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FISHERIES**

# Assessing the vulnerability of marine life to climate change in the Pacific Region

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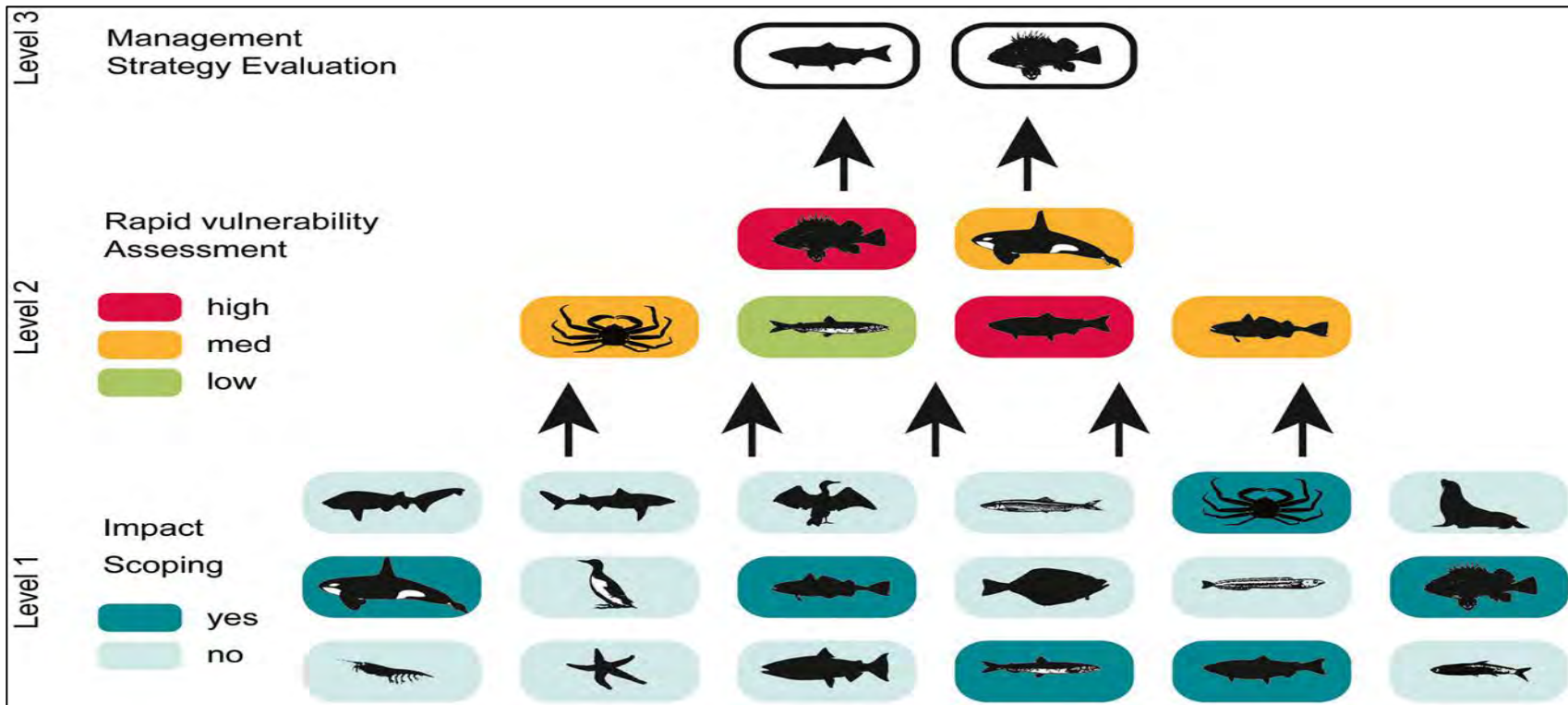
# Outline

- Project overview
  - **VA general methodology**
- Progress
  - **Pacific Islands preliminary results**
- Next steps

# Which species are most at risk?



# Scale of assessment methods



# Where are the assessments being done?



Morrison et al. 2015; Hare et al. 2016

# Pacific Islands Vulnerability Assessment



# Methodology framework

## Stock Vulnerability

### Exposure

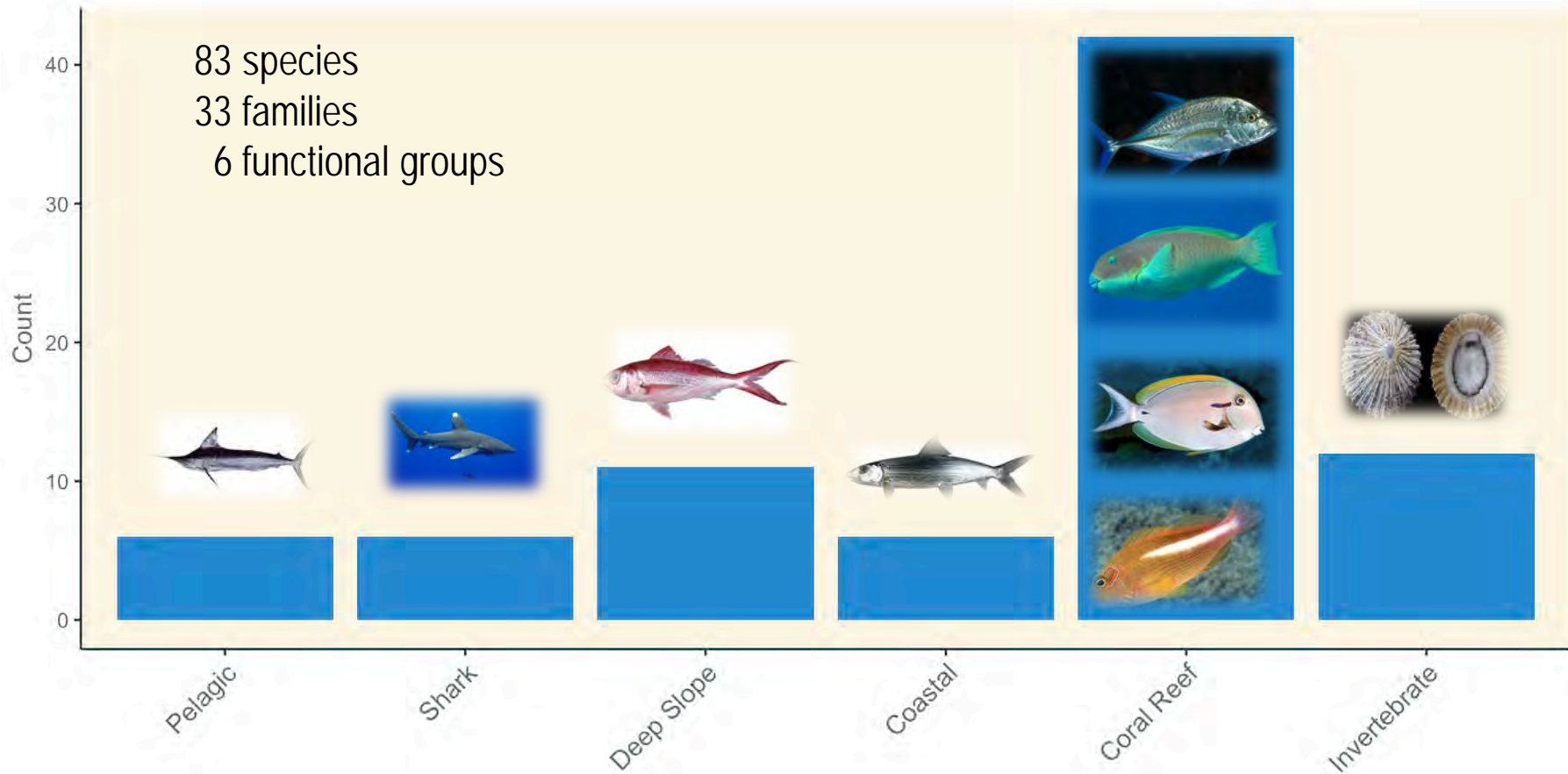
- Temperature (air, bottom, SS)
- Salinity (surface, bottom)
- Ocean acidification (pH)
- Mixed layer depth
- Precipitation
- Currents (NS, EW)
- Windstress (Mag, NS, EW)
- Surface oxygen
- Sea level rise
- Chlorophyll, productivity

### Sensitivity

- Habitat specificity
- Prey specificity
- Sensitivity to OA
- Sensitivity to temperature
- Stock size/status
- Other stressors
- Adult mobility
- Spawning cycle
- Complexity in reproduction
- Early life history survival & settlement requirements
- Population growth rate
- Dispersal of early life stages



# Taxonomic scope





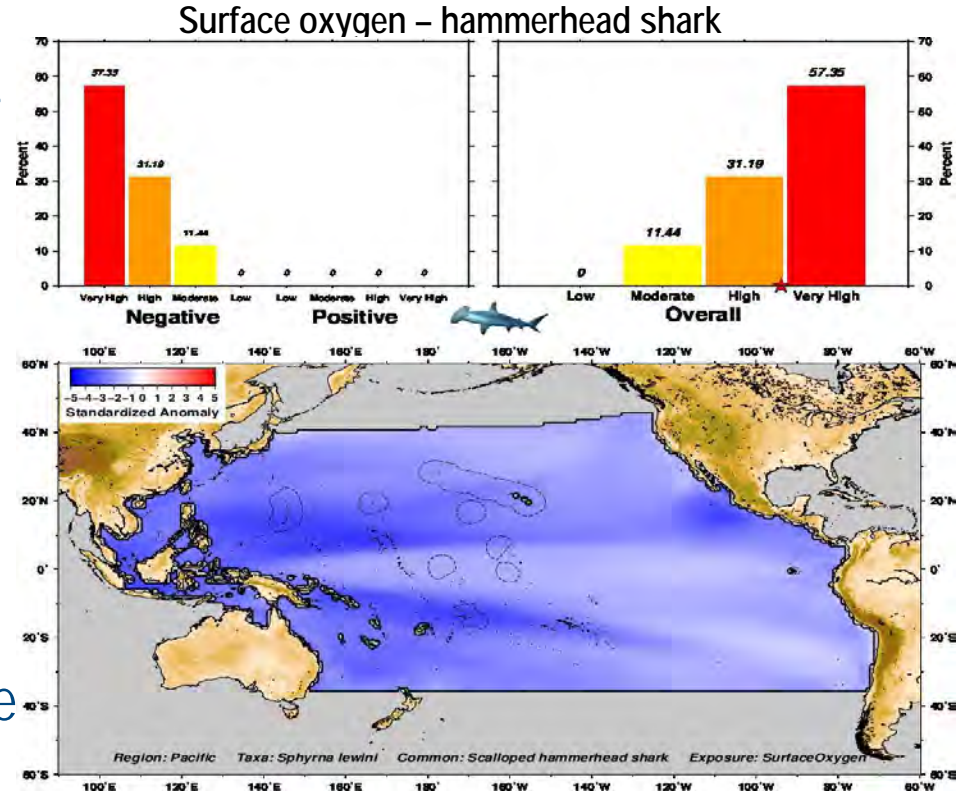
# Methodology overview: sensitivity

- Trait-based
- Existing knowledge + expert opinion
  - Group workshop to discuss results



# Methodology overview: exposure

- Measure of how much a species is likely to experience a change in climate
  - Spatial overlap - species' current distribution and the expected climate change
  - Mean change is related to current variability
  - Changes in variability are measured with an F-test (future variability/current variability)



# Pelagics

Sensitivity



Very High

High

Moderate

Low

				Slender armorhead Striped marlin Two spot snapper
				Bigeye tuna Mahimahi Skipjack tuna Wahoo Yellowfin tuna

Low

Moderate

High

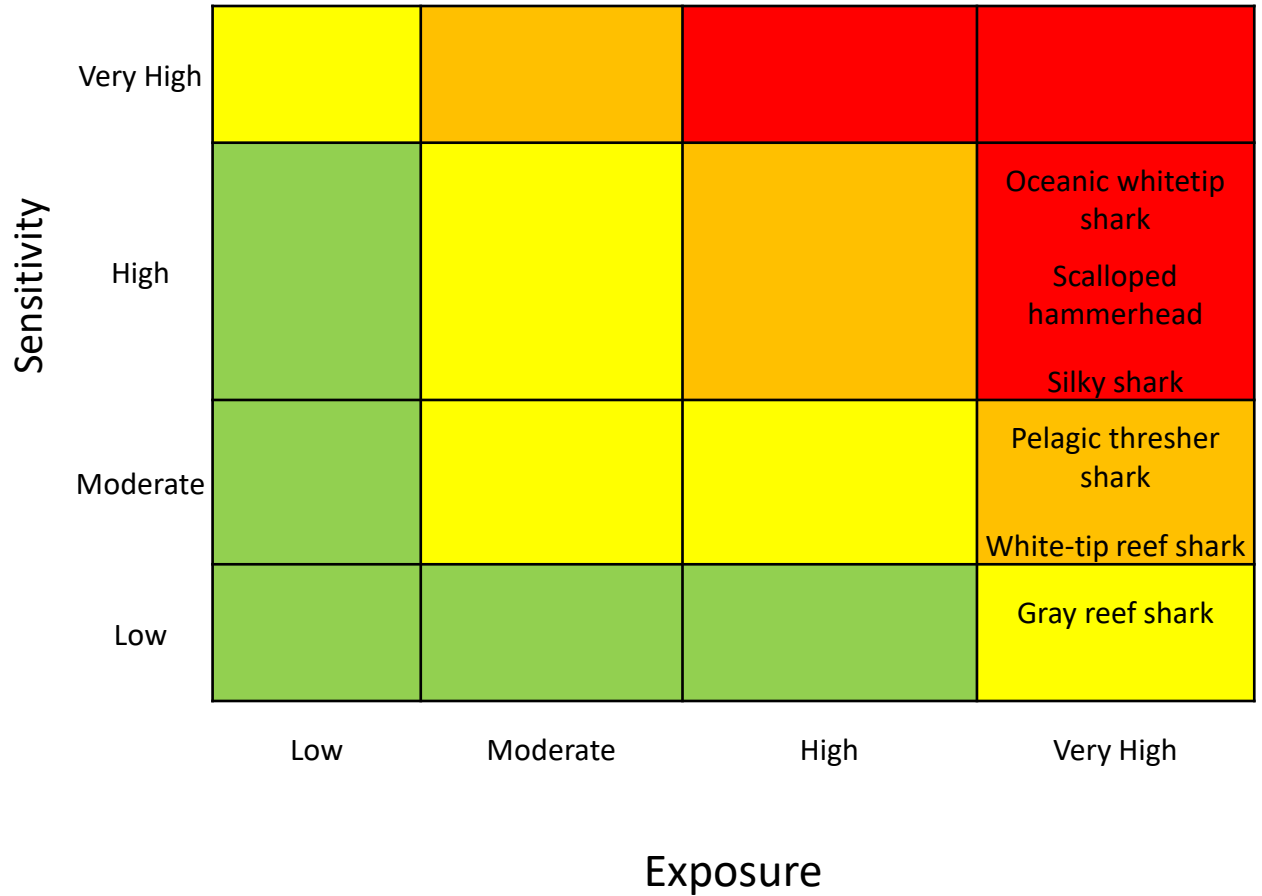
Very High

Exposure



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# Sharks



# Deep slope



Sensitivity

Very High

High

Moderate

Low

Very High				
High				
Moderate				Deep-water red snapper Hawaiian grouper Slender armorhead
Low				Deepwater longtail red snapper Golden eye jobfish Goldflag jobfish Green jobfish Lavender jobfish Oblique-banded snapper Pink snapper Rusty jobfish

Low

Moderate

High

Very High

Exposure



# Coastal



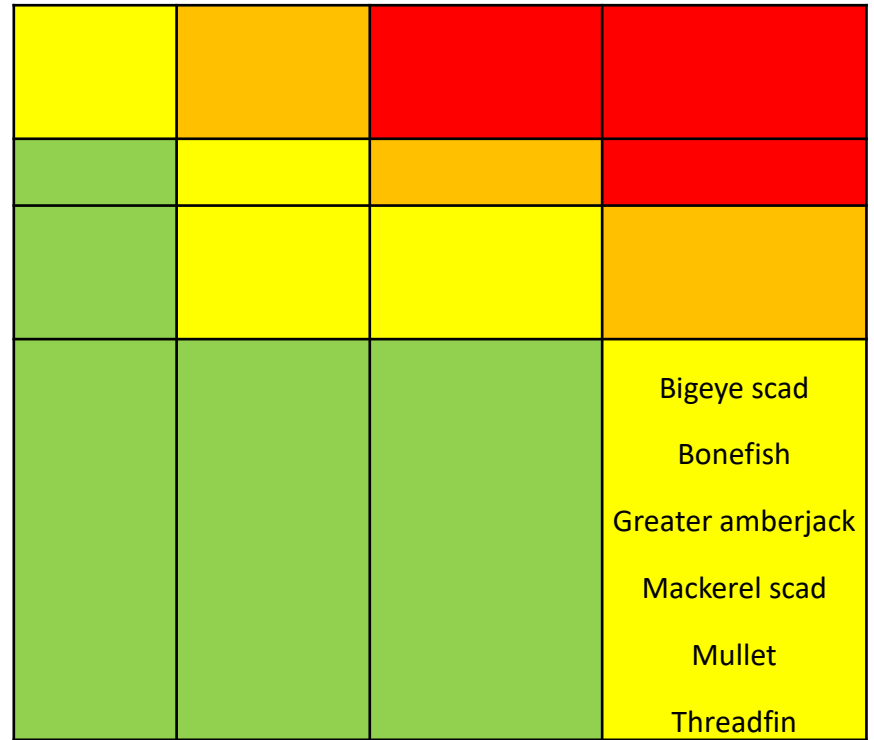
Sensitivity

Very High

High

Moderate

Low



Low

Moderate

High

Very High

Exposure



# Coral reef: Jacks, Emperors, Goatfish, Snappers



Sensitivity

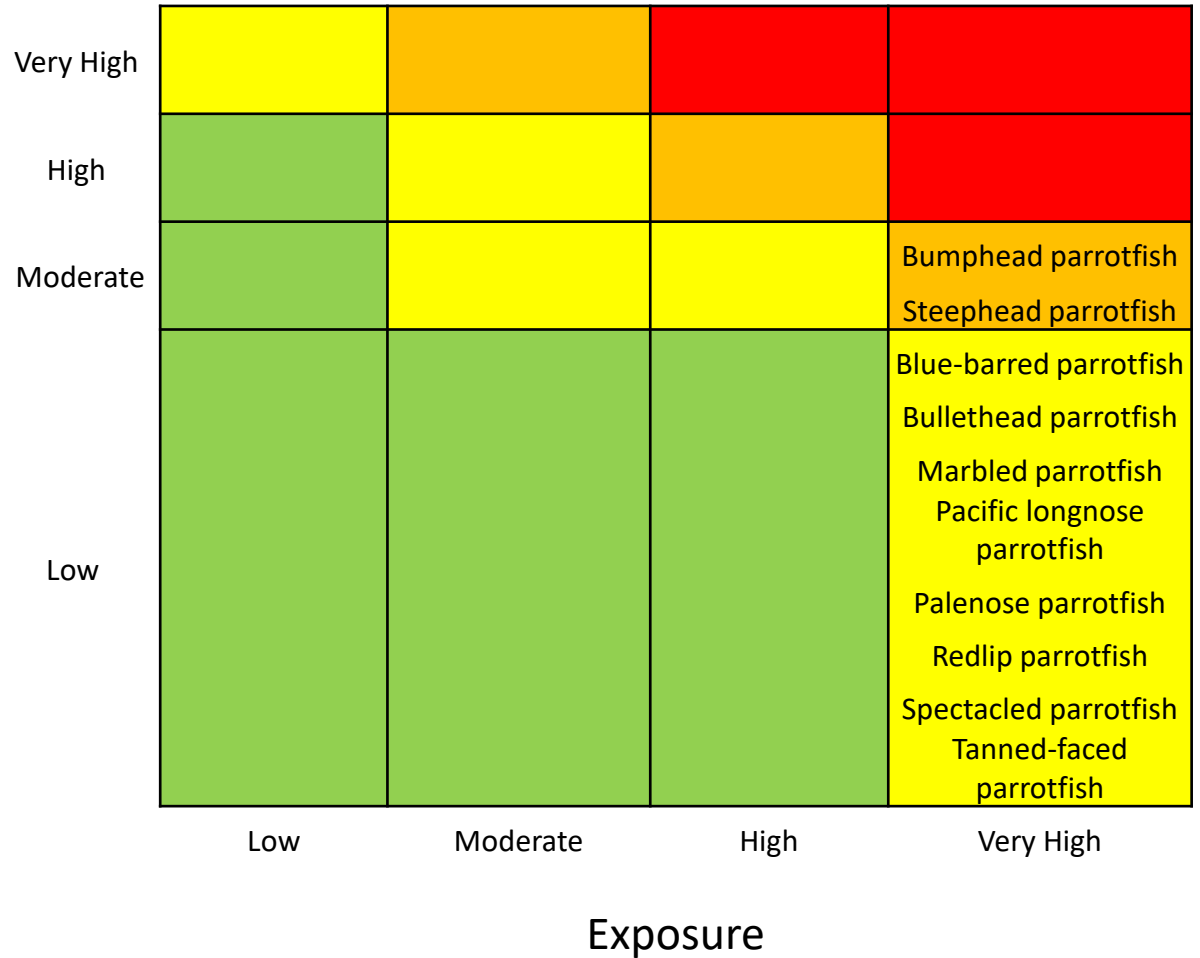
Very High  
High  
Moderate  
Low

Very High				
High				
Moderate			Blacktip grouper Whitesaddle goatfish	
Low			Bluefin trevally Bluestripe snapper Dash-and-dot goatfish Giant trevally Humpnose big-eye bream Orange-striped emperor Peacock grouper Yellowfin goatfish Yellowstripe goatfish	
	Low	Moderate	High	Very High

Exposure

# Coral reef parrotfish

Sensitivity





# Coral reef surgeonfish



Sensitivity

Very High				
High				
Moderate				Achilles tang Bluespine unicornfish Eyestripe surgeonfish Yellow tang
Low				Bristle-toothed surgeonfish Convict tang Sleek unicornfish
	Low	Moderate	High	Very High

Exposure

# Other coral reef



Sensitivity

Very High				
High				Arceye hawkfish Ornate butterflyfish
Moderate				Achilles tang Green damselfish Humphead wrasse Little spine foot
Low				Blotcheye soldierfish Brassy chub Brown chub Gold spotted spinefoot Humpnose big-eye bream Pinecone soldierfish Sabre squirrelfish Tripletail wrasse
	Low	Moderate	High	Very High
	Exposure			

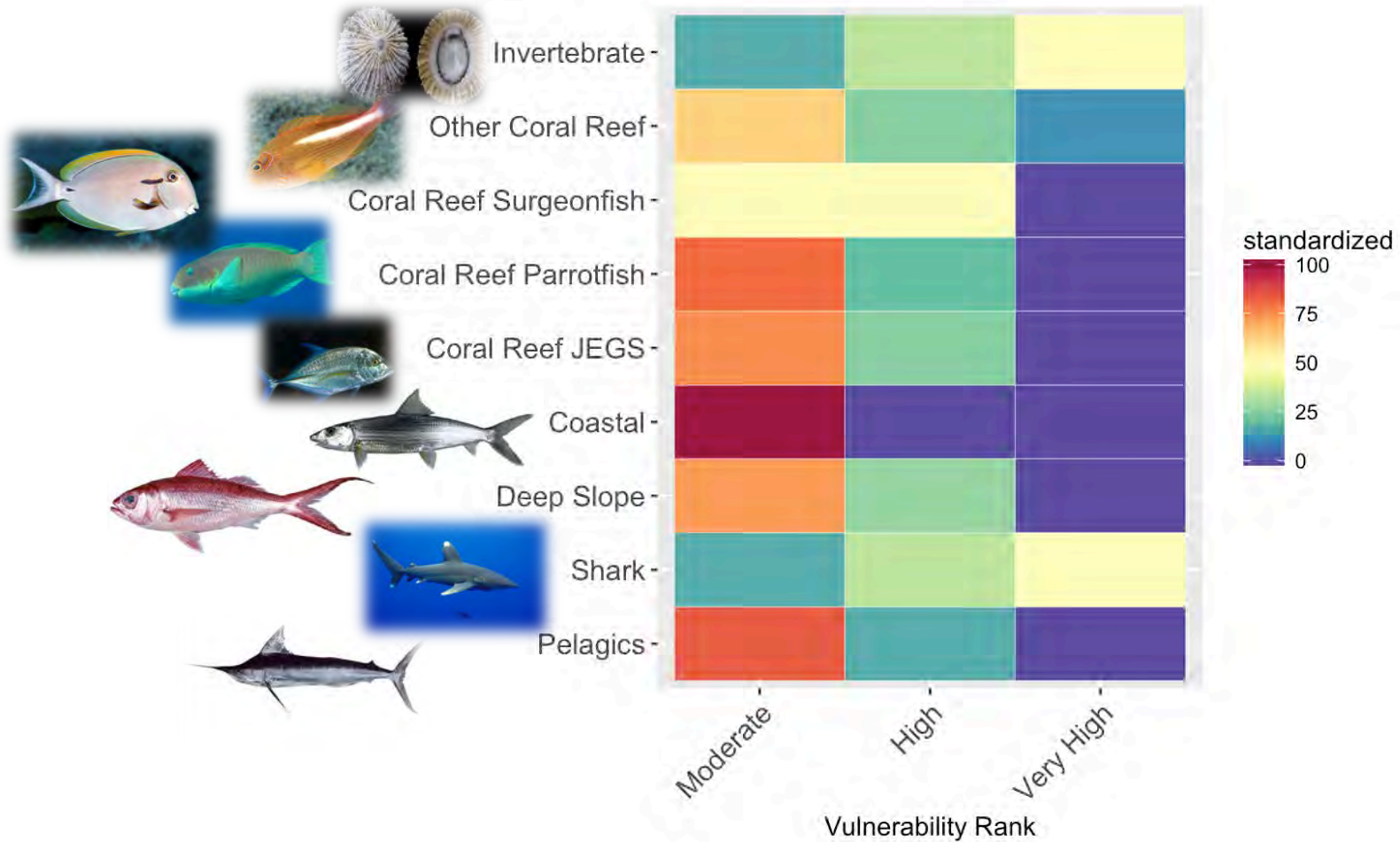
# Invertebrates



Sensitivity

Very High				Limpet
High				Black teatfish Collector urchin Maxima clam Surf redfish White teatfish
Moderate				Black sea cucumber Kona crab Palolo worm Spiny lobster
Low				Blue octopus Samoan crab
	Low	Moderate	High	Very High

Exposure



# Next steps: Vulnerability narrative



Spanish mackerel - *Scomberomorus maculatus*

Overall vulnerability rank = Moderate

Sensitivity = Low

Exposure = Very High

Data Quality = 0.79

Hare et al. 2016

<i>Scomberomorus maculatus</i>	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Stock Status	1.9	2.2	
Other Stressors	2.1	1.8	
Population Growth Rate	1.7	2.6	
Spawning Cycle	2.4	2.8	
Complexity in Reproduction	2.1	2.6	
Early Life History Requirements	2.3	1.2	
Sensitivity to Ocean Acidification	1.1	2.2	
Prey Specialization	1.3	2.8	
Habitat Specialization	1.6	3.0	
Sensitivity to Temperature	1.3	3.0	
Adult Mobility	1.3	2.4	
Dispersal & Early Life History	2.0	2.6	
<b>Sensitivity Score</b>	<b>Low</b>		
Sea Surface Temperature	4.0	3.0	
Variability in Sea Surface Temperature	1.0	3.0	
Salinity	3.1	3.0	
Variability Salinity	1.2	3.0	
Air Temperature	4.0	3.0	
Variability Air Temperature	1.0	3.0	
Precipitation	1.2	3.0	
Variability in Precipitation	1.3	3.0	
Ocean Acidification	4.0	2.0	
Variability in OA	1.0	2.2	
Currents	2.0	1.0	
Sea Level Rise	1.2	1.5	
<b>Exposure Score</b>	<b>Very High</b>		
<b>Overall Vulnerability Rank</b>	<b>Moderate</b>		

■ Low  
■ Moderate  
■ High  
■ Very High



How will results be used?

## ***Science***

Identify:

- Vulnerable species
- Key environmental drivers
- Unknowns in species biology and ecology

## ***Management***

- Provide context for fisheries management decisions
- Identify future scenarios + potential actions
- Support resilient oceans and human communities



# Acknowledgements

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