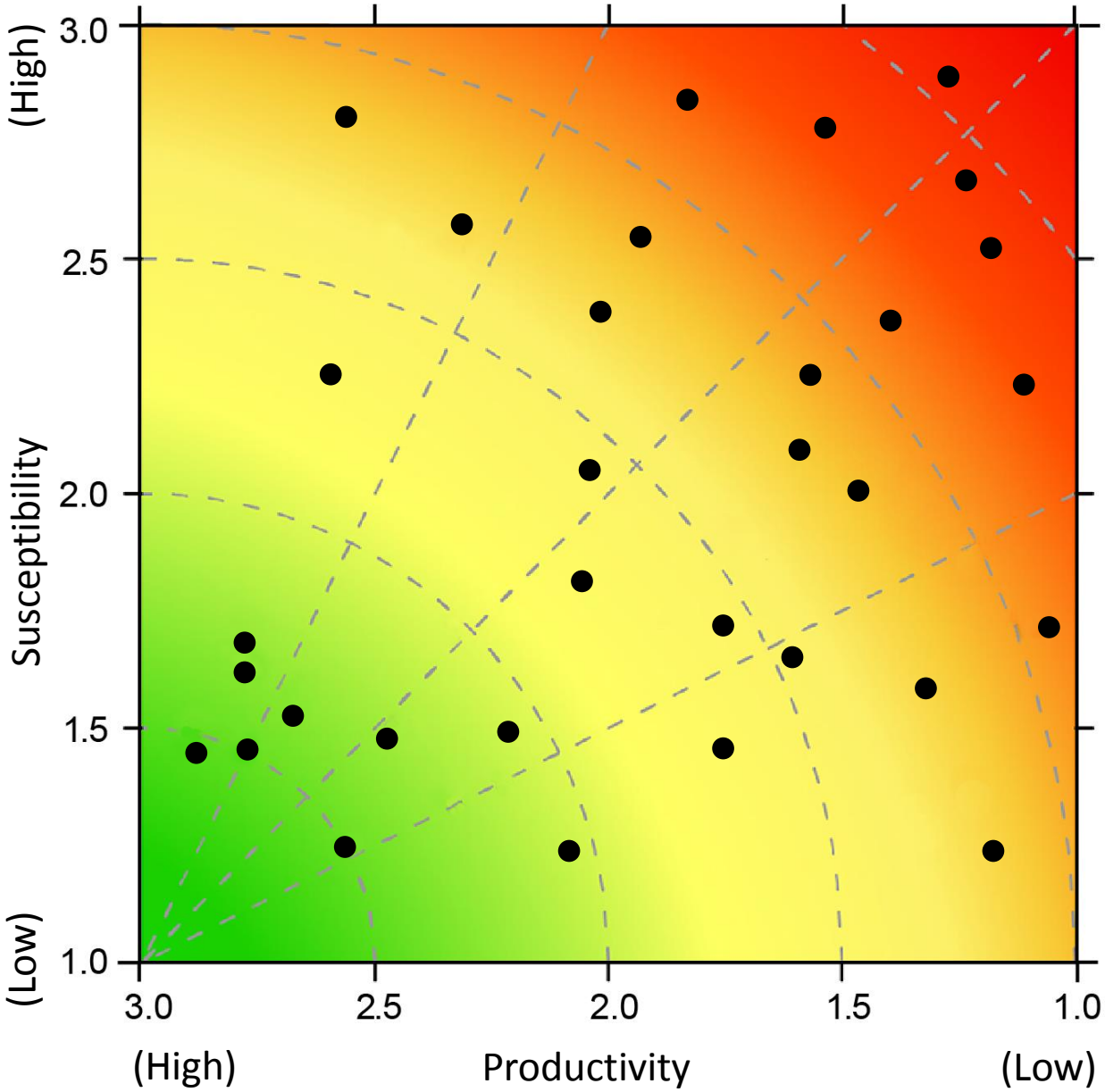

Vulnerability (v) is measured as Euclidean distance from plot origin

$$v = \sqrt{(p-3)^2 + (s-1)^2}$$

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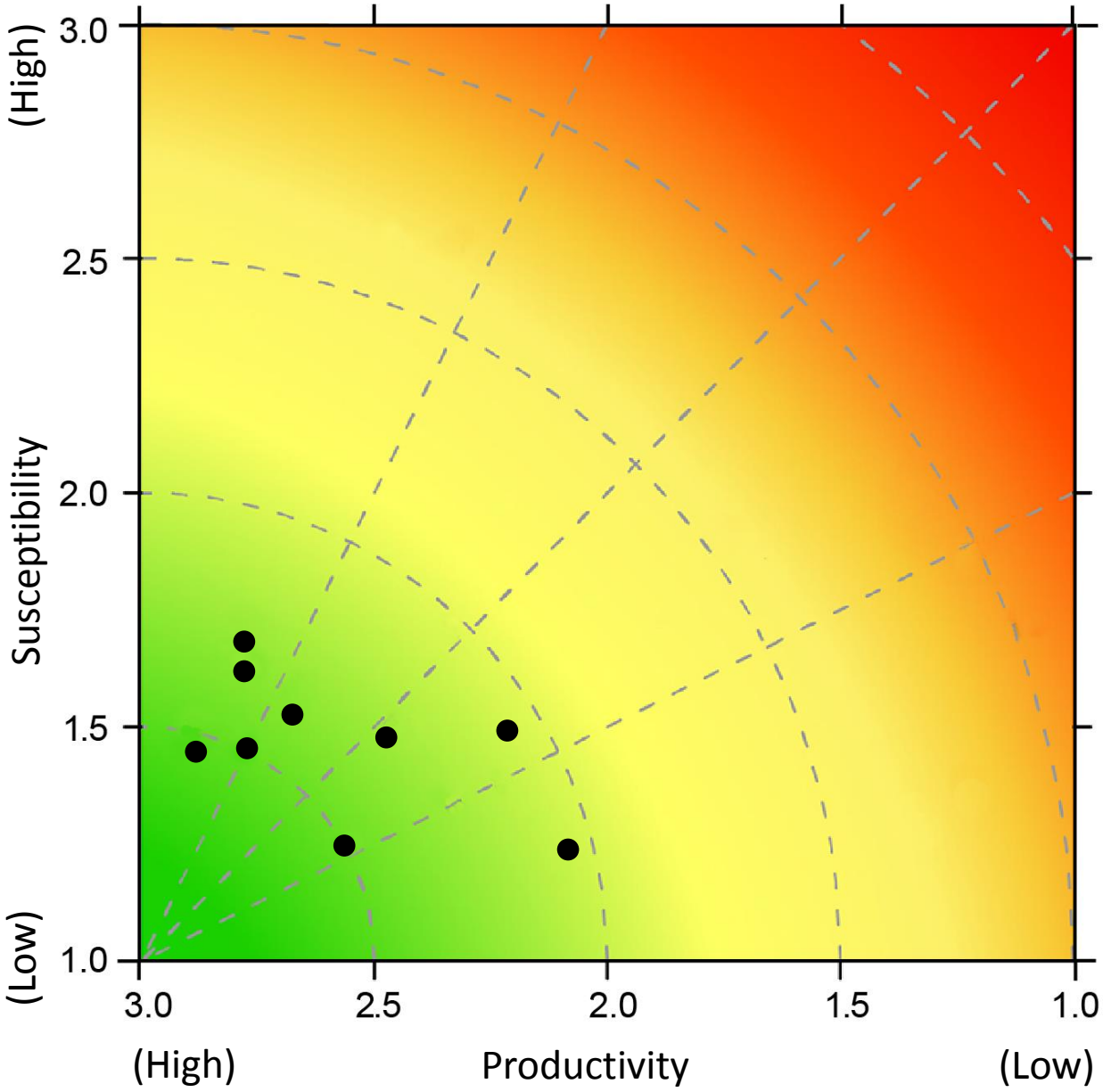

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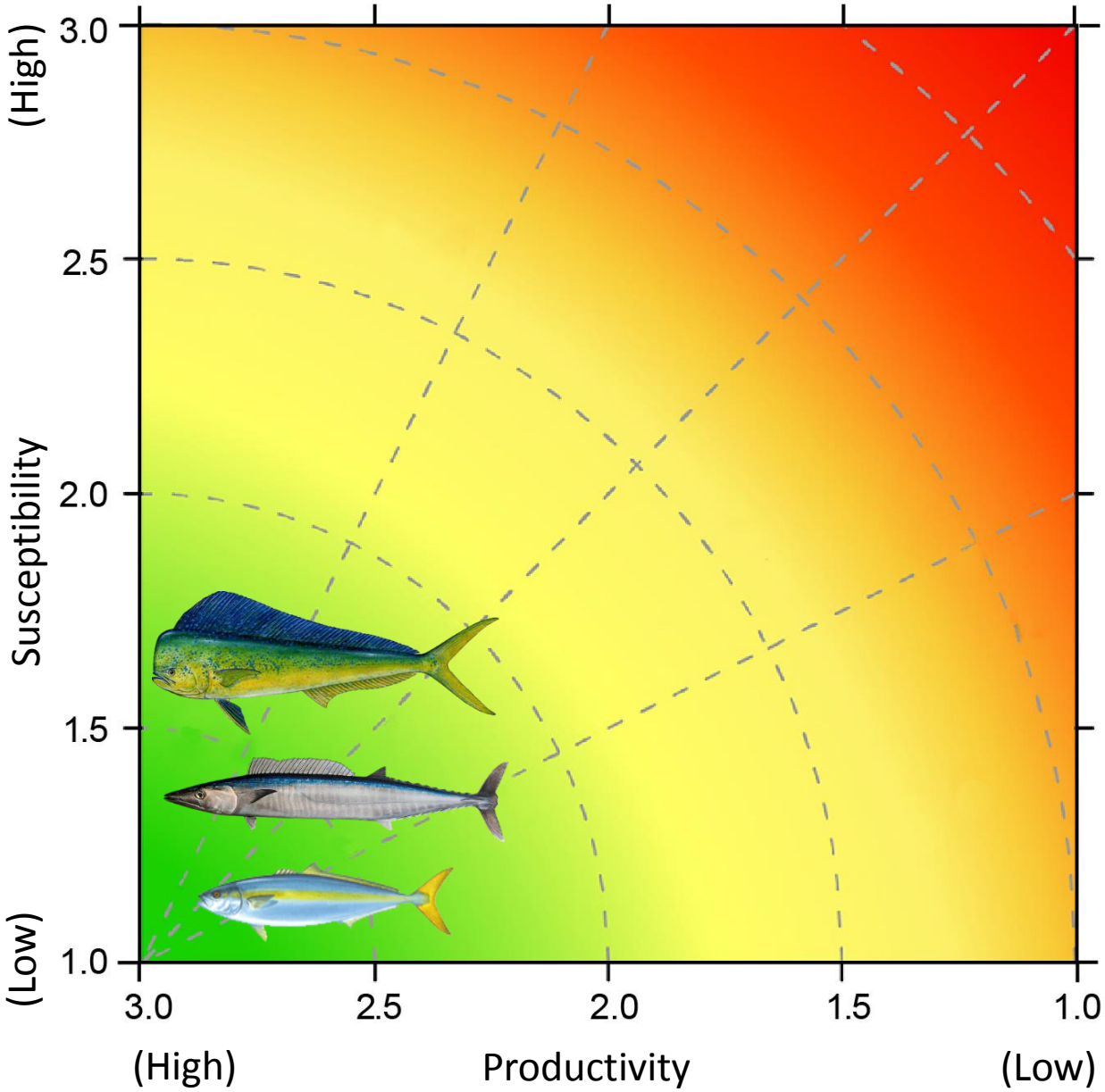

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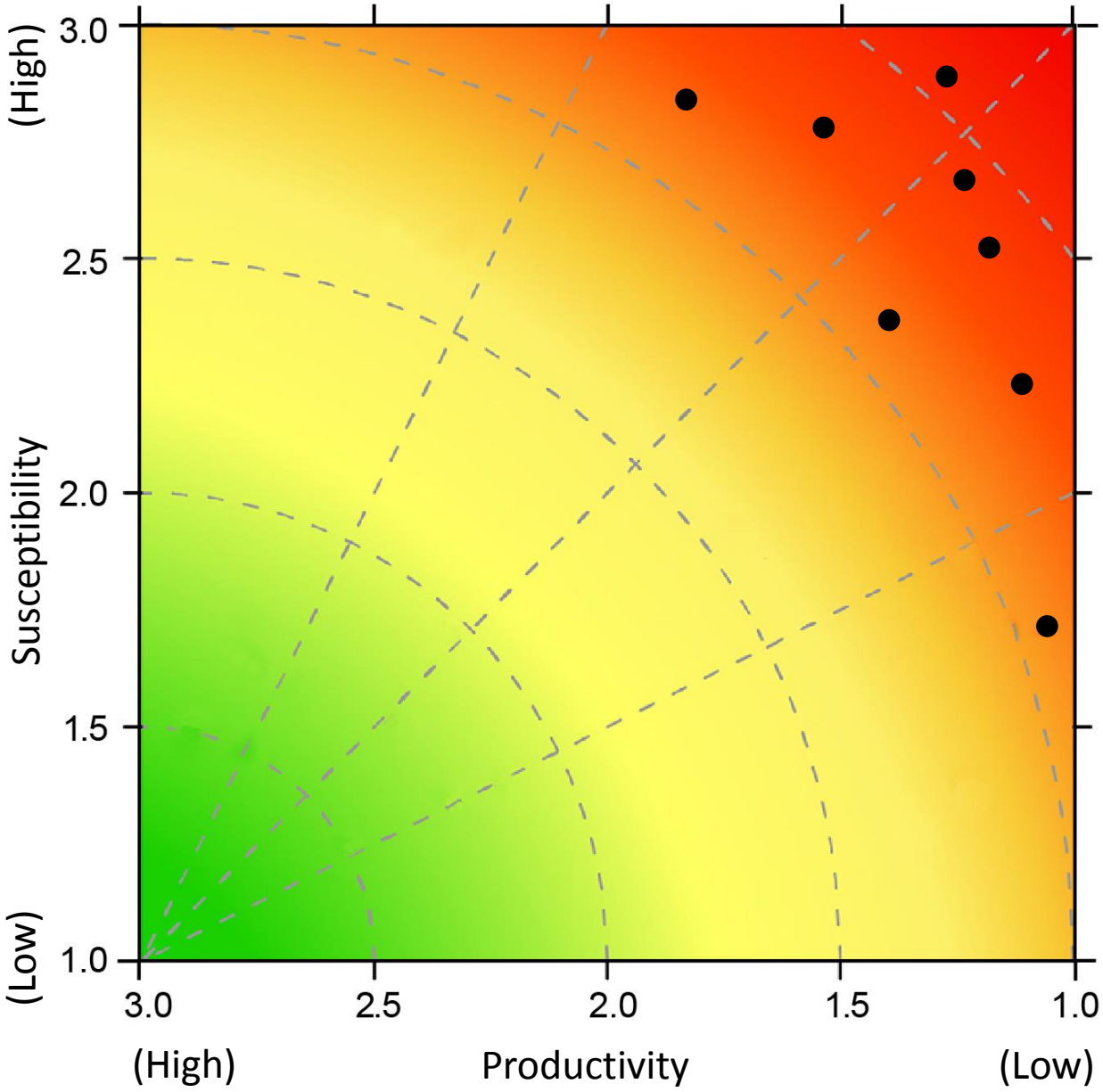

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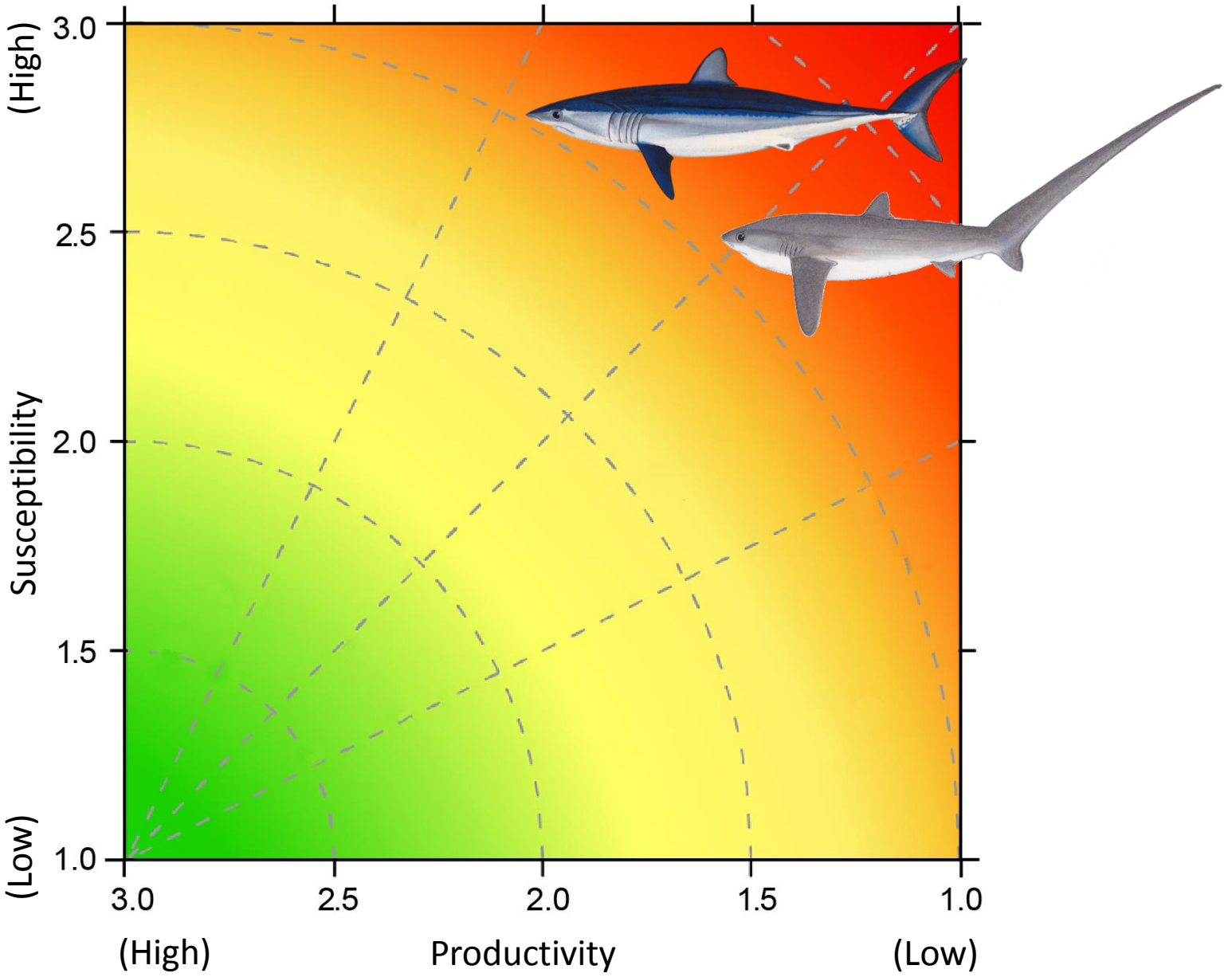
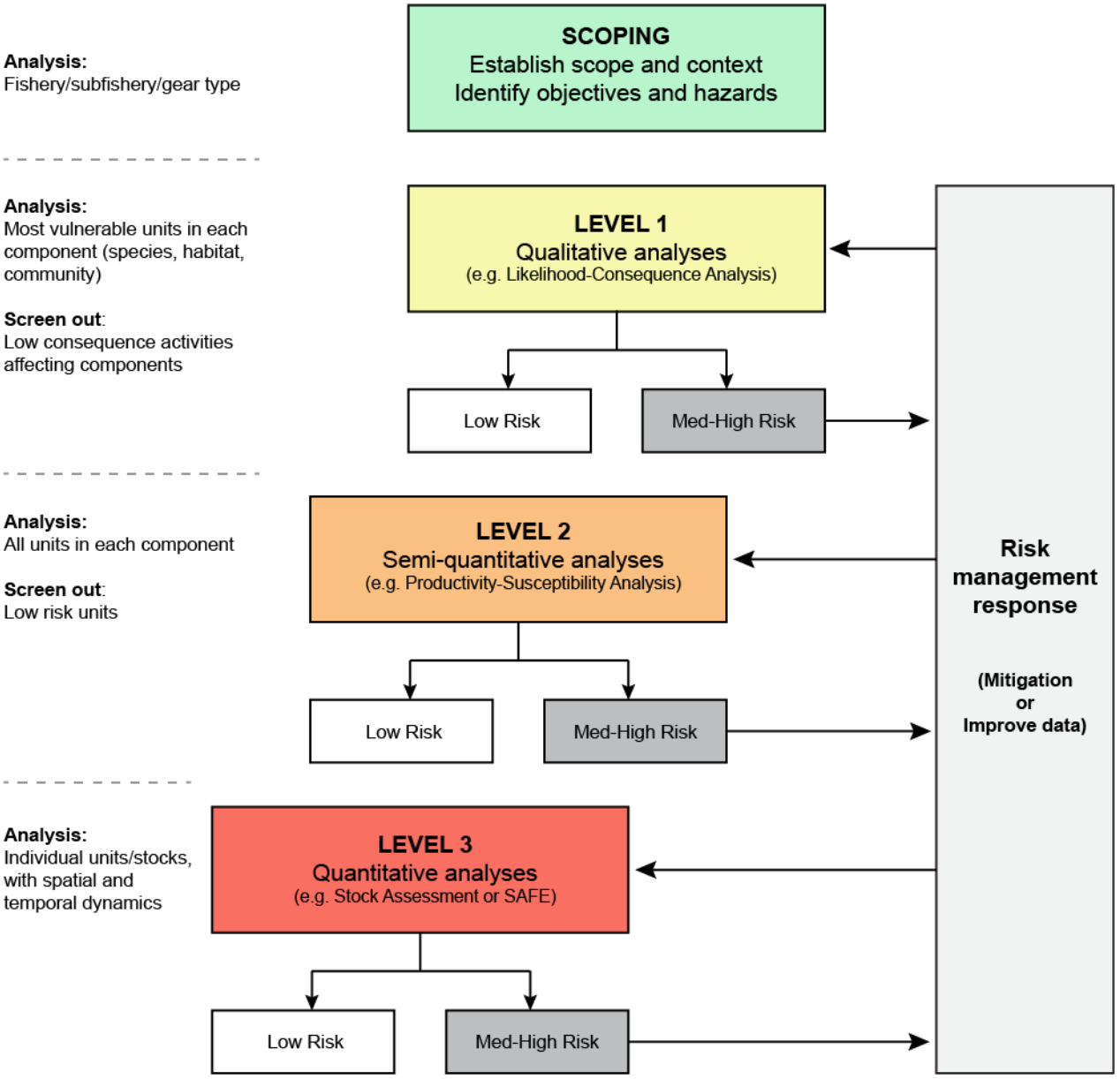
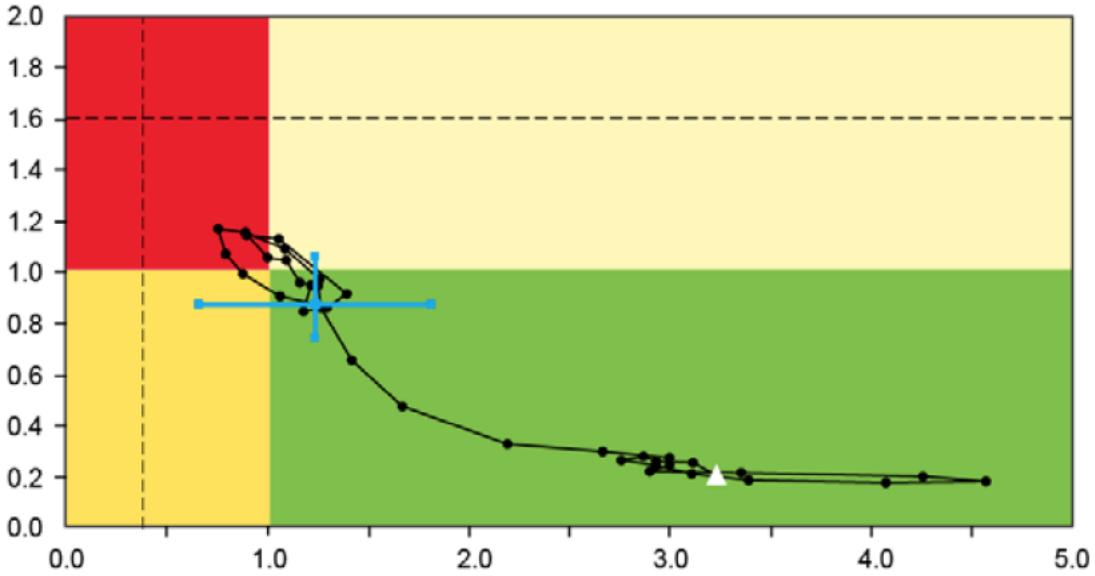


ERAEF Framework



Assessing ecological sustainability

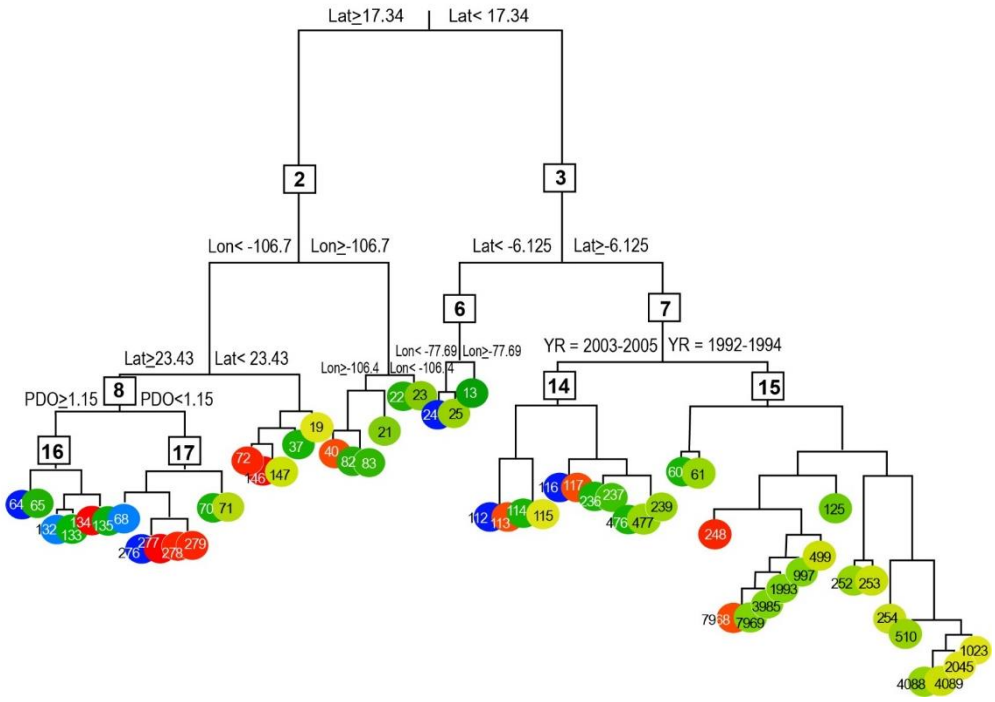
- Highly vulnerable species may be subjected to stock assessment
- But, ignores species interdependencies and ecosystem structure



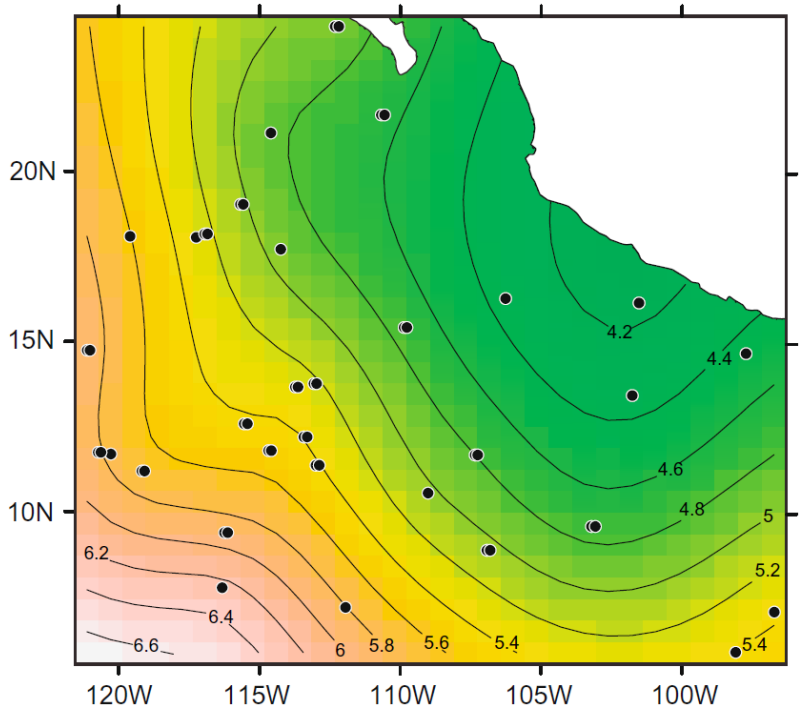
Assessing ecosystem integrity

- Even if species assessed to be fished sustainably, large biomass removals may eventually result in a change in ecosystem trophodynamics
- Need to understand, quantify and monitor ecological dynamics:
  - Species composition in the ecosystem & impacted species (by fishery)
  - Trophic linkage between species (stomach content analysis, stable isotopes)

Stomach content analysis



Stable isotope analysis



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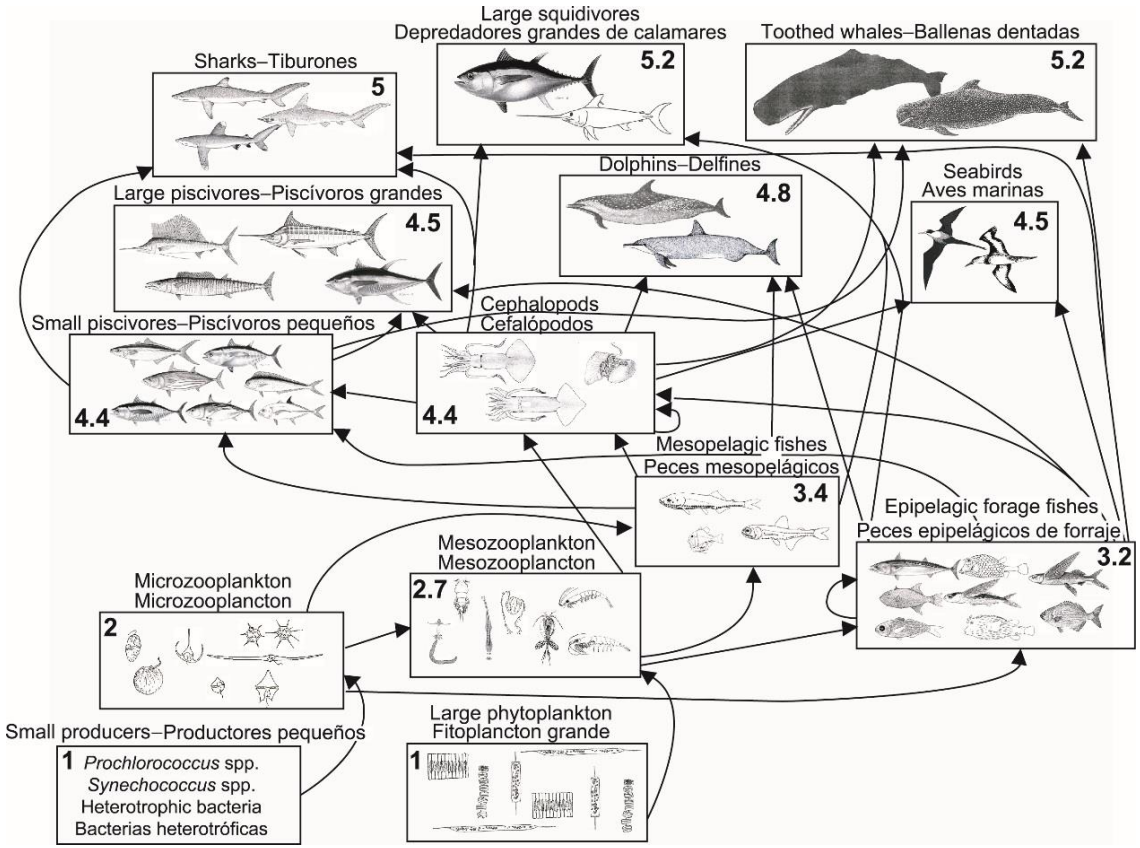

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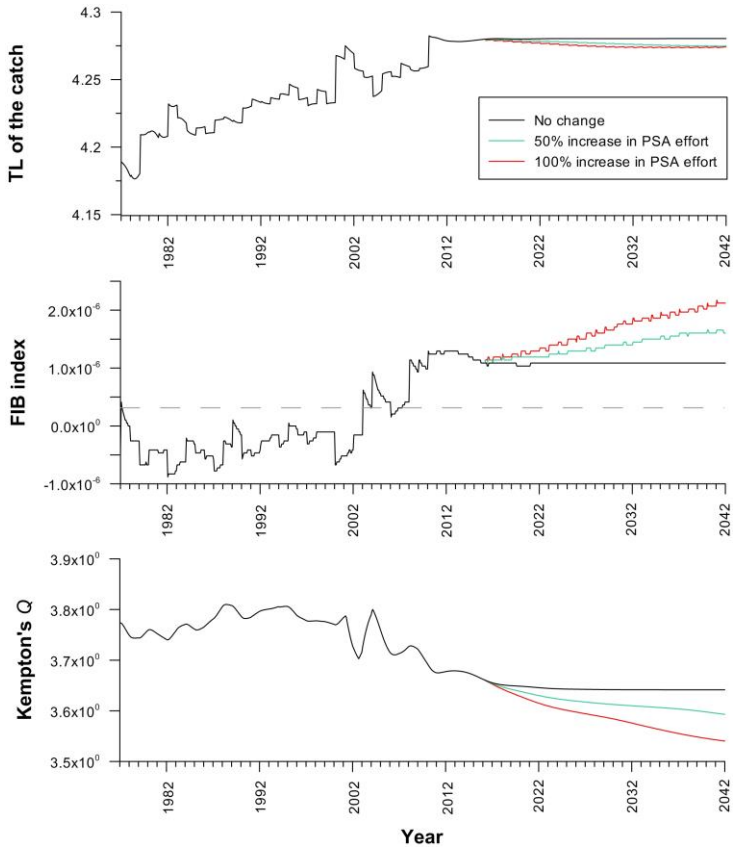
  - Calculation of ecological indicators



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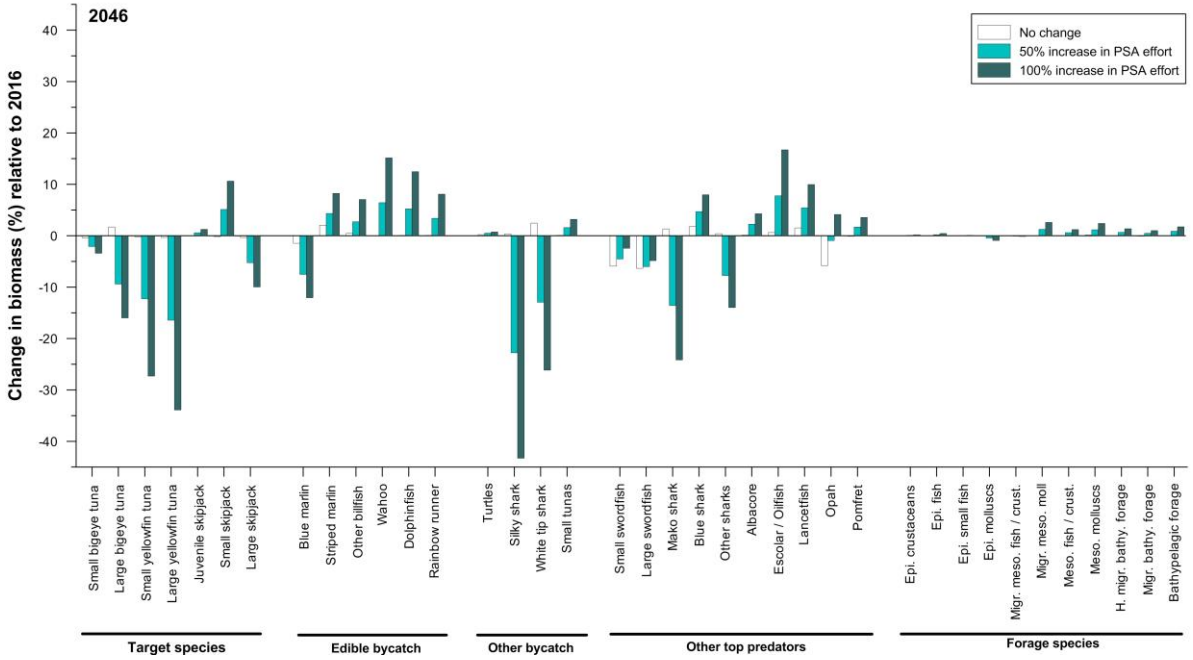
  - Develop food web models
  - Calculation of ecological indicators
  - Forecast ecological impacts of management measures and climate change



Preliminary strategy for Ecosystem Group

- In the following series of ‘ecosystem considerations’ papers we will detail progress in our strategy to address ecological sustainability in the EPO.

1) Identified the need for ecological research to meet IATTC mandates and to demonstrate EPO fisheries are fishing responsibly.

2) Provided an ERA framework to guide our future work, and possible assessment methods to demonstrate ecological sustainability.

3) Describe a metadata analysis of the longline fishery data as a pre-cursor to ERA.

4) Improving PSA methodology to before application to future assessments

5) Identify data gaps and vulnerable species in PSA to prioritize future work.

Questions