
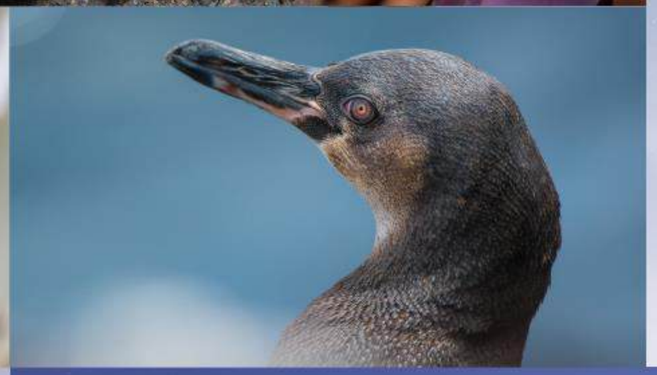

fundación Charles Darwin foundation

Vulnerability of chondrichthyan fish to climate change in the Eastern Tropical Pacific

Cerutti-Pereyra, F., Denkard, L., Espinoza, M., Finucci, B. , Galván-Magaña, F., Hacohen-Domené, A. , Hearn, A., Hoyos-Padilla, M., Ketchum, J.· Mejía-Falla, P.A., Moya, A., Navia, A.F, Pazmiño, D.A., Ramírez-Macías, D., Rummer, J.L., Salinas-de-León, P., Sosa-Nishizaki, O., Stock, C., Chin, A.

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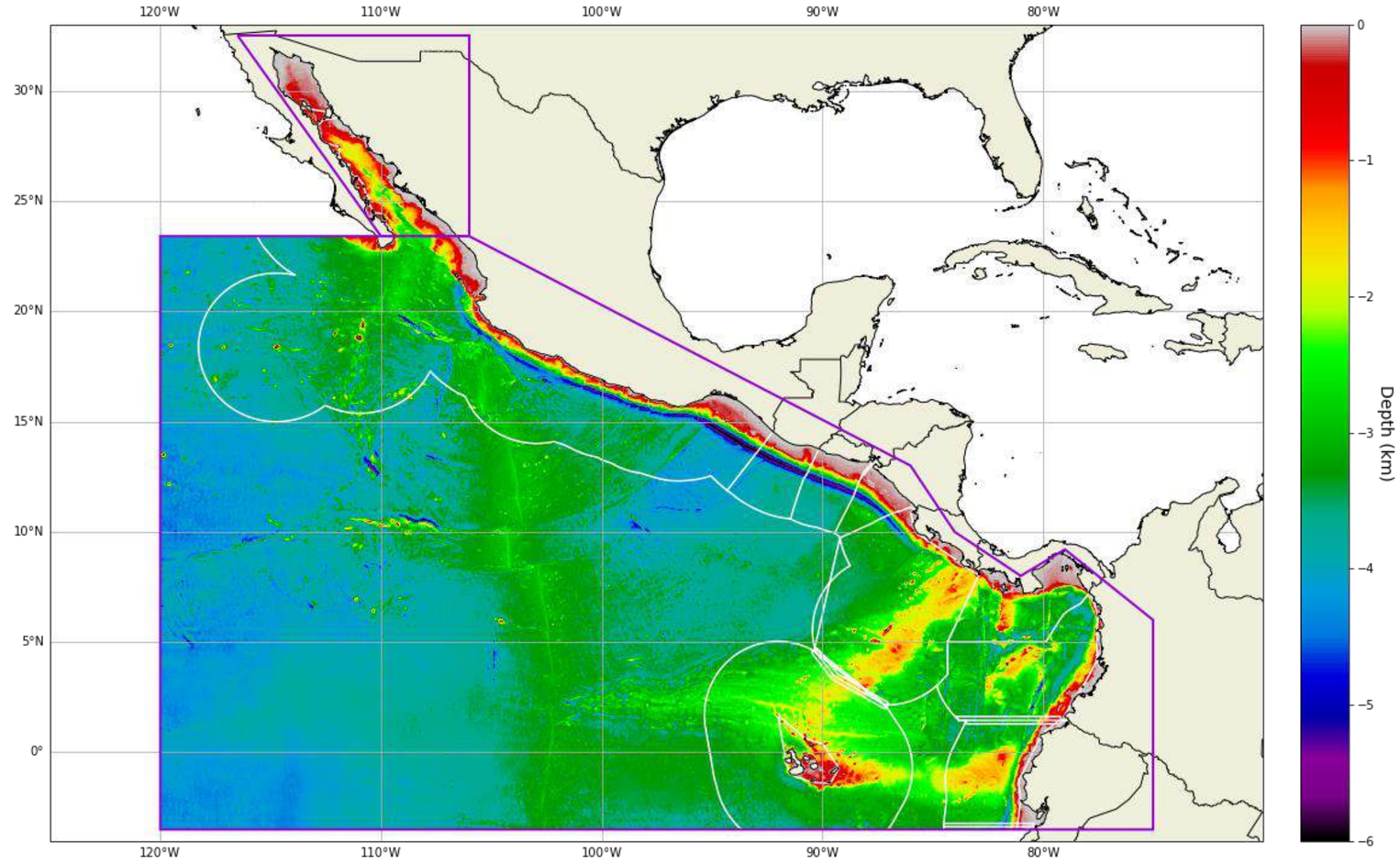
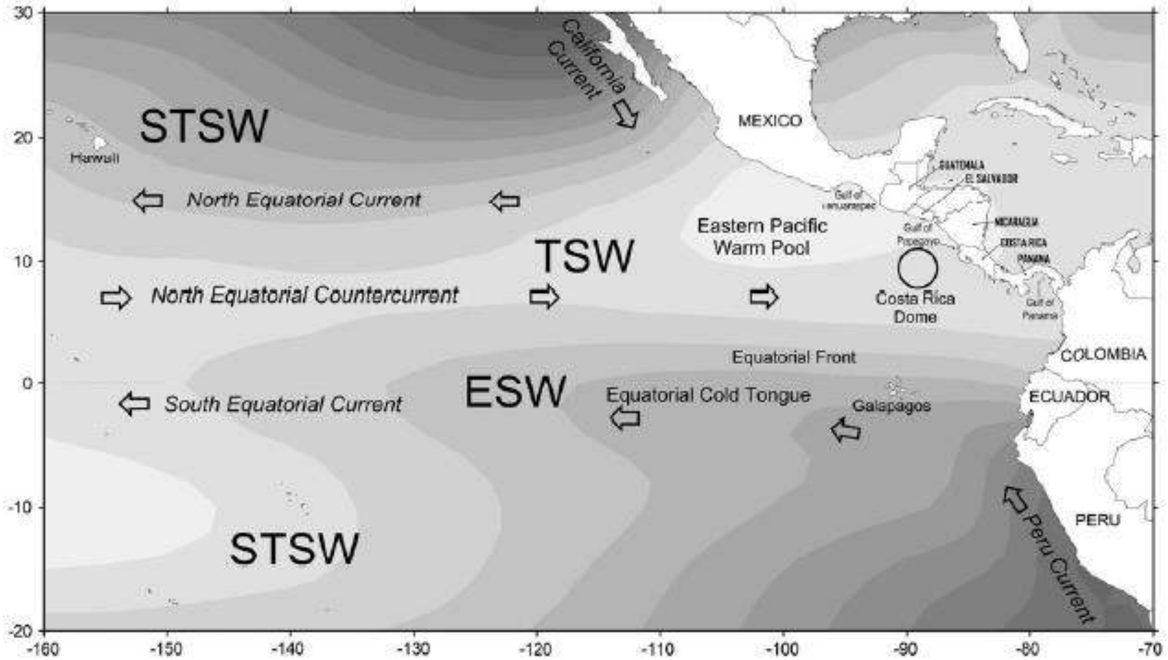
Where? → Eastern Tropical Pacific

- N: Gulf of California and the tip of the Baja peninsula
- S: border between Ecuador and Peru
- W: 120ºW (western limit of El Niño zone 3).
- 9 countries

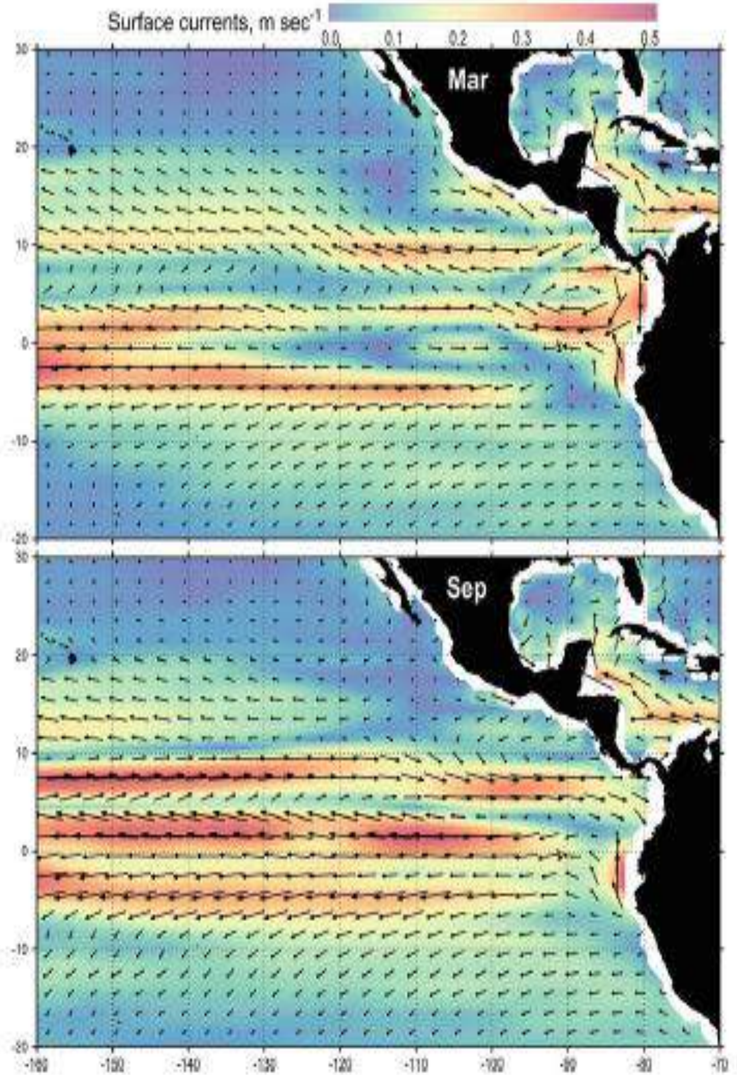


Where? → Eastern Tropical Pacific

Cold currents, tropical currents, local currents, wind jets from the Caribbean, domes, upwellings, a shallow thermocline, ENSO = very complex region!



Fiedler & Lavin 2016



Fiedler & Lavin 2016

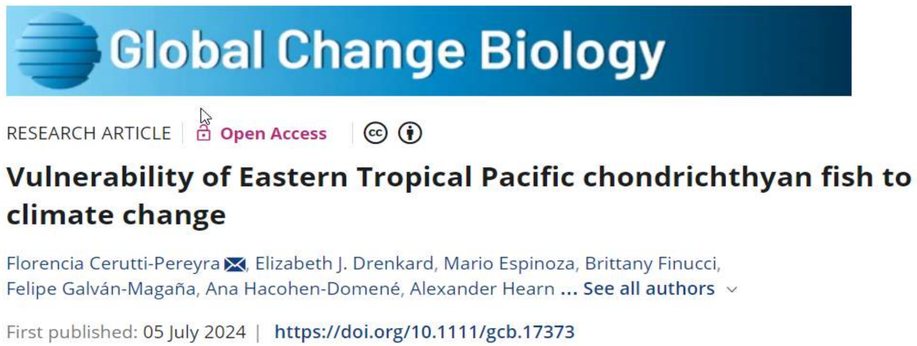
Why and What?

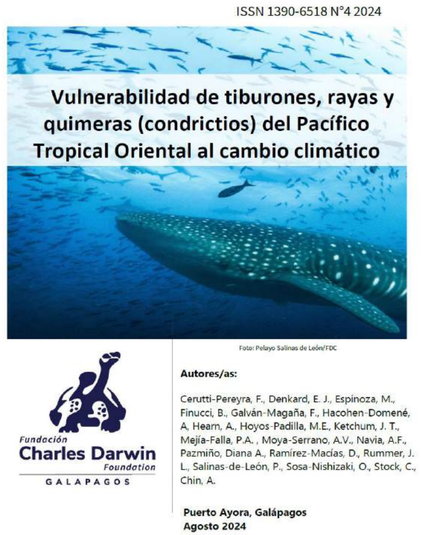
- How will chondrichthyan fish be affected by climate change?
- How will the habits or ecological processes they depend on be affected?
- What species are more vulnerable?

Aim:

To assess the vulnerability of 132 species of chondrichthyan fish occurring in the ETP to the impact of climate change.

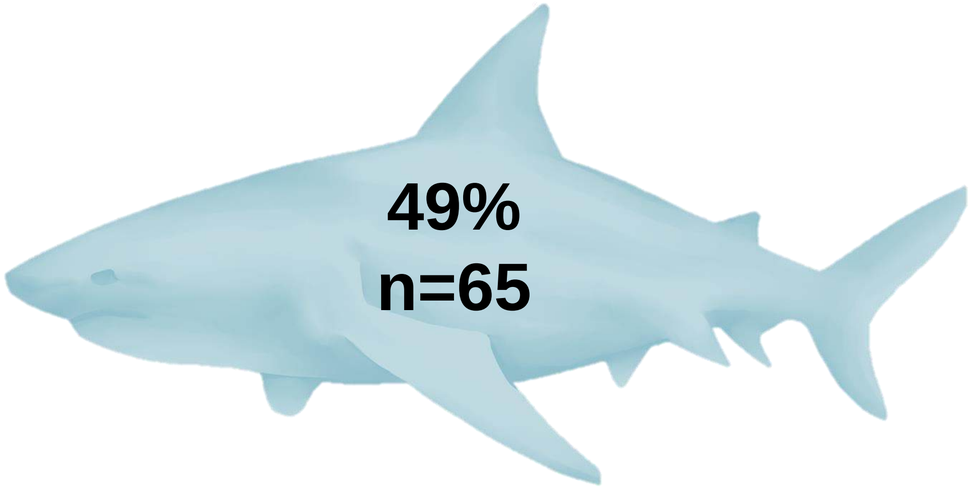
By 2100, SSP585 (≈RCP8.5)

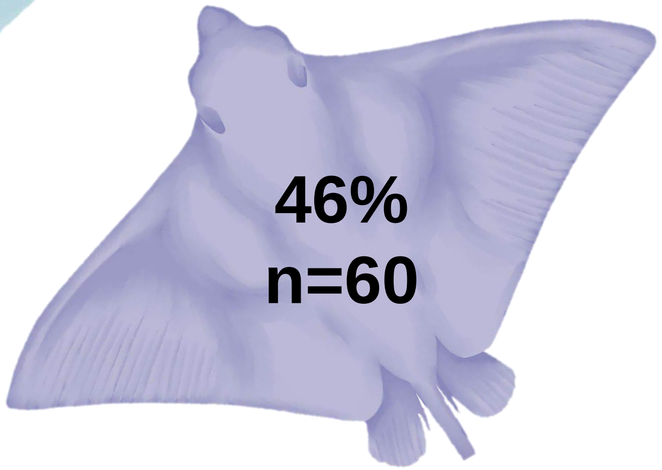


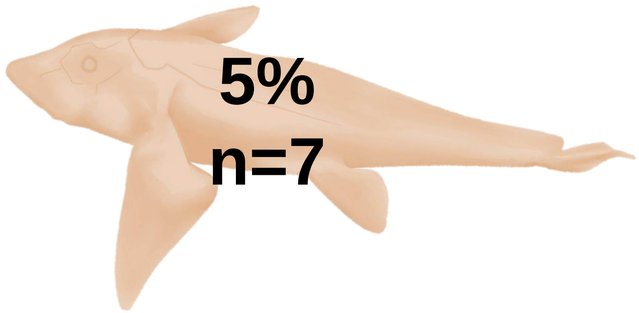


Why and What?

132 species

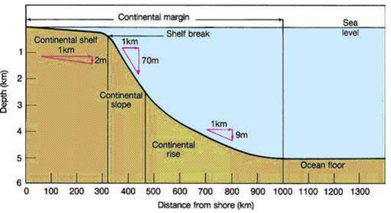




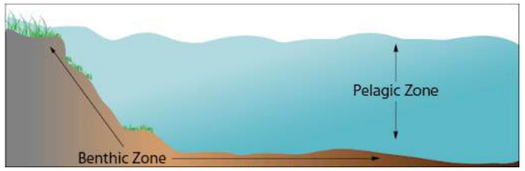


Who? → 4 ecological groups

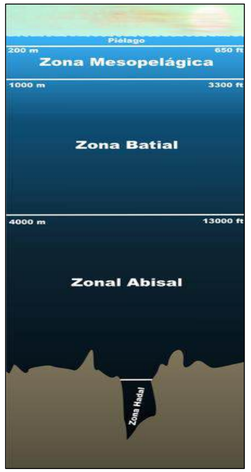
Coastal and inshore - coastal, including estuaries, bays, mangroves, intertidal to mid-shelf platform. Includes all benthic habitats to **40 m depth**.
Includes species with coastal **nurseries** too.



Shelf - deeper water and seabed habitats, extending to the continental slope edge. From **the surface to the isobath of 500 m**, including the platform around oceanic islands of the ETP.



Pelagic - species generally found in depths **less than 200 m** above continental slope and plain. **Open ocean** waters.



Bathyal - benthic habitats of the continental slope and beyond, extending down **to 2000 m depth.**

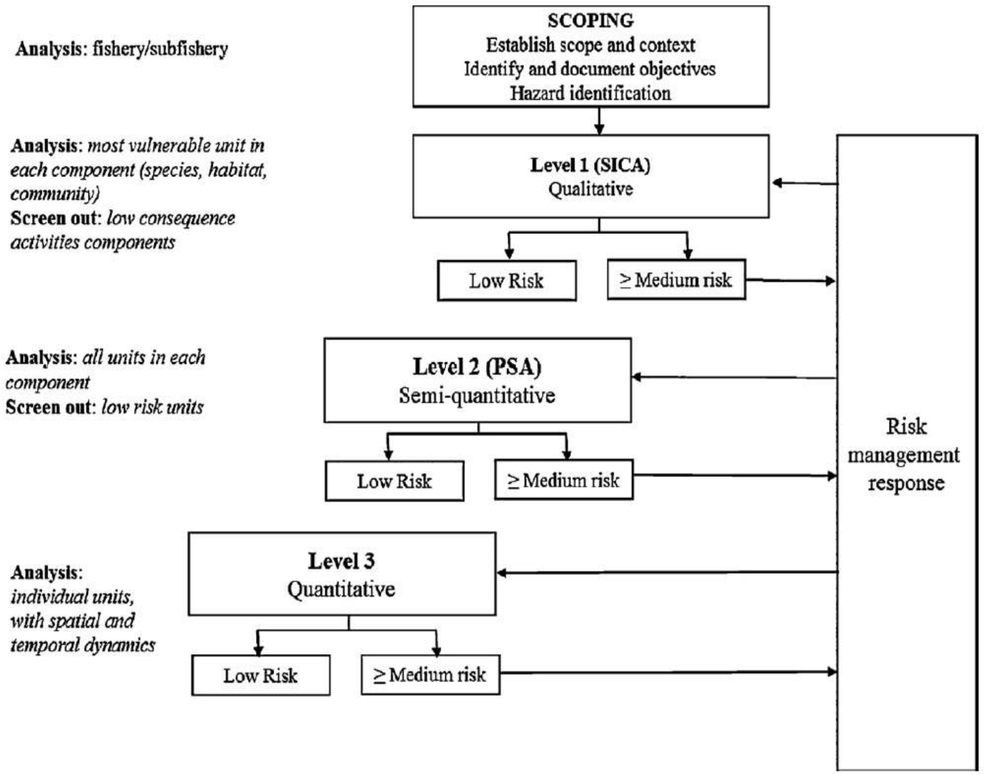
2 things to highlight

The Ecological Risk Assessment

- ERAs have been applied extensively in other domains (hazard risk and human health, pollutants)

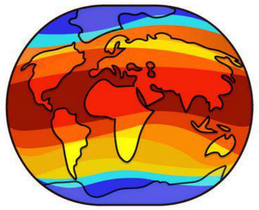
- ERA**F** → **effects to the threat of fisheries**

Particularly useful for data-poor spp – Mex, USA, Aus, etc



The Ecological Risk Assessment

- But it is a **relatively new method for assessing vulnerability to climate change**

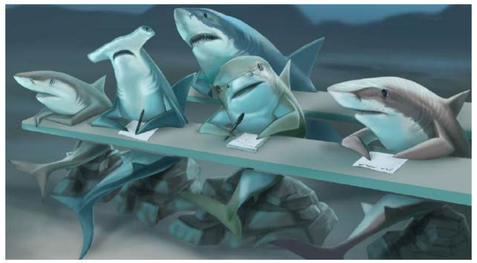


- ERA for Climate Change in 2010 at the GBR, 2016 USA, 2021 South Australia....

- **Nothing for the ETP**

How? → Ecological Risk Assessment

- Semi-quantitative or qualitative ERA uses a **combination of attributes (also called indicators)** of the species.



- Knowledge of vulnerability is generally derived from an integrated assessment that i**ncludes scientific information** (published and unpublished) **and expert opinion**.

- After gathering the dataset → Ranking of components and attributes = low, medium or high **vulnerability of each species to a stressor.**

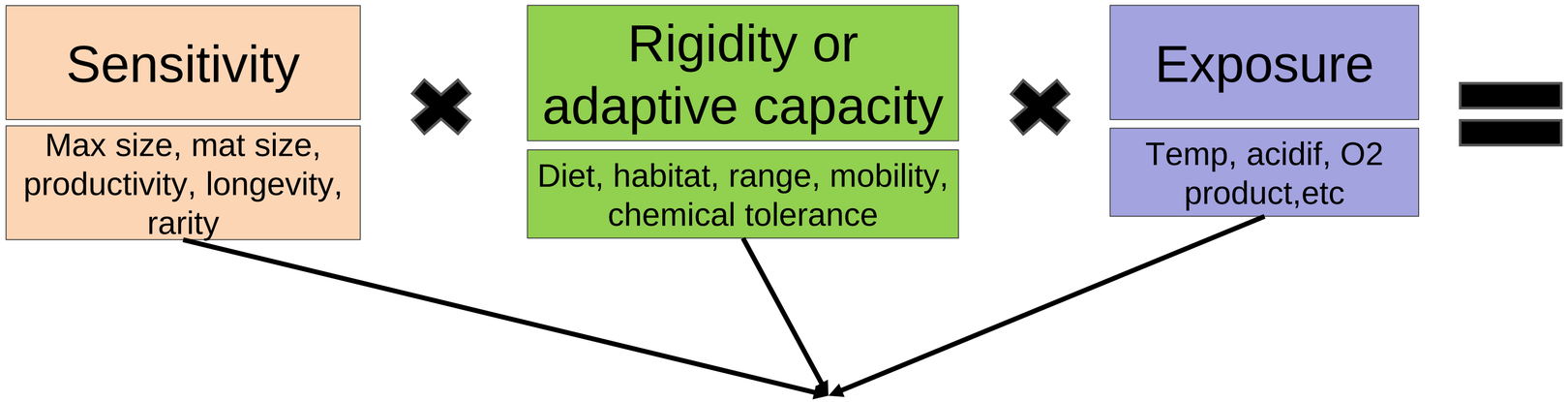
	Low	Medium	High
High	Low	Medium	High
Medium	Low	Medium	Medium
Low	Low	Low	Low

How? → Ecological Risk Assessment

➢ ERA uses **three components** to assess vulnerability:

Components→	Sensitivity	Rigidity or adaptive capacity	Exposure
	Biological traits that are not easily changed.	Alter behaviour to accommodate changing conditions.	How exposed the species is to the stressor.
Indicators→	Max size	Diet	Increase in T
	Maturity size	Habitat specificity	Acidification
	Productivity	Mobility	Decrease in O2
	Longevity	Latitudinal range	Changes in prod.
	Rarity	Physiol intolerance	Changes salinity*
			Sea level rise*
			FW input*

How? → Ecological Risk Assessment

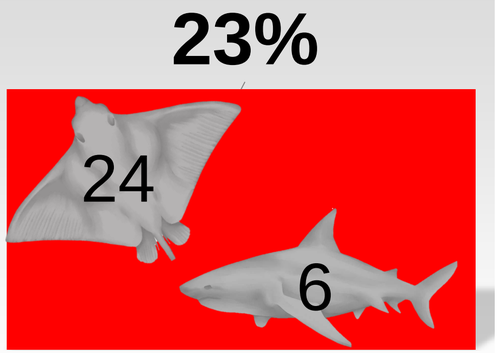


Each indicator is rated as **Low**, **Medium** or **High**

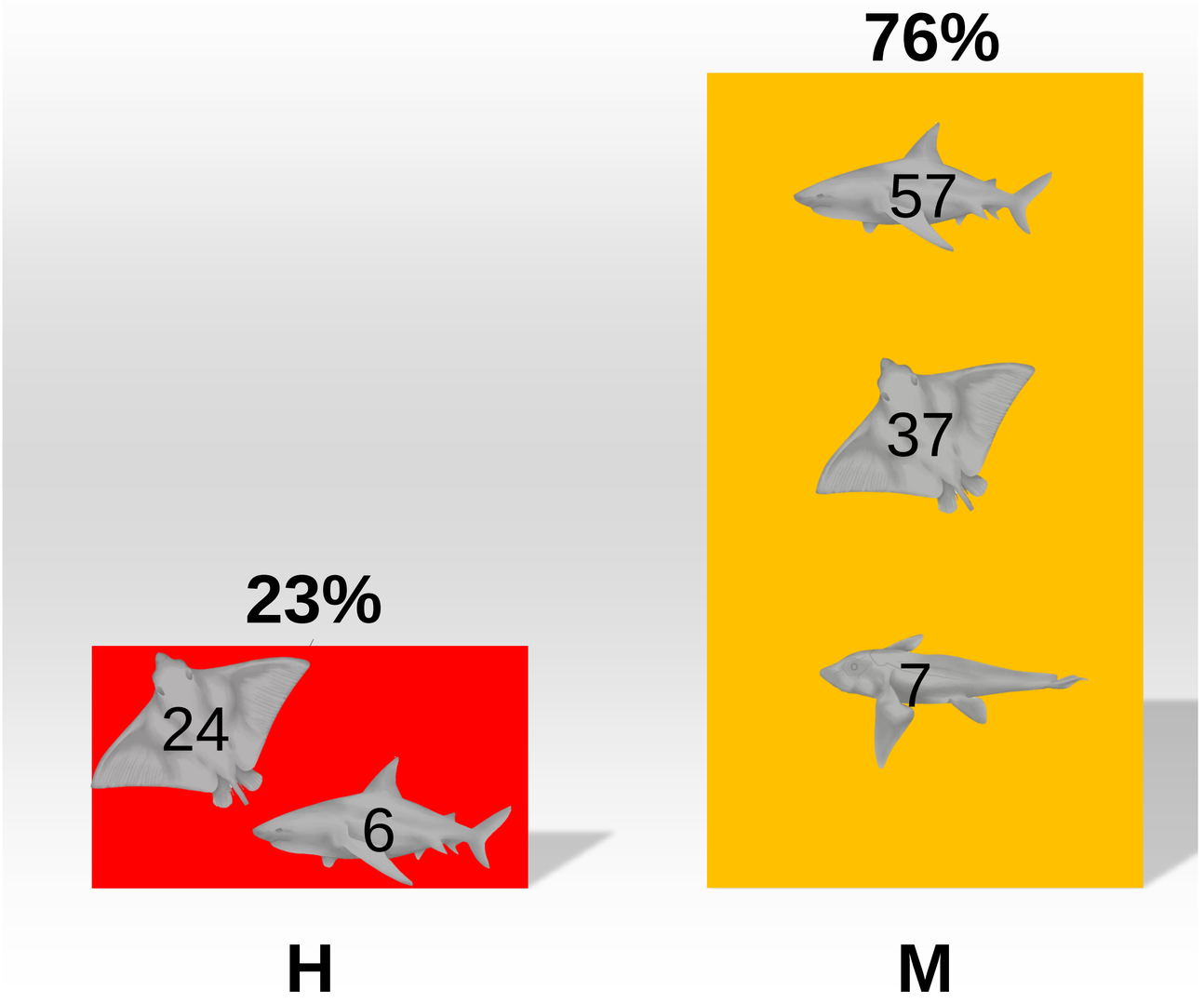
- These qualitative rankings are coded → 0.33 (low), 0.66 (moderate) or 1.00 (high).
- Vulnerability is expressed as a proportion ranging from 0.00 to 1.00

Review → experts' judgement and consensus

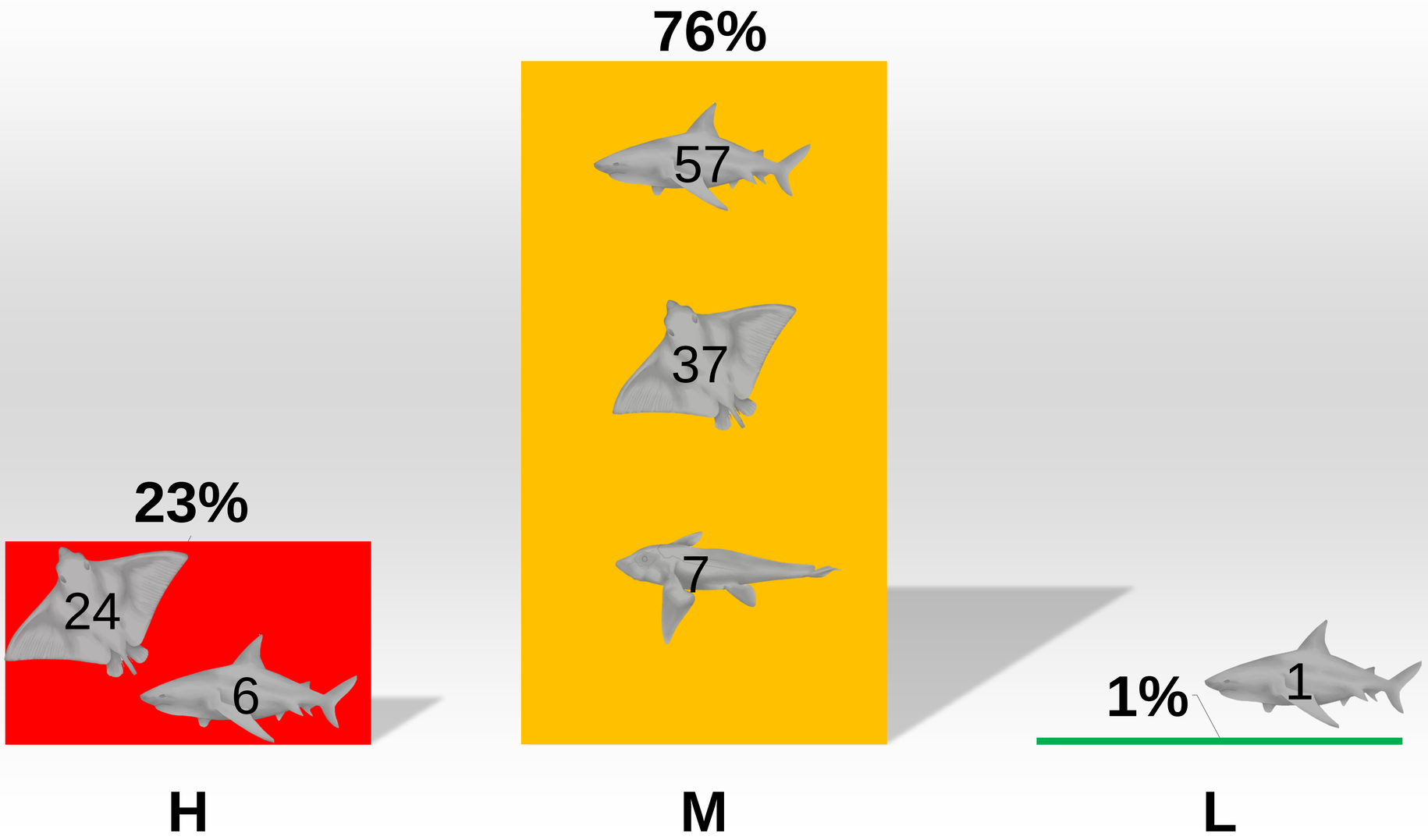
Overall vulnerablity



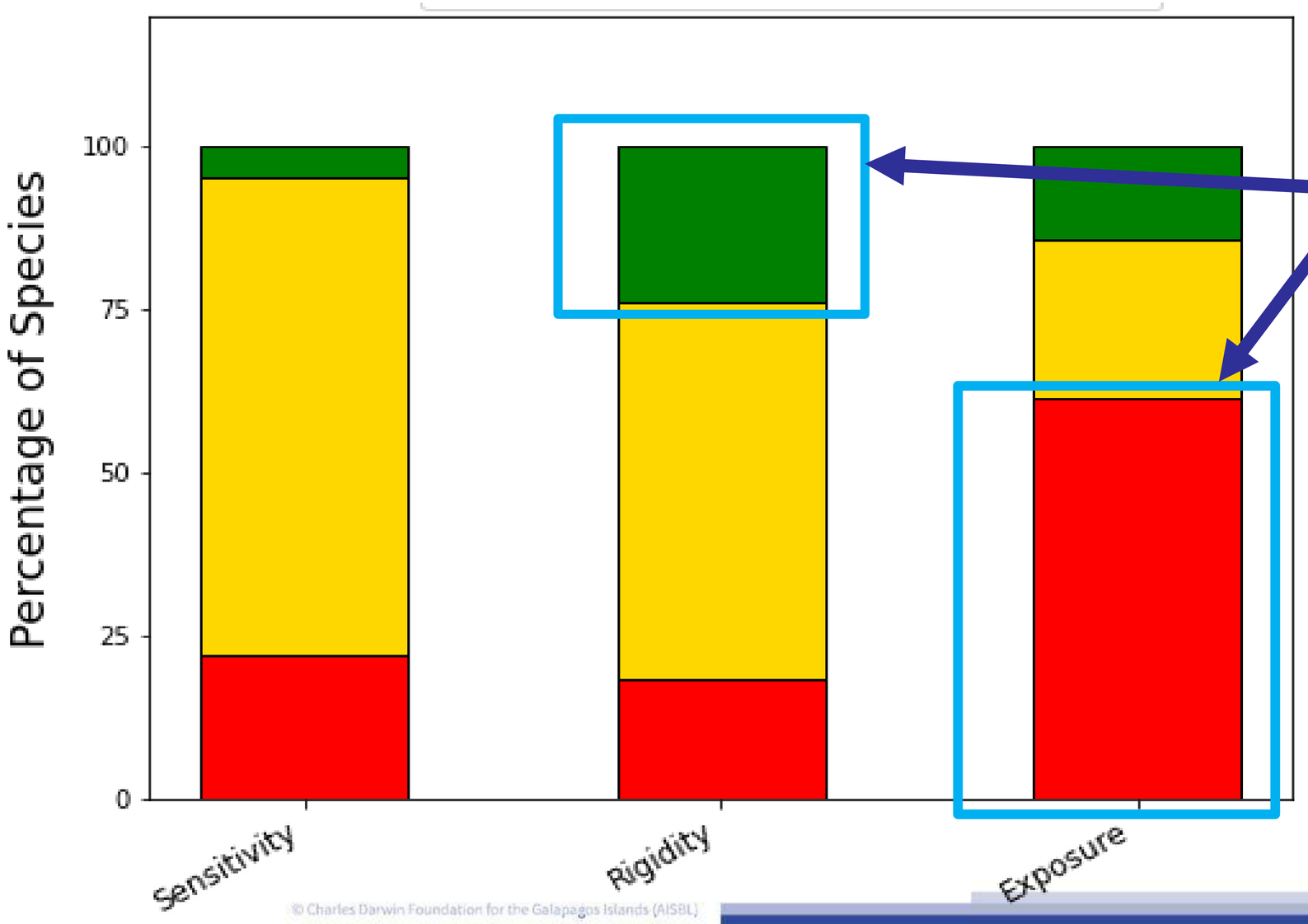
Overall vulnerablity



Overall vulnerablity



Exposed but adaptable?



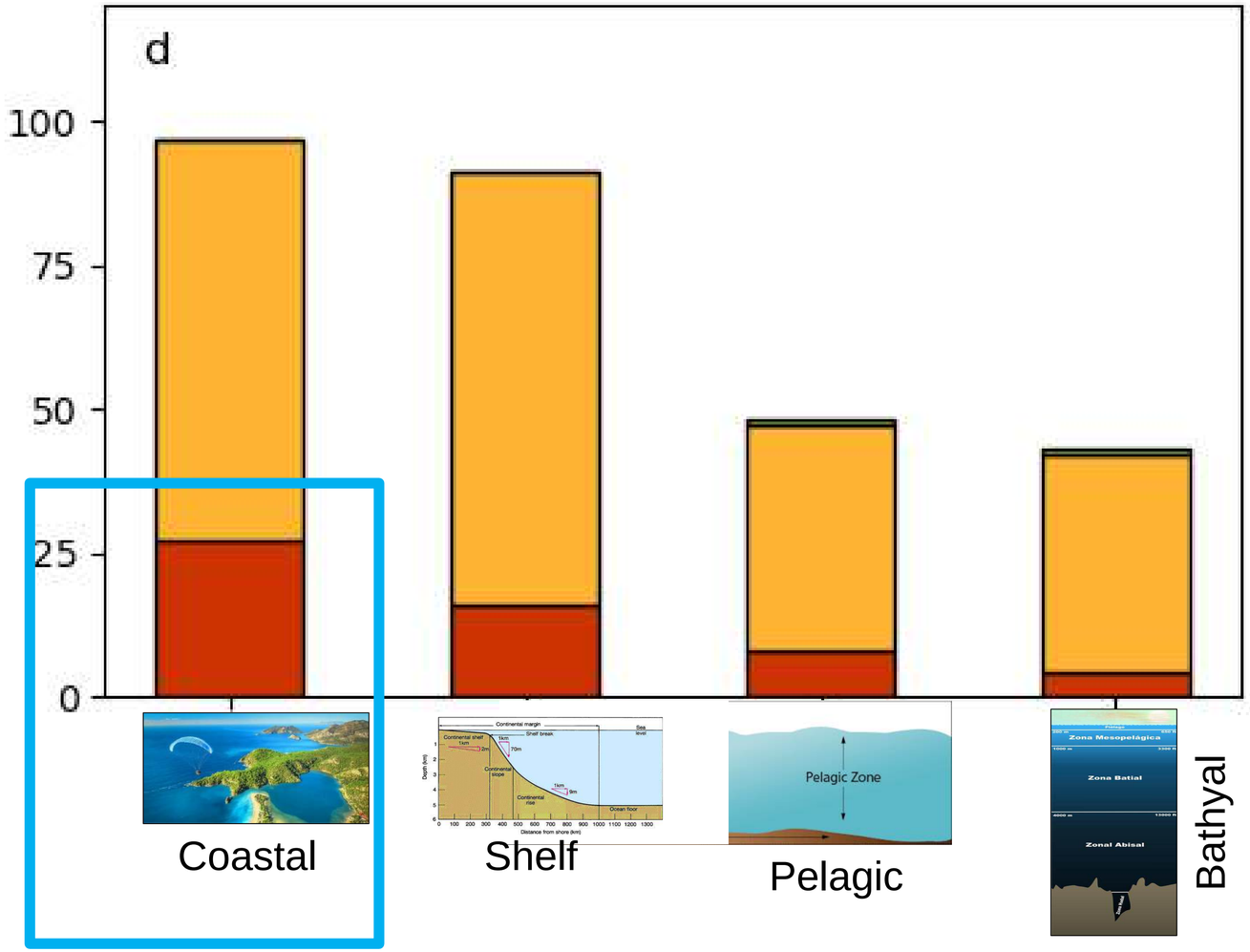
Exposure
(**H: 62**%, M: 24%, L:14%),
Rigidity
(H: 19%, M: 59%, **L: 22%**)
Sensitivity
(H: 22%, **M: 74%,** L: 4%),

Most vulnerable group

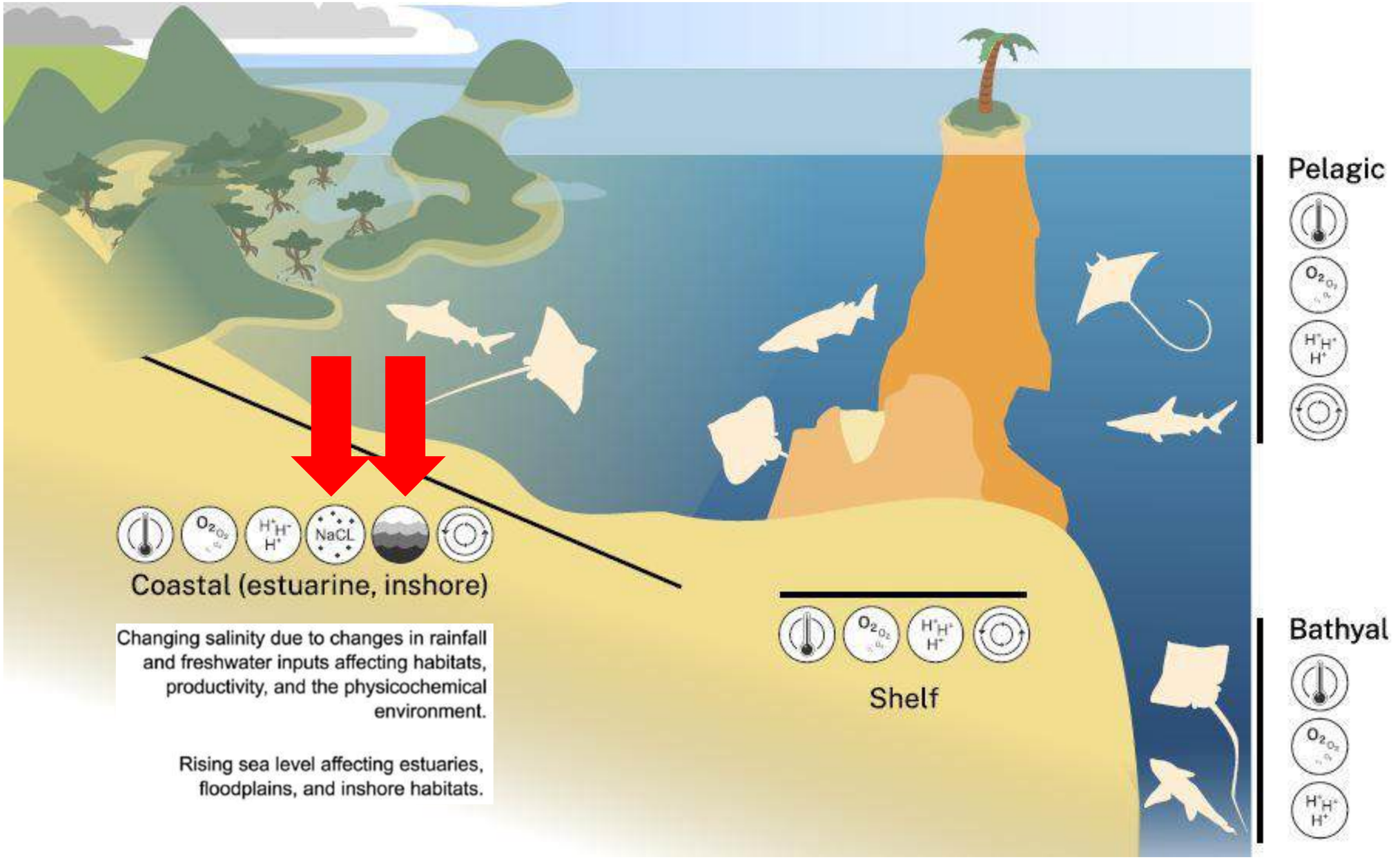
COASTAL GROUP

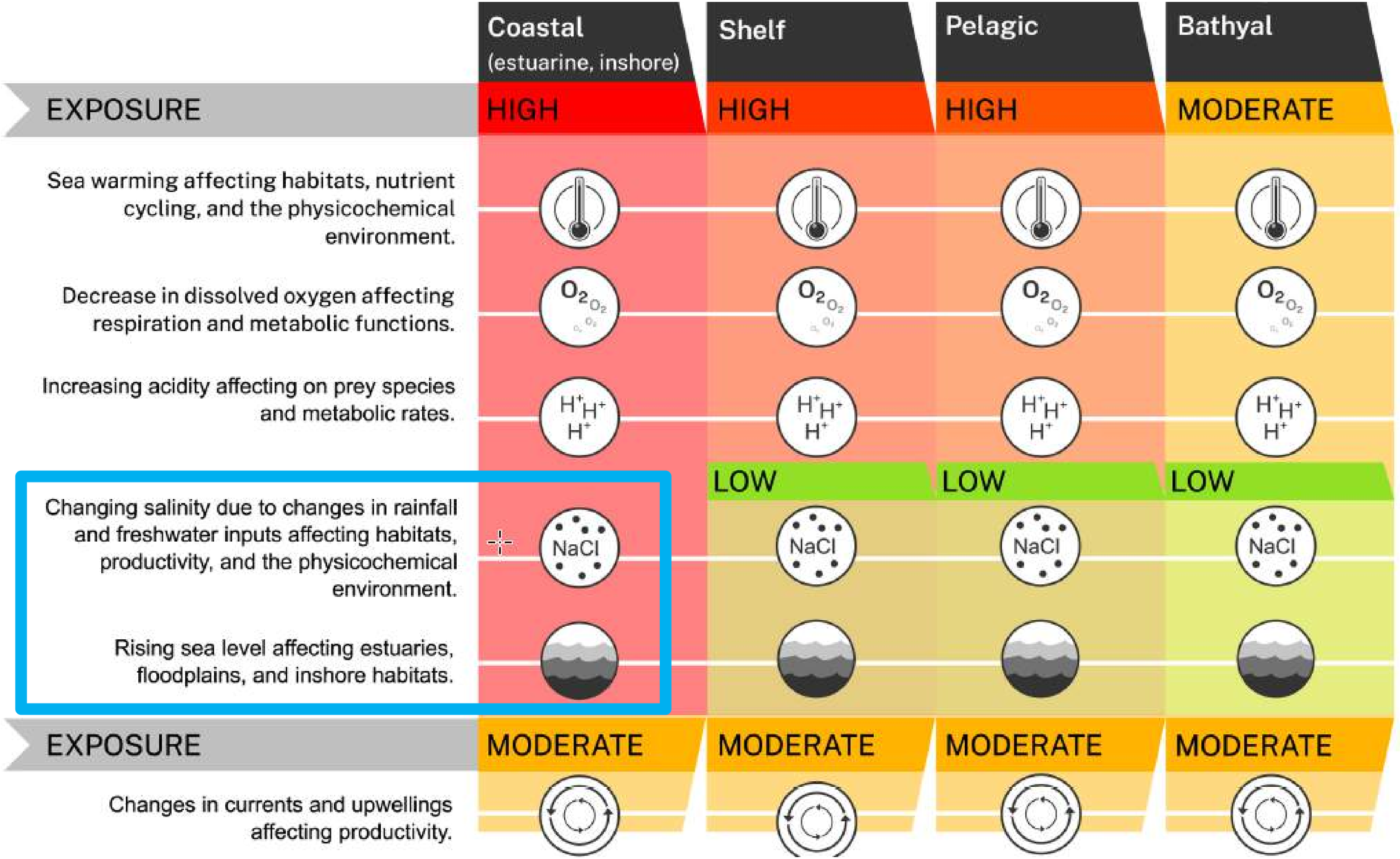
30 *Highly* vulnerable spp -
90% Coastal

Found in coastal ecosystems and/or use coastal nurseries.



EXPOSURE

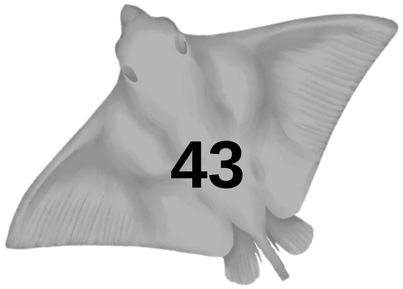

Pelagic
Bathyal
NaCL
Coastal (estuarine, inshore)
Changing salinity due to changes in rainfall and freshwater inputs affecting habitats, productivity, and the physicochemical environment.
Rising sea level affecting estuaries, floodplains, and inshore habitats.
Shelf

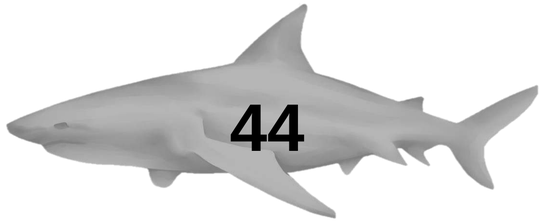

Coastal
(estuarine, inshore)
Shelf
Pelagic
Bathyal
EXPOSURE
HIGH
HIGH
HIGH
MODERATE
Sea warming affecting habitats, nutrient cycling, and the physicochemical environment.
Decrease in dissolved oxygen affecting respiration and metabolic functions.
Increasing acidity affecting on prey species and metabolic rates.
LOW
LOW
LOW
Changing salinity due to changes in rainfall and freshwater inputs affecting habitats, productivity, and the physicochemical environment.
NaCl
Rising sea level affecting estuaries, floodplains, and inshore habitats.
EXPOSURE
MODERATE
MODERATE
MODERATE
MODERATE
Changes in currents and upwellings affecting productivity.

Most vulnerable group: Coastal

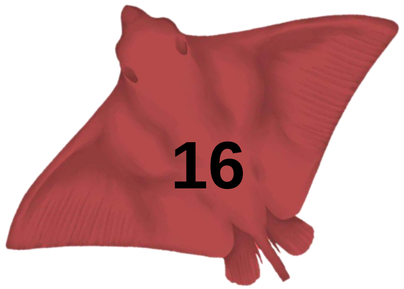
Coastal nurseries

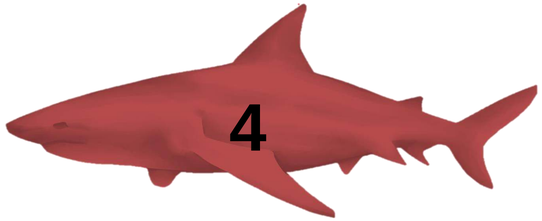
66% (87) spp - records of coastal nurseries.





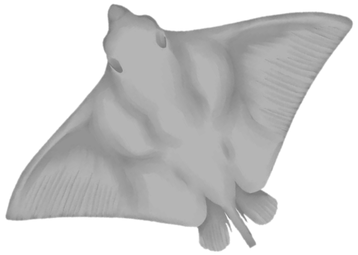
23% (20) spp with coastal nurseries also HIGHLY vulnerable

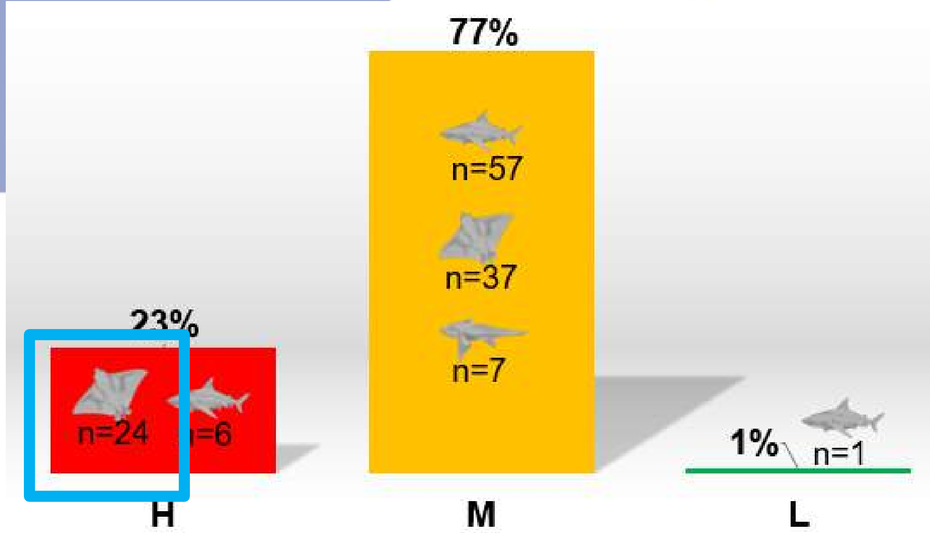




Most vulnerable

Batoids

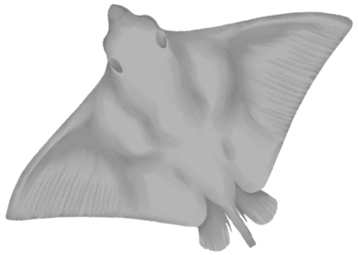


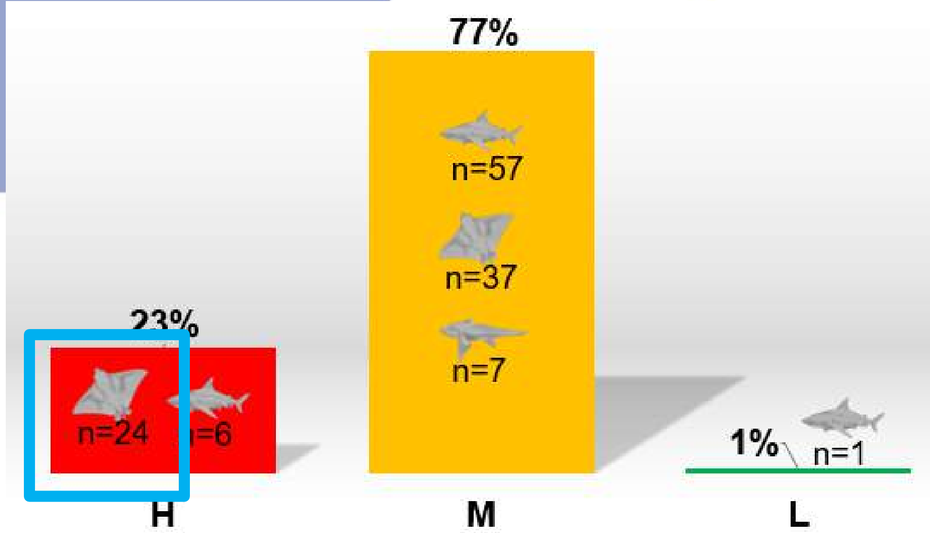


23% (20) spp with coastal nurseries also HIGHLY vulnerable

Most vulnerable

Batoids



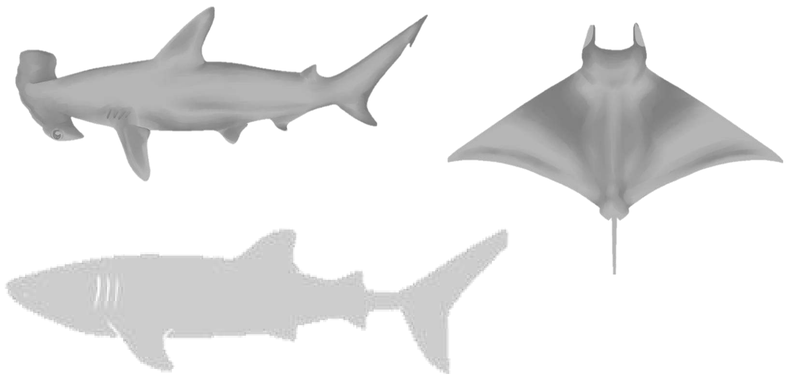


23% (20) spp with coastal nurseries also HIGHLY vulnerable

6 batoids **HIGH** vulnerable in all three components:

Species	Common name	Main habitat
Aetomylaeus asperrimus	Roughskin eagle ray	Coastal
Beringraja cortezensis	Cortez skate	Shelf
Hypanus longus	Longtail stingray	Coastal, Shelf
Pristis pristis	Common sawfish	Coastal
Styracura pacifica	Pacific chupare	Coastal
Urotrygon simulatrix	Fake round ray	Coastal

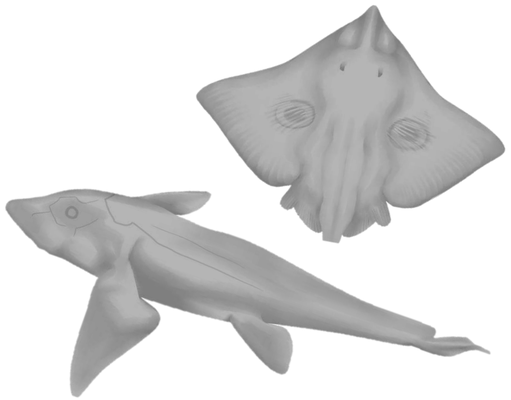
Highly migratory and iconic spp



- Mix of HIGH and MODERATE
- Facing threats throughout migrations, but good at dealing with changes?

- Important for fishery *and* tourism

Deepwaters



- Mix of HIGH / MODERATE *sensitivity* and *rigidity*
- but low *exposure*

= overall MODERATE vulnerability

- Used to a steady environment?
- Big knowledge gaps
- Deepwater fishery

So, where do we focus *effort*?

This integrated risk assessment approach was successfully used to assess **the vulnerability of ETP chondrichtyans to climate change.**

- 30 Highly **vulnerable species** = higher potential for extinction → Priority for management
- Highly vulnerable group → **coastal**
- **Coastal batoids**

So, where do we focus *effort*?

Reducing the impacts of climate change will require a **variety of spatially- and non-spatially fixed approaches.**

- For example, the **habitats that sustain species and species groups at high risk** must be protected to maximize their resilience.

- Identifying and **protecting critical habitats** – **coastal nurseries**.

- Fisheries management plans - **High-risk species** should be considered for specific conservation actions.

And *research*?

This assessment is also useful to identify **knowledge gaps, understanding:**

- ETP chondrichthyans' **reliance to mangrove, coastal, and estuarine habitats.**
- **Links** between population dynamics and habitat preservation.
- **Bathyal** chondrichthyans.
- Identifying synergies and **cumulative effects** for adaptive management.

Thank you team

Gracias!
Questions?

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