

Comparing Climate Vulnerability Assessment of Fish and Shellfish Resources across Large Marine Ecosystems

Elliott Hazen¹, **Myron A. Peck**², Kathy Mills³, Eddie Allison⁴, Ignacio Catalan⁵, William Cheung⁶, Lisa Colburn⁷, Julie Ekstrom⁸, Karen Hunter⁹, Elena Ojea¹⁰, Mark Payne¹¹, Gretta Pecl¹², John Pinnegar¹³, Nancy Shackell¹⁴, and Paul Spencer¹⁵

1) NOAA NMFS Southwest Fisheries Science Center, Pacific Grove, CA, USA

2) University of Hamburg, Hamburg, Germany.

3) Gulf of Maine Research Institute, Portland, ME, USA

4) University of Washington, Seattle, WA, USA

5) Spanish National Research Council, University of the Balearic Islands, Majorca, Spain

6) University of British Columbia, Vancouver, Canada

7) NOAA NMFS Northeast Fisheries Science Center, Narragansett, RI, USA

8) University of California, Davis, CA, USA

9) Department of Fisheries and Oceans, Nanaimo, BC, Canada

10) University of Vigo, Vigo, Spain

11) DTU-Aqua, Lyngby, Denmark

12) University of Tasmania, Hobart, Tasmania, Australia

13) CEFAS, Lowestoft, United Kingdom

14) Department of Fisheries and Oceans, Dartmouth, Canada

15) NOAA NMFS Alaska Fisheries Science Center, Seattle, WA, USA

myron.peck@uni-hamburg.de



ICES
CIEM



ICES PICES Strategic Initiative on Climate Change Impacts on Marine Ecosystems



Some of our workshop goals:

1

- Compare and contrast various climate vulnerability assessment (CVA) approaches used for fisheries and aquaculture including their strengths and weaknesses,

2

- Discuss opportunities for comparative studies looking at the relative vulnerability of species in different LMEs,

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- Discuss best practices for extending vulnerability assessments of marine fish and invertebrates to the human communities that depend on these resources,

- Discuss opportunities for operationalizing CVA methods
- Incorporate climate change text into ecosystem overviews (ICES)

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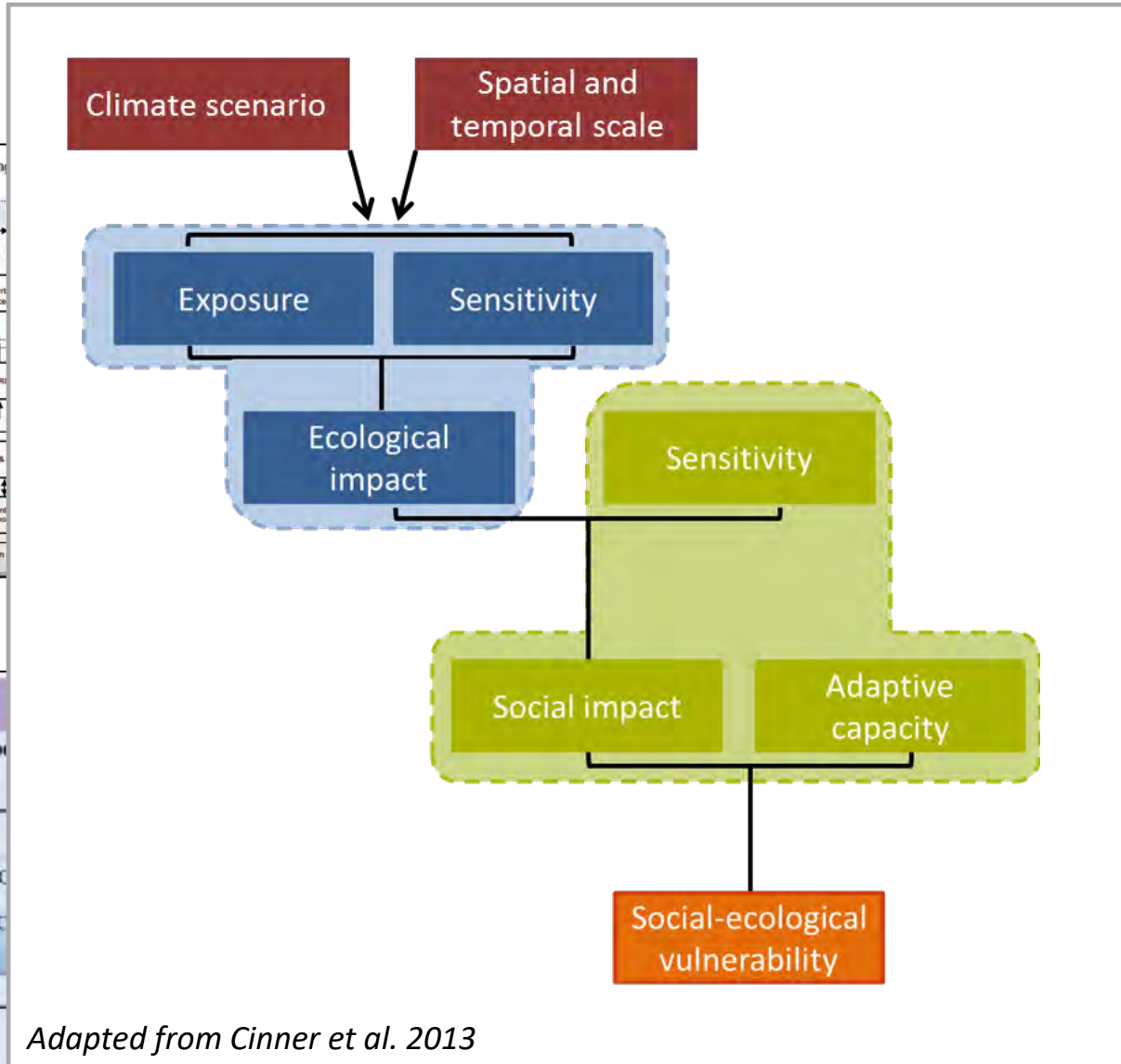
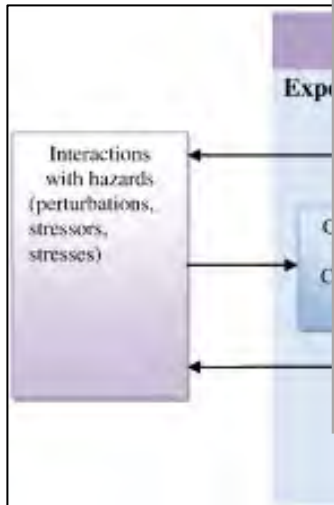
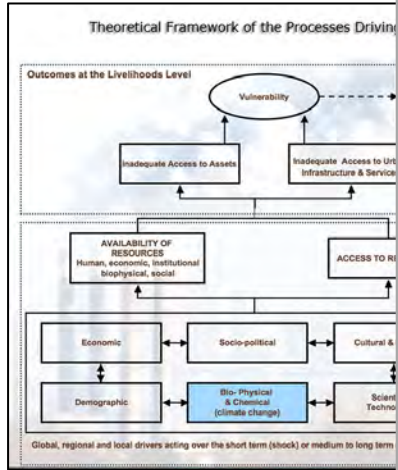
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Frameworks...



Adapted from Cinner et al. 2013

→ negative impact
- - - Positive or negative impact

$$\text{VULNERABILITY} = \text{EXPOSURE} + \text{SENSITIVITY}$$

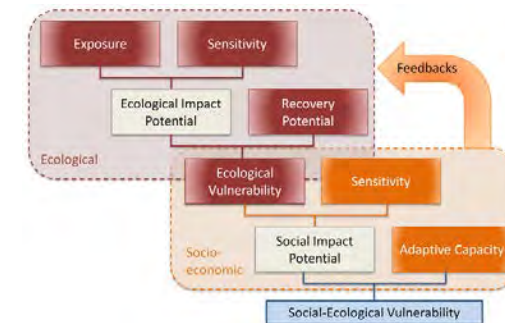
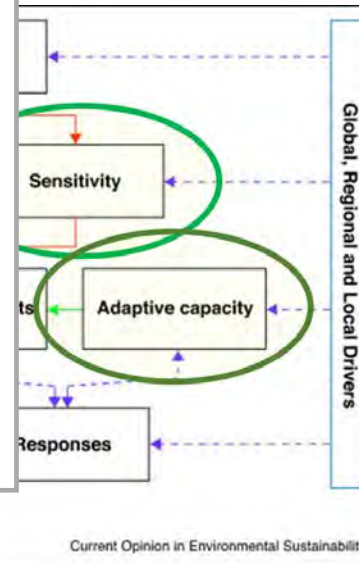
Adaptive Capacity

- ✓ Still significant, but addressed separately
- ✓ Not part of vulnerability formula/score
- ✓ Adaptive actions taken for assets help reduce exposure and/or sensitivity

The new modified formula for the vulnerability of the built environment.



Vulnerability is commonly comprised of three equally weighted metrics or components



Comparisons of 25 CVAs

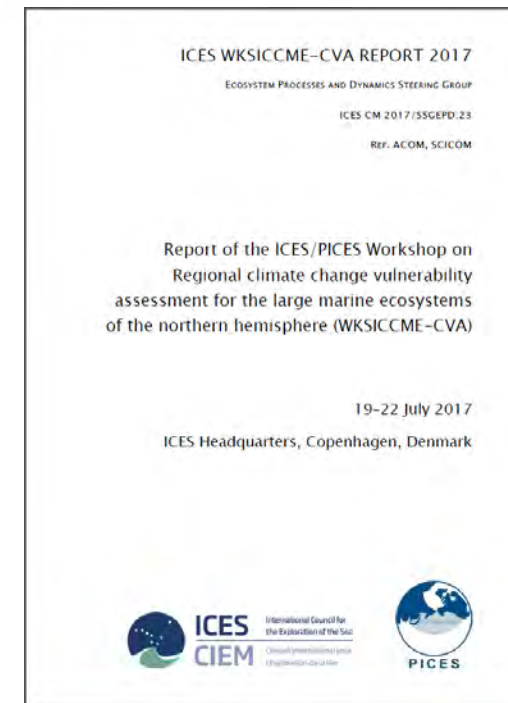
- Location
- Project name
- Rationale/Purpose
- Targeted users
- Finest scale (unit of analysis)
- Biological component (Y/N)
- Species / habitat focus
- Socio-ecological component (Y/N)
- Socio-economic scale?
- Physical CC scenario(s) (e.g. RCPs) examined
- Capturing uncertainty
- Timeframe covered
- Stage of completion
- Key resources needed
- What would you change if repeated?
- Application: stakeholder engagement, outreach
- Literature citation
- Website info

Metadata

Focus

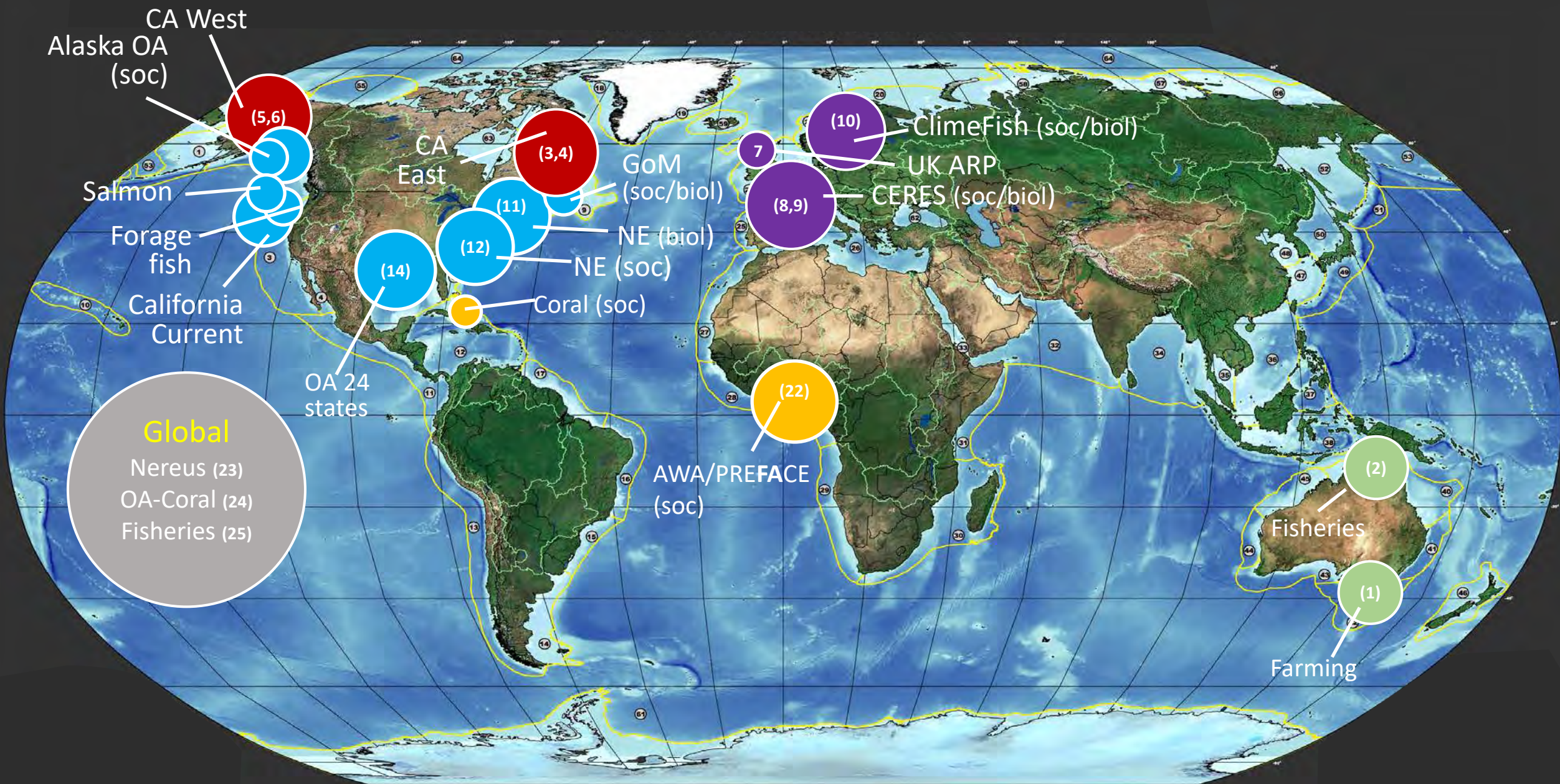
Scenario information

Nuts & Bolts



<https://goo.gl/VDDG7g>

25 Climate Vulnerability Assessments at WKSICCME-CVA

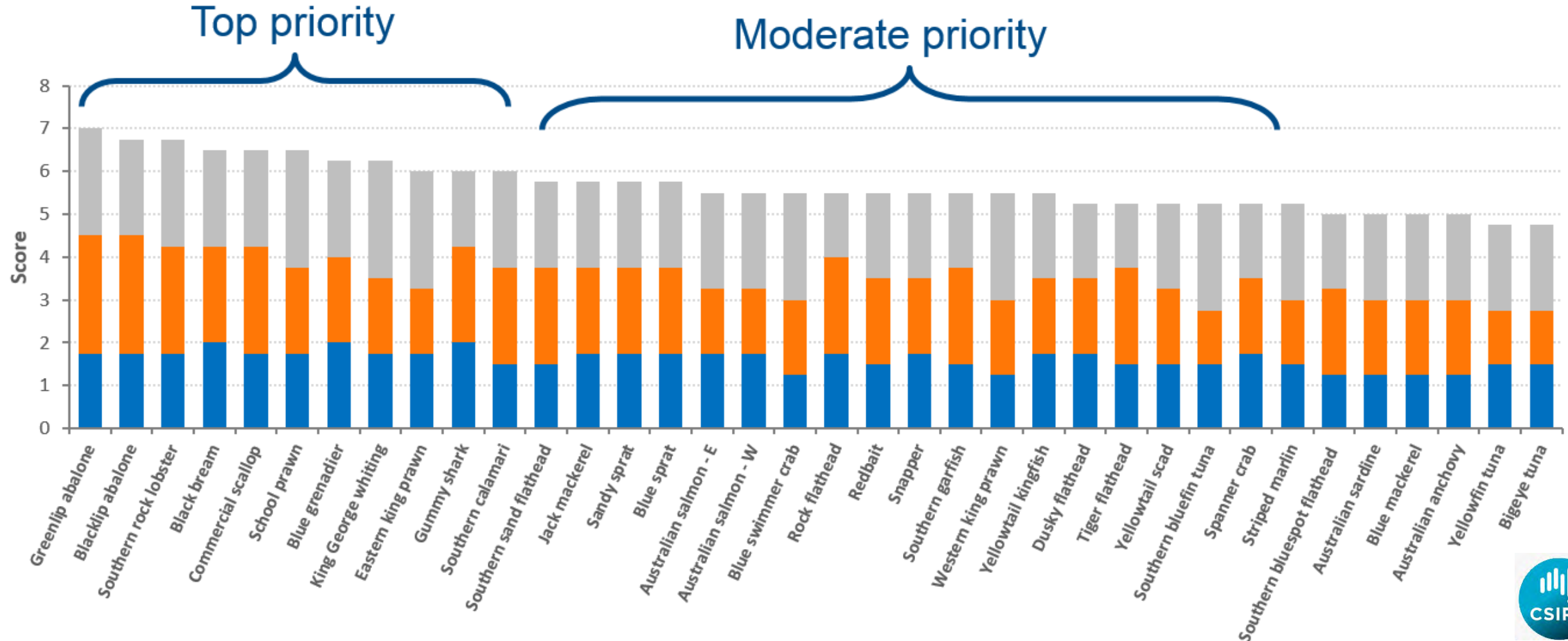


Fisheries
 Aquaculture
 Ecological
 Social

	Fisheries	Aquaculture	Ecological	Social	
Southeast Australia Rapid (1)					Australia
Gulf of Carpentaria (2)					
Eastern Canada, CVA (3)					
E Canada Coastal Infrastructure (4)					
Pacific Coastal Waters (5)					
Pacific Canada Infrastructure (6)					
UK ARP (7)					
CERES (Fisheries) (8)					Europe
CERES (Aquaculture) (9)					
ClimeFish (Europe) (10)					
US East Coast CVA (11)					USA Pacific
USA 24 Coastal States (12)					
USA NE Shelf (13)					
USA, Shellfish OA (14)					
California Current (15)					
NE Pacific Salmon (16)					
Forage Fish automated CCCVA (17)					
Eastern Bering Sea (18)					USA Pacific
Alaska Fisheries OA (19)					
East Africa (20)					
Arabian Gulf (21)					
Caribbean Coral (22)					
Coral Reefs OA (23)					
Fisheries Global (24)					
Nereus Program (25)					

SE Australia: Vulnerability / Sensitivity Analysis

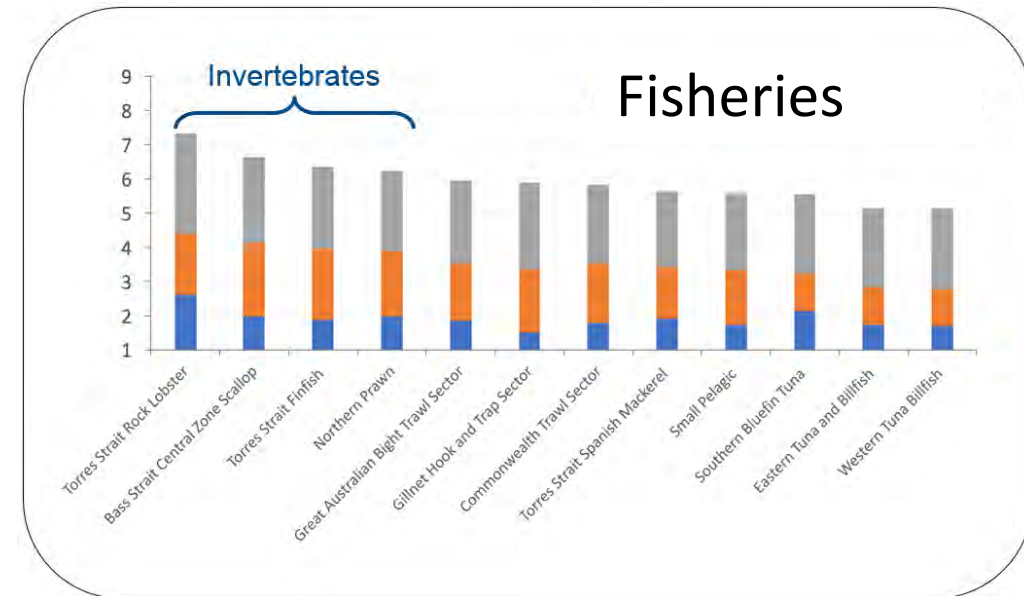
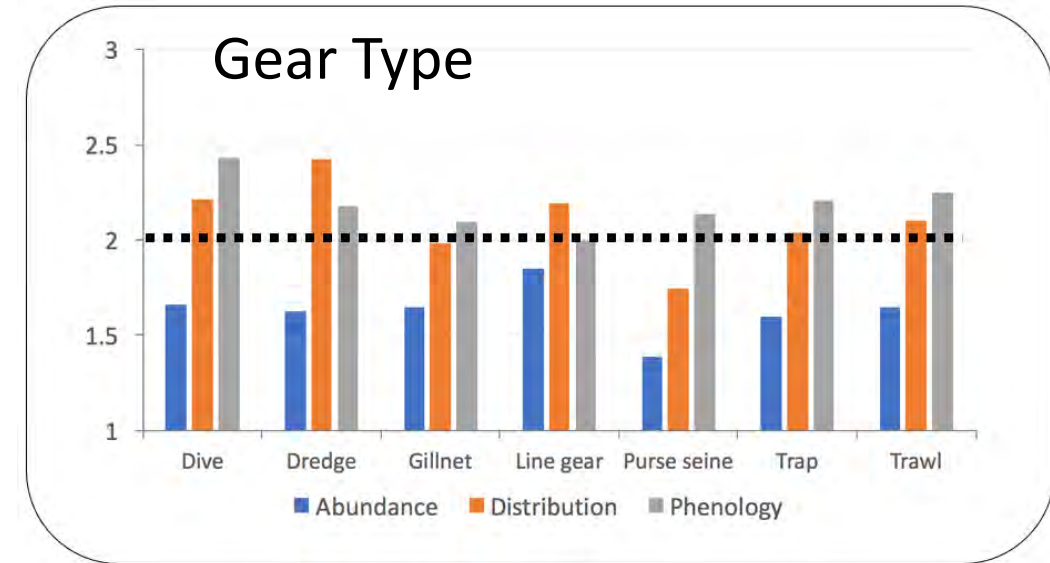
Gretta Pecl
Beth Fulton



- **Abundance** – life history traits (fecundity, recruitment pattern, longevity, feeding type, habitat dependence)
- **Distribution** – larval dispersal, adult movement, physiological tolerance, available habitat (range shift capacity)
- **Phenology** – environmental cues, spawning & moulting duration, migration



Combined Regional Assessments → Gear Type → Fisheries



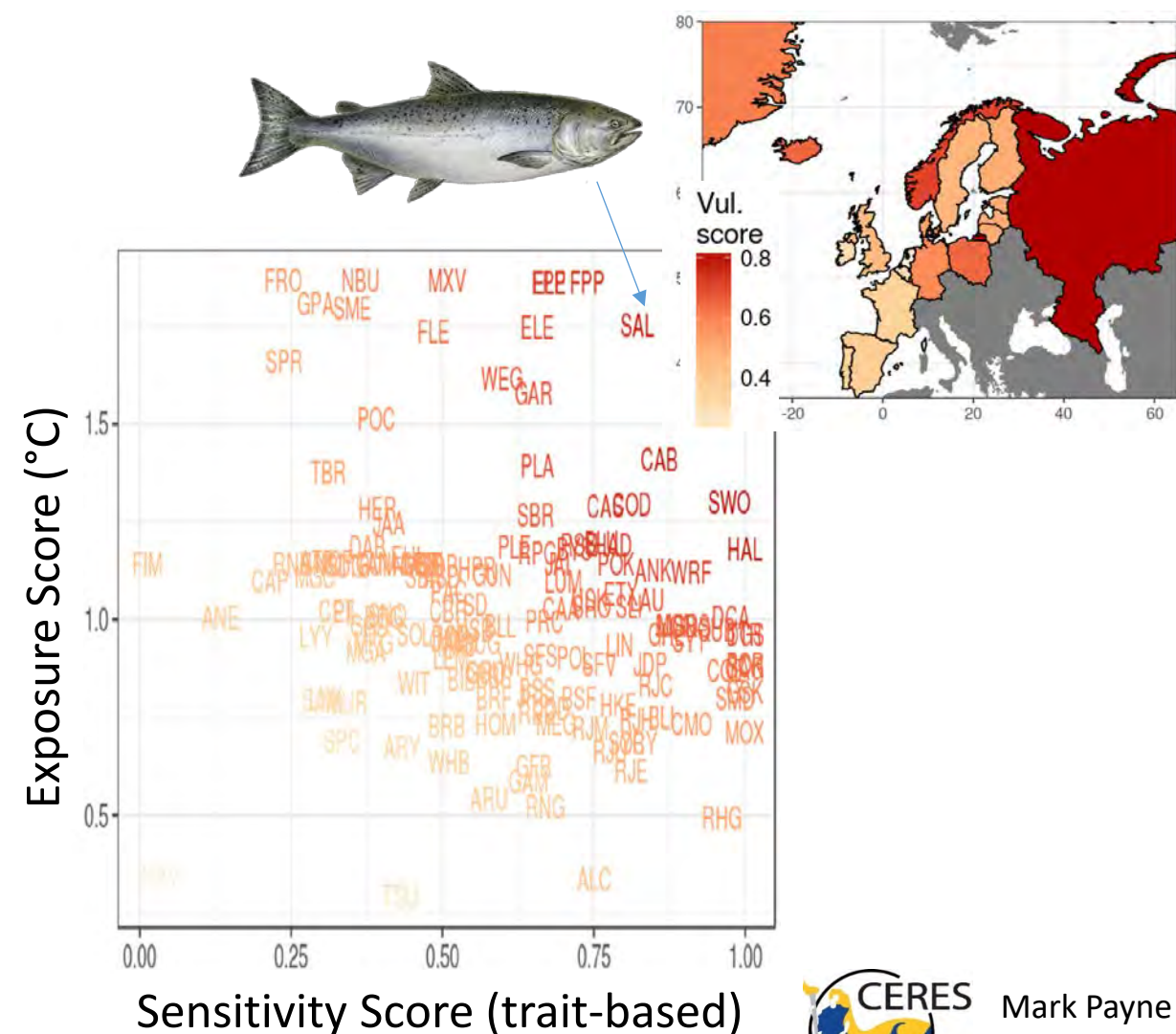
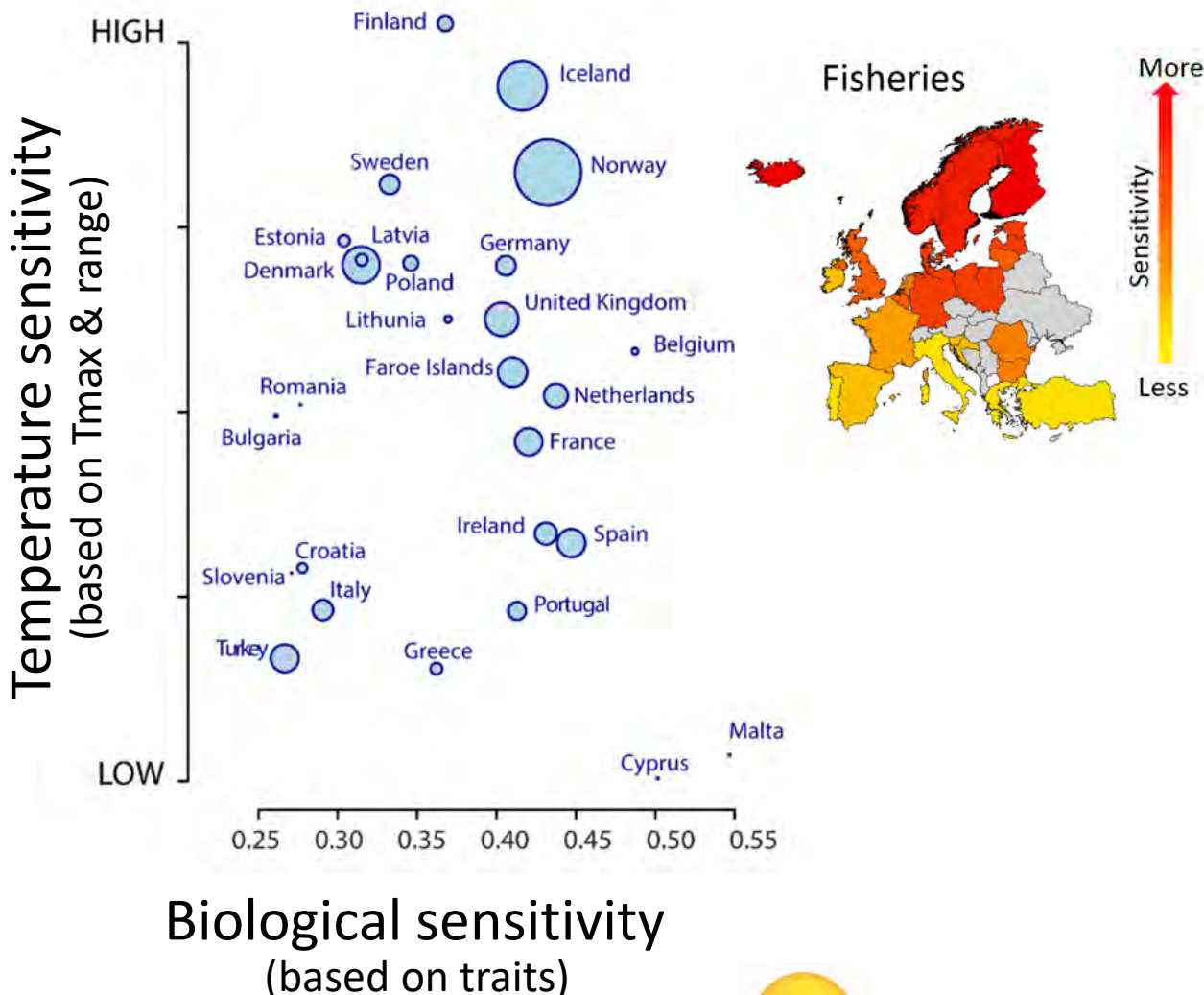
Beth Fulton & Alistair Hobday & Gretta Pecl

Ongoing (national-level) Climate Vulnerability Assessments in Europe

This project has received funding from the European Union's Horizon 2020 research and innovation action under grant agreement no.677039



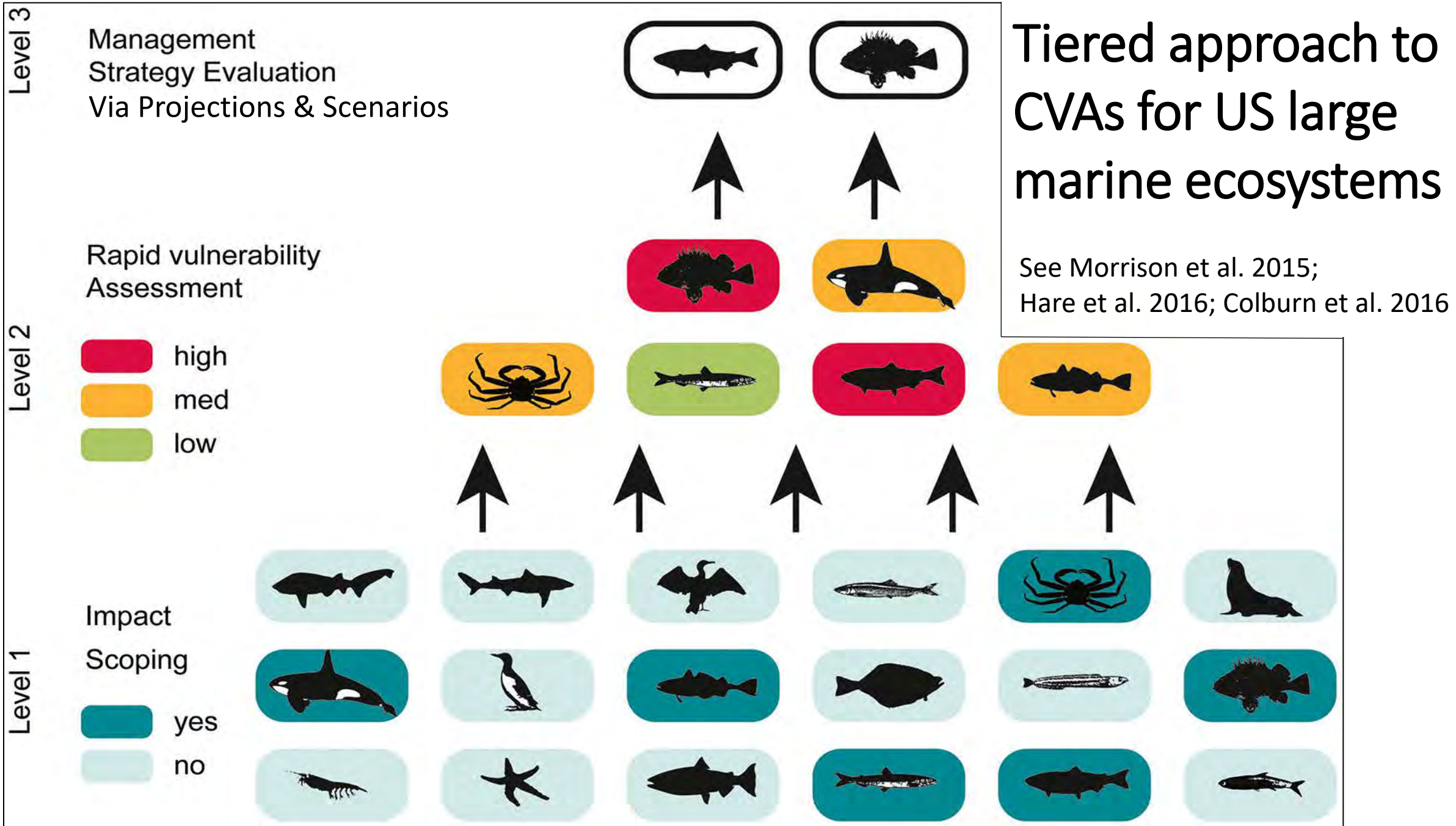
EU H2020



Marie-Ann Blanchet
Michaela Aschon

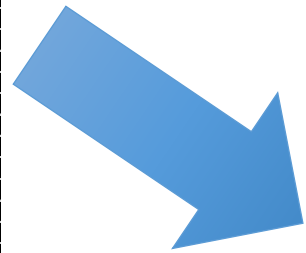


Mark Payne



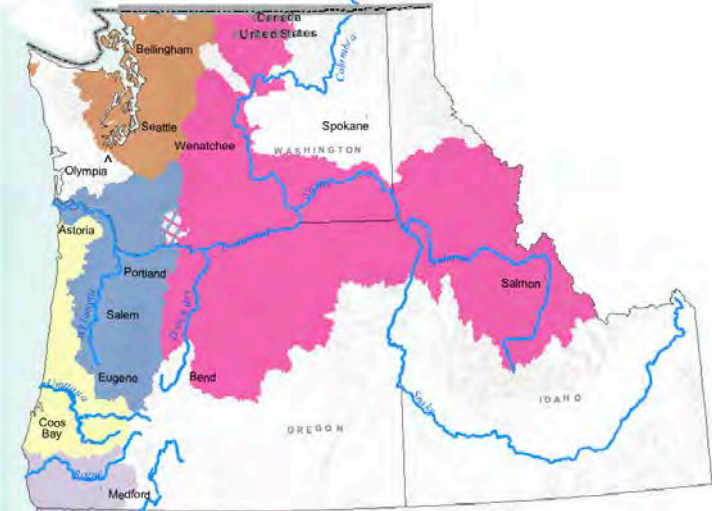
West Coast CVA Preliminary Results

Biological Sensitivity	Climate Exposure			
	Low	Moderate	High	Very High
Very High			Green Sturgeon Yelloweye Rockfish - Puget Sound <i>Chinook salmon</i>	
High			Coho salmon Sockeye salmon Steelhead Salmon Black Rockfish Bluefin Tuna Bocaccio Rockfish - Puget Sound Canary Rockfish Canary Rockfish - Puget Sound Chum salmon Yelloweye Rockfish <i>Pacific ocean perch</i> <i>Spiny dogfish</i> Yellowtail Rockfish	
Moderate	Longnose Skate Pacific Cod		Blackgill Rockfish Bocaccio Rockfish Calico Rockfish Chillipepper Rockfish China Rockfish Cowcod Rockfish Widow Rockfish Aurora Rockfish Common Thresher Shark Darkblotched Rockfish Gopher Rockfish Honeycomb Rockfish Kelp Greenling Lingcod Market Squid Mola Pacific Herring Petrale Sole Pygmy Rockfish Rosethorn Rockfish Rougheye rockfish Sablefish Shortbelly Rockfish Southern Eulachon Striped Marlin <i>North Pacific Albacore</i>	
Low	Arrowtooth Flounder Dover Sole Pacific Grenadier		Leopard Shark Northern Anchovy Pacific Sardine Shortraker rockfish Shortspine thornyhead Starry flounder White Shark Blue Shark English Sole Jack Mackerel Jack Smelt Pacific Chub Mackerel Pacific Sanddab Pacific Whiting Rock Sole Shortfin Mako Shark Swordfish Yellowfin Tuna	

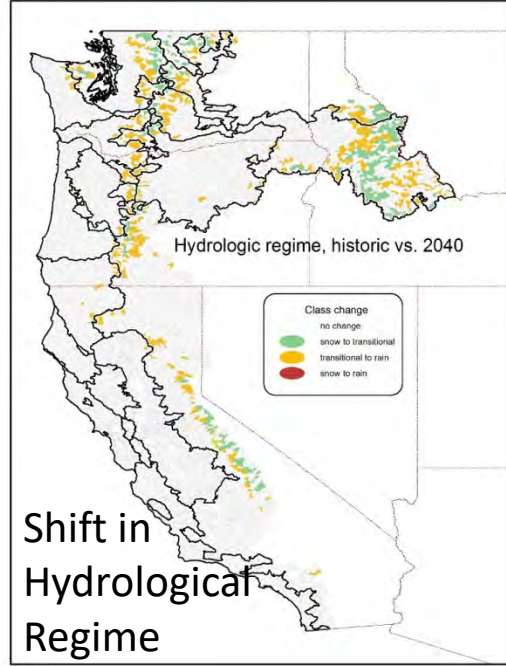


- Green Sturgeon
- Yelloweye Rockfish - Puget Sound
- Chinook salmon*
- Coho salmon
- Sockeye salmon
- Steelhead Salmon
- Black Rockfish
- Bluefin Tuna
- Bocaccio Rockfish - Puget Sound
- Canary Rockfish
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- Chum salmon
- Yelloweye Rockfish
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- Yellowtail Rockfish

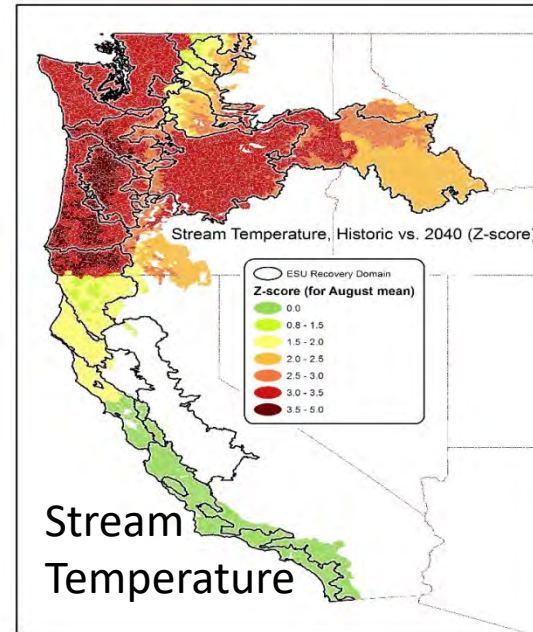
5 out of 6 are
anadromous



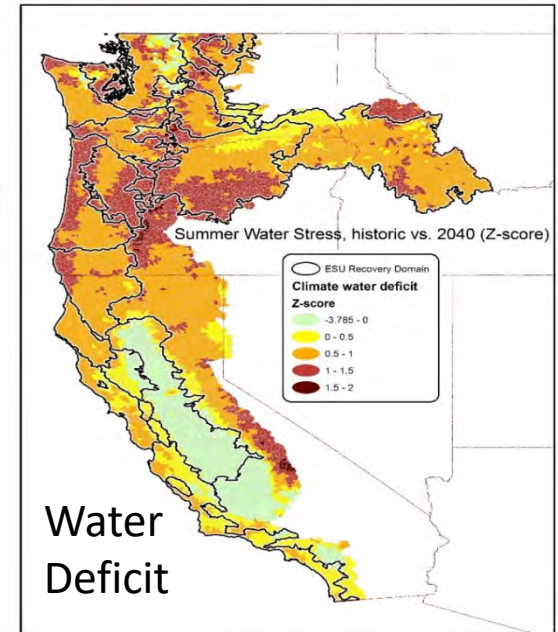
- Recovery Domain**
- Puget Sound
 - Interior Columbia
 - Willamette / Lower Columbia and Interior Columbia Overlap
 - Willamette / Lower Columbia
 - Oregon Coast
 - Southern OR / Northern CA Coast
 - So. OR / No. CA Coast and North-Central CA Coast Overlap
 - North-Central California Coast
 - North-Central California Coast and Central Valley Overlap
 - Central Valley
 - South-Central / Southern CA Coast



Shift in Hydrological Regime

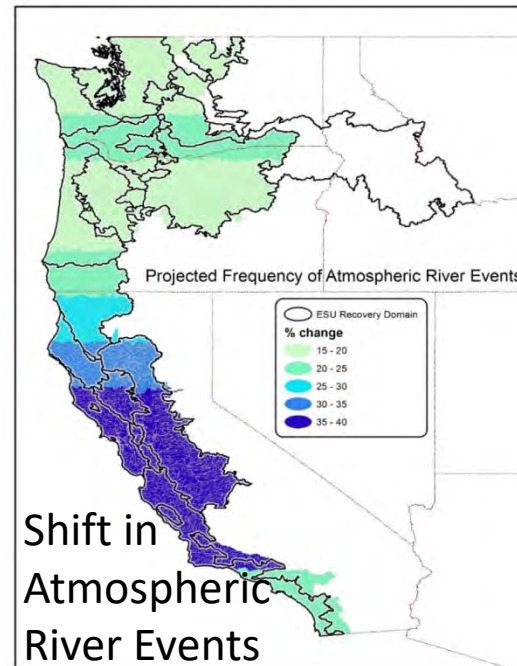


Stream Temperature

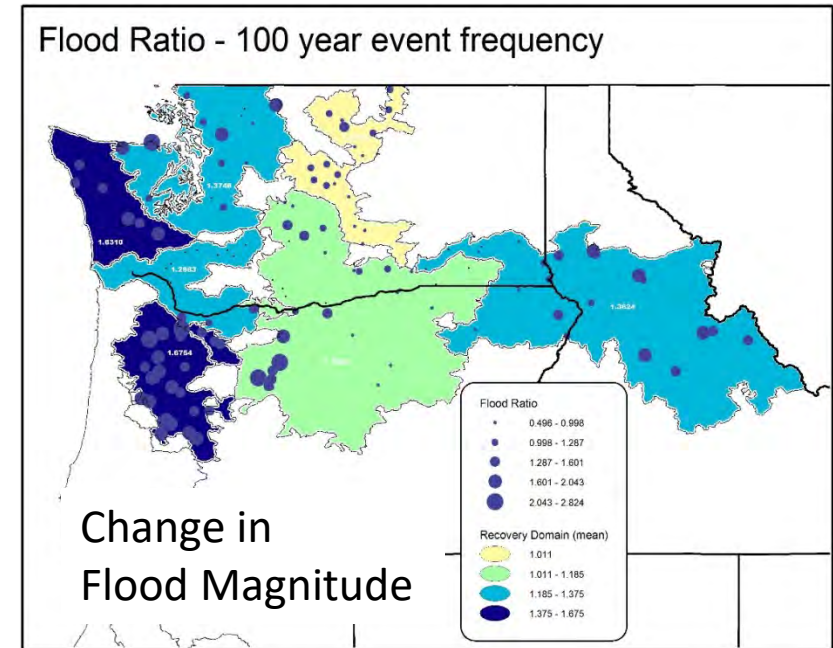


Water Deficit

Salmon-specific CVA

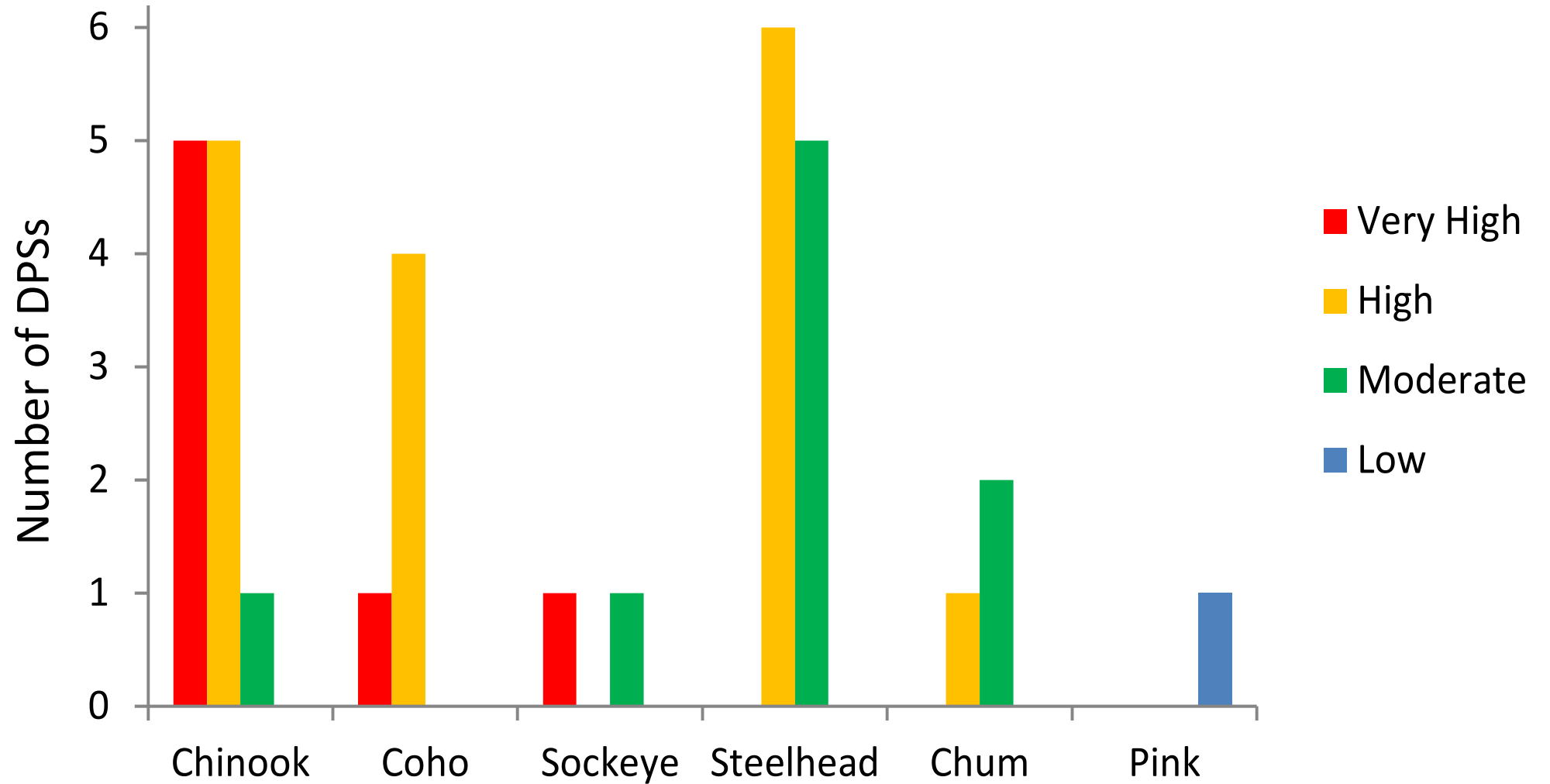


Shift in Atmospheric River Events



Change in Flood Magnitude

Spread of distinct population segments within each species



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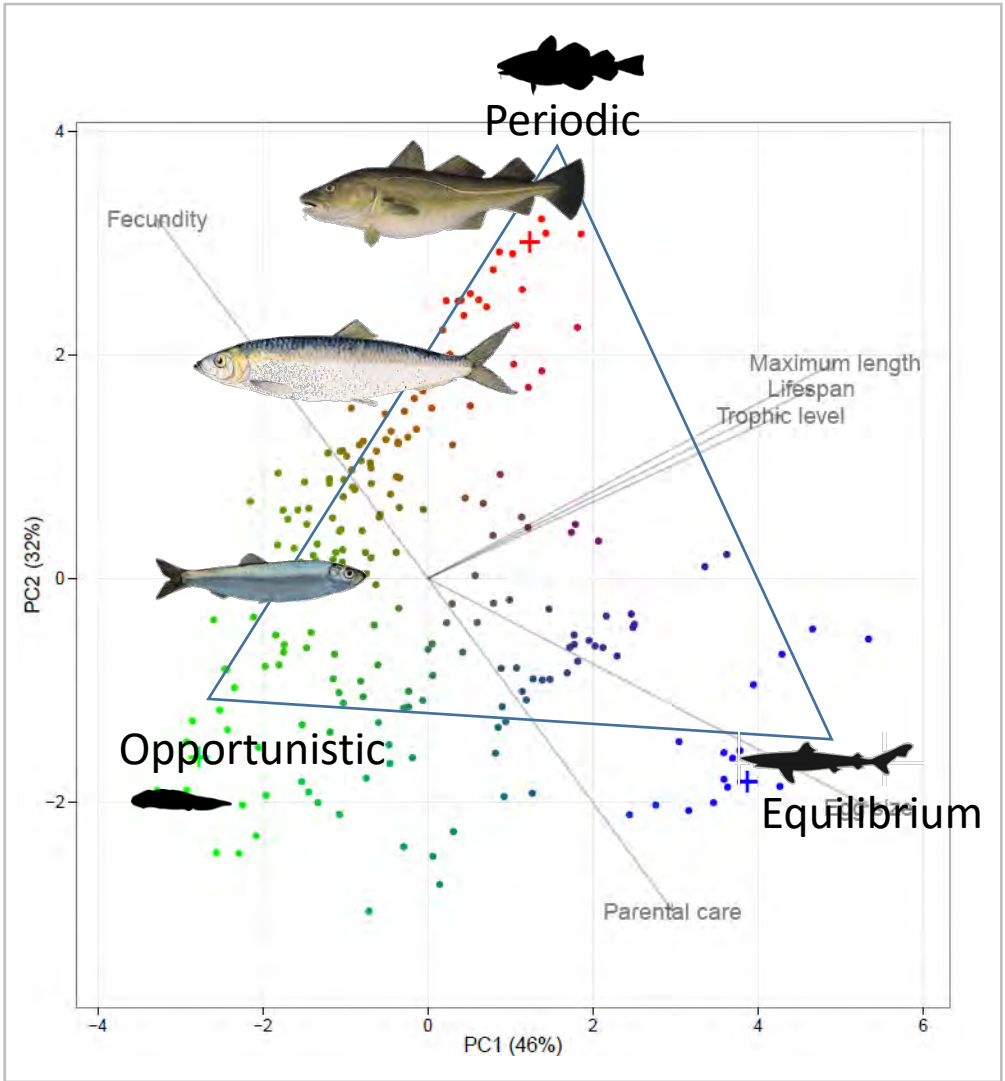
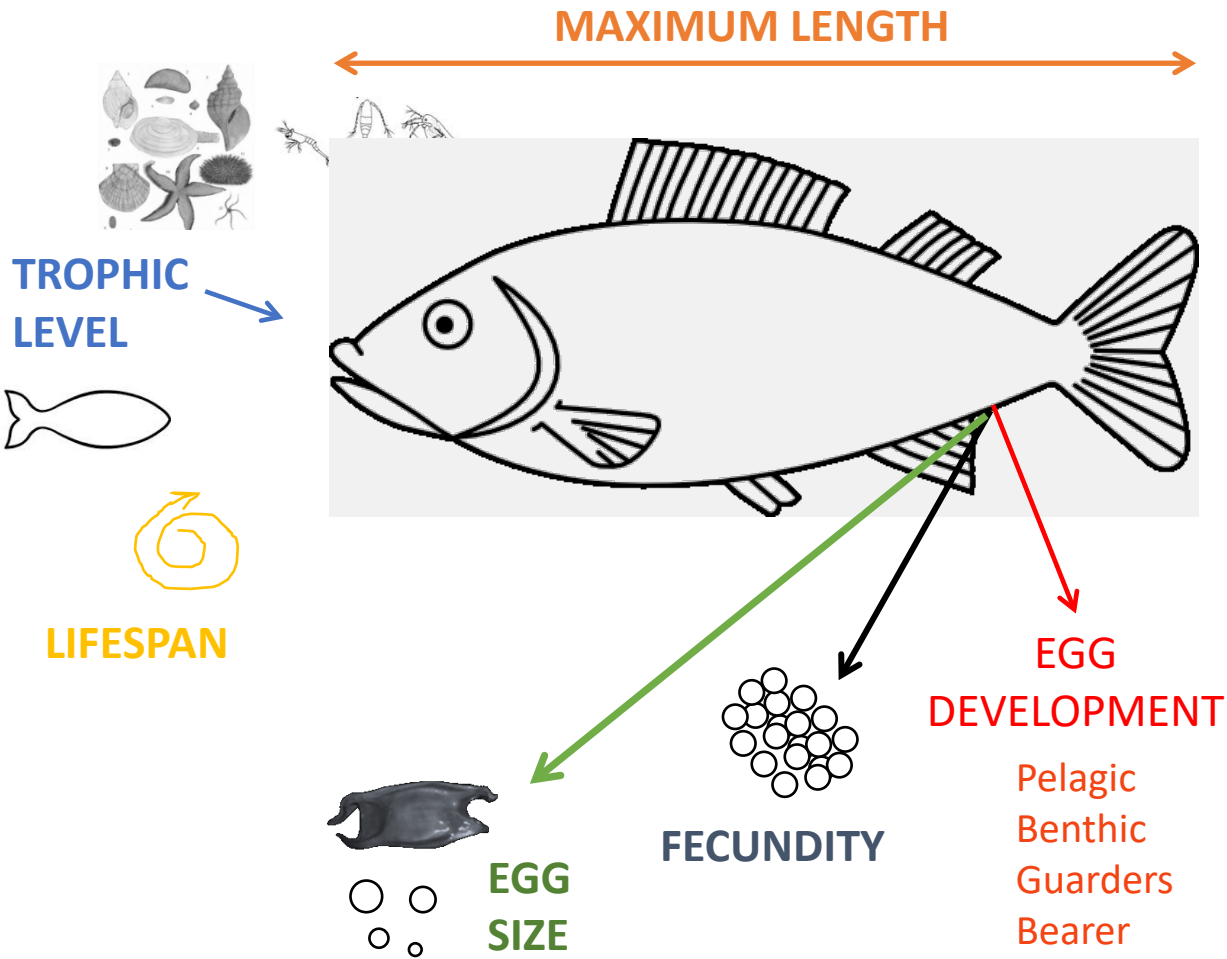
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Trait-based approach (comparisons across LMEs)



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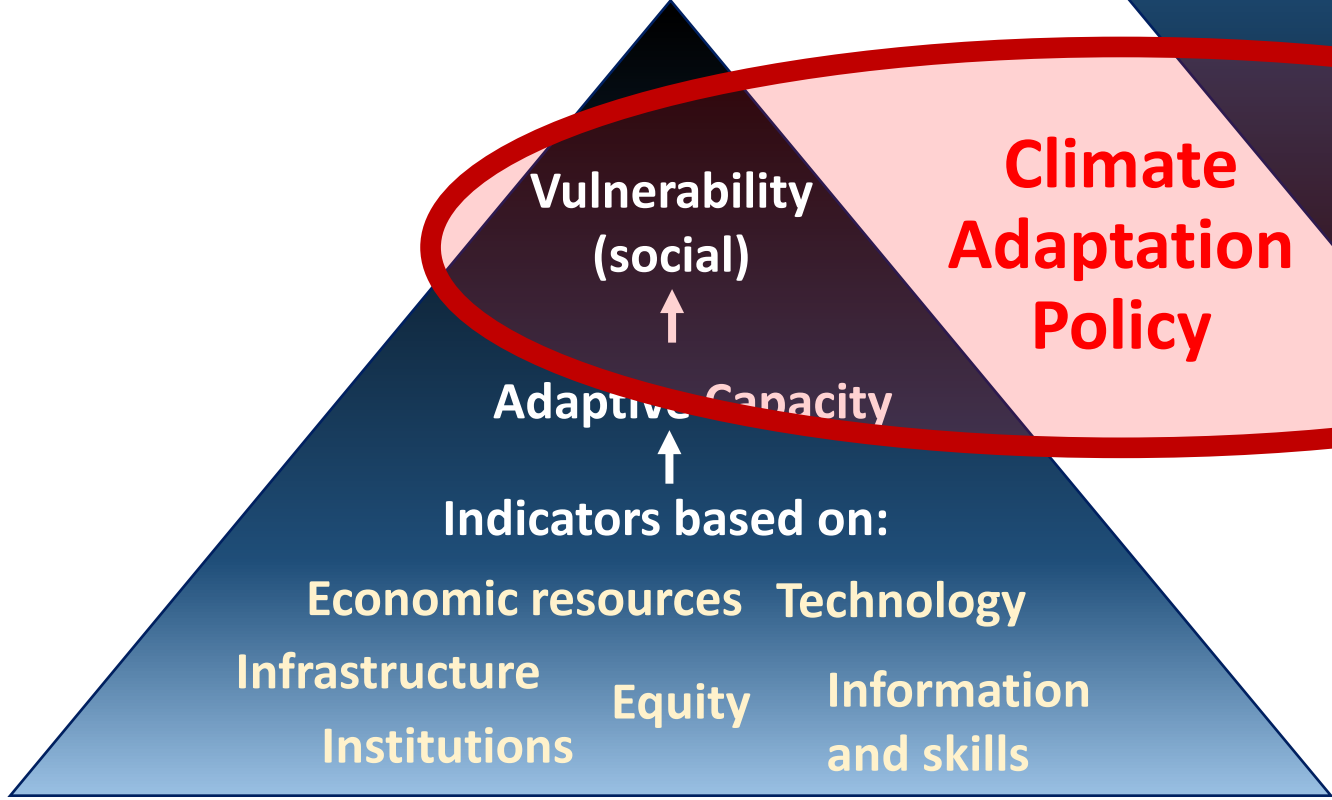
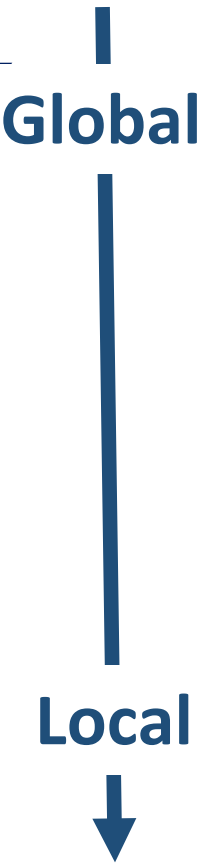
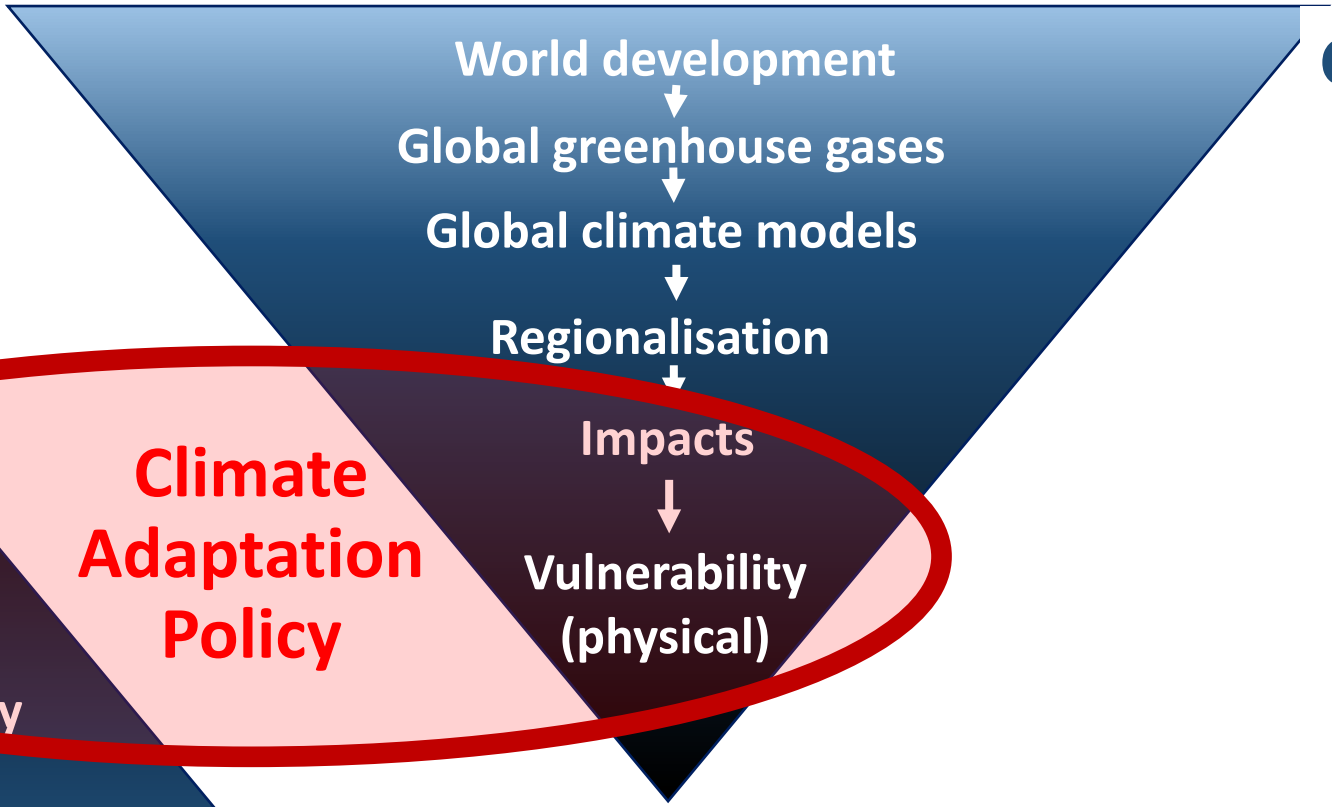
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Biological - Top-down approach

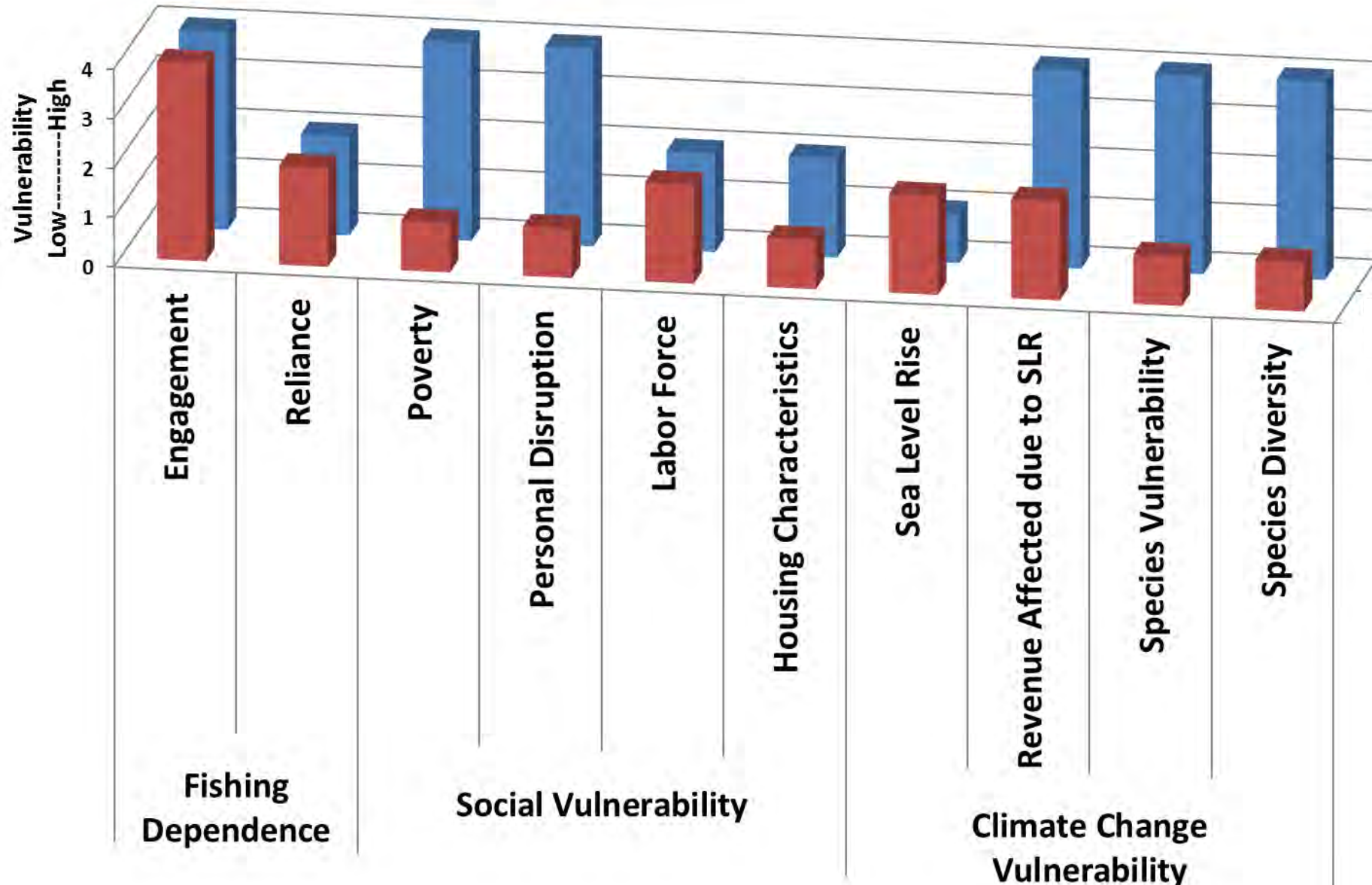


Social - Bottom-up approach

Dessai & Hulme 2004



Socio-ecological Vulnerability (combine or not to combine?)



New Bedford, MA
Point Judith, RI

Lisa Colburn





Some take-home messages

- The 25 CVAs compared here used similar frameworks but components and methods depended heavily on the purpose and data availability.
- Opportunities exist to normalized results to facilitate inter-regional comparisons which could be useful for global-level prioritization such as UN SDG-14
- Few analyses integrated vulnerability rankings based on both biological resources as well as social and economic indicators of human communities – work is ongoing...
- CVAs of fish & shellfish are often conducted at large (basin-) scales that limit the potential gains in knowledge relevant to human management systems and communities (a barrier to socio-ecological CVAs).
- Importance of how results communicated to stakeholders (policy) was an important discussion at the workshop.
- A paper stemming from this workshop / report is in prep. (the report can be accessed at <https://goo.gl/VDDG7g>)



Thank you! Questions?



Not pictured: William Cheung, Jörn Schmidt

