Building capacity to adapt to climate change in communities engaged in small-scale fishing and aquaculture

Edward H. Allison

eha1@uw.edu

www.marinalab.org

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SCHOOL OF
Marine & Environmental Affairs
College of the Environment • University of Washington

Outline

1. Climate change research: from impacts to responses

2. Key principles: from vulnerability assessments to adaptation actions

3. What is adaptive capacity and how do you measure it?

4. Assessing the outcomes of adaptation actions: from principles to indicators (workshop outcomes)

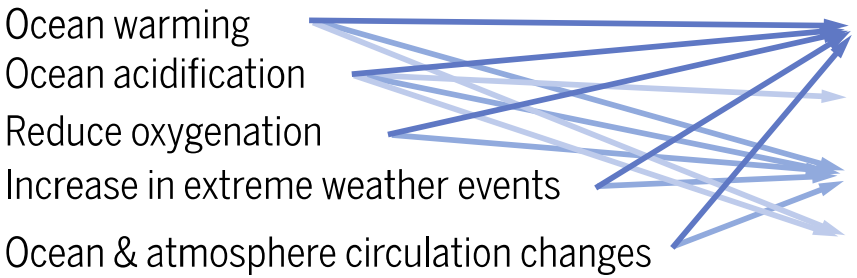
1: A changing ocean: from impacts to responses

IPCC 5th Assessment: Sectors of the 'blue economy' that are based on living marine resources are all predicted to be negatively impacted under anthropogenic GEC

Confidence in effects

- Very high
- High to very high
- High
- Medium high
- Medium
- Low

***IPCC confidence levels assigned to impacts on marine industries**



Allison & Bassett (2015) Climate change in the oceans: human impacts and responses *Science*

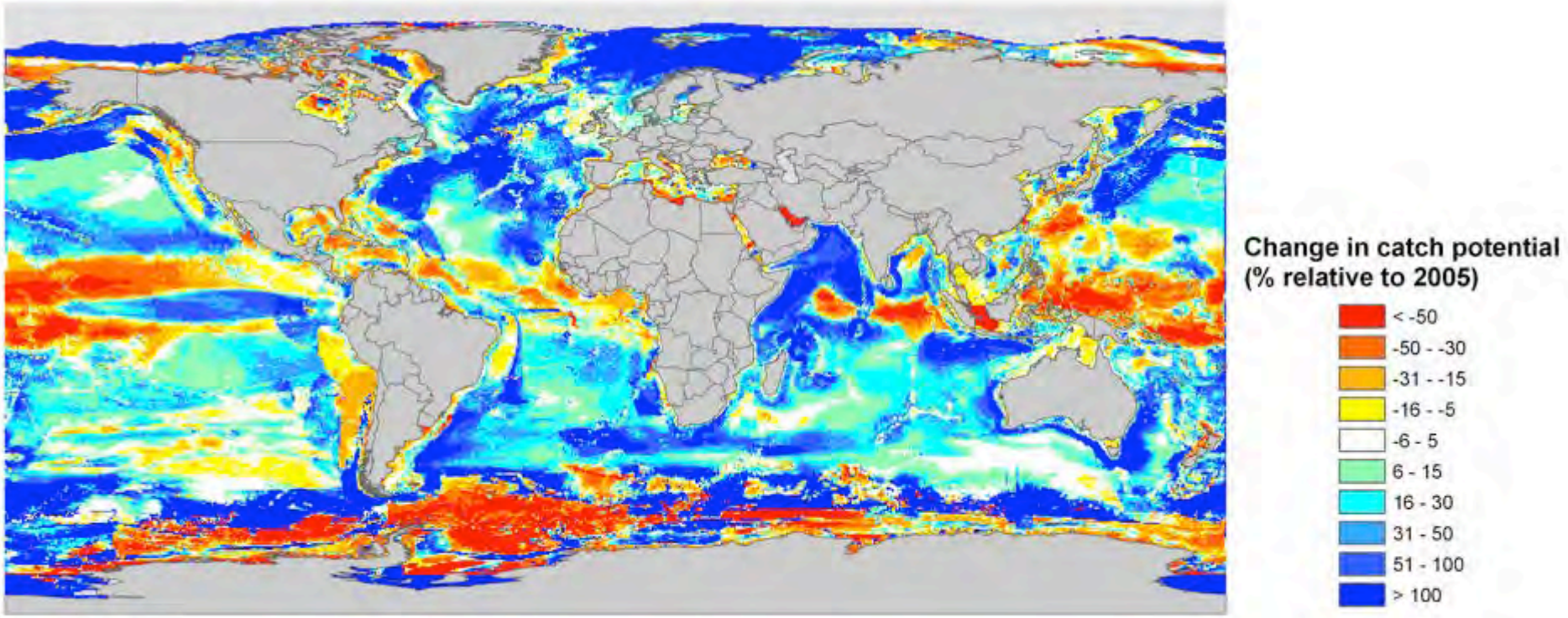
Engaging citizens in climate action: "Fear won't do it"

(O'Neill & Nicholsen-Cole, 2009. *Sci. Comm.* 30(3)

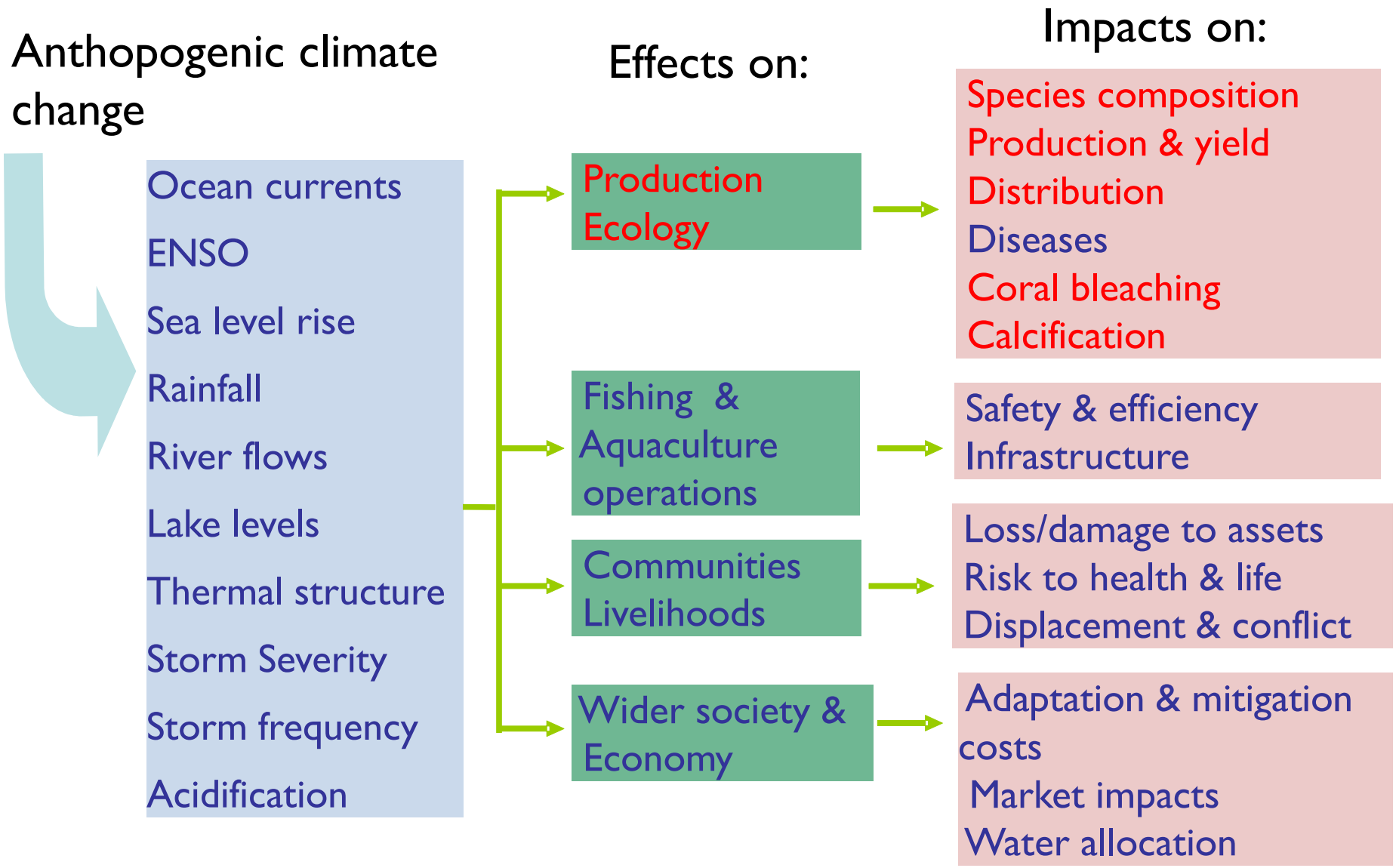
“non-threatening images that relate to every-day emotions and concerns tend to be the most engaging”

Change in production potential of fish (%) by 2055, relative to 2005 values

Cheung et al 2010 *Global Change Biol.*

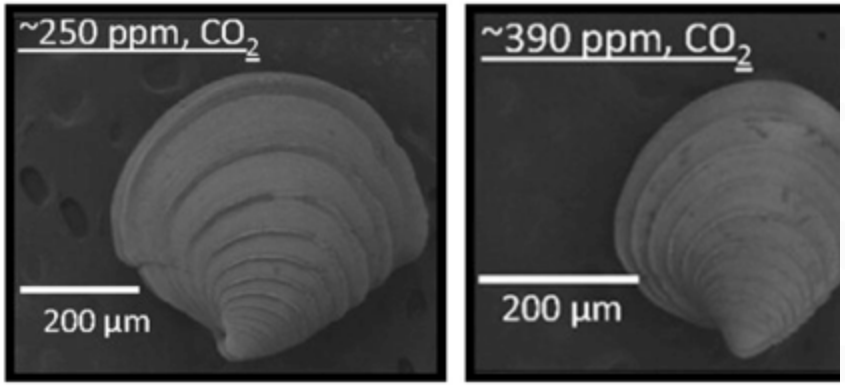


CC impacts on fisheries and aquaculture



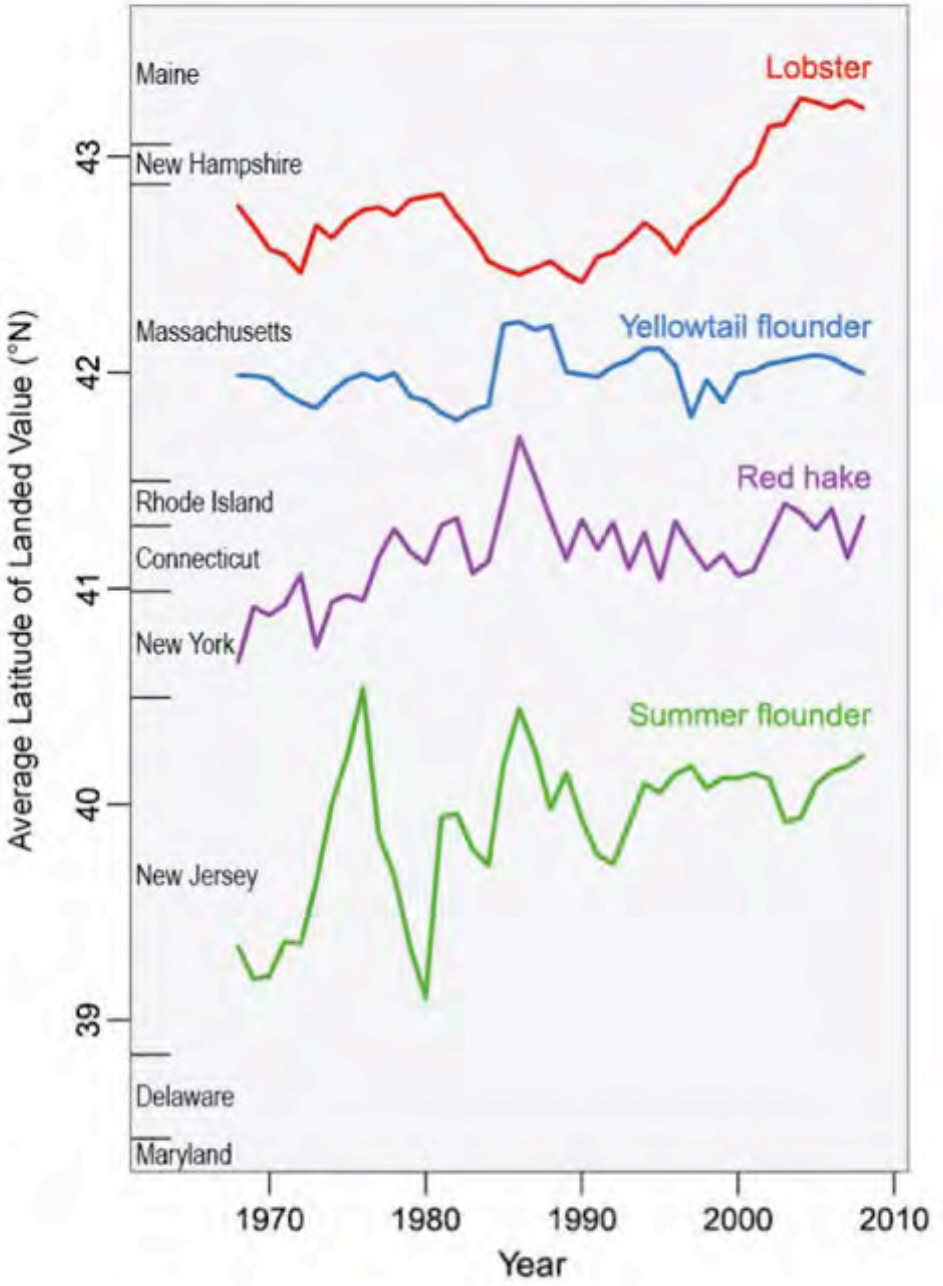
Badjeck, Allison, Halls & Dulvy 2010 *Marine Policy*

Ocean Acidificatio



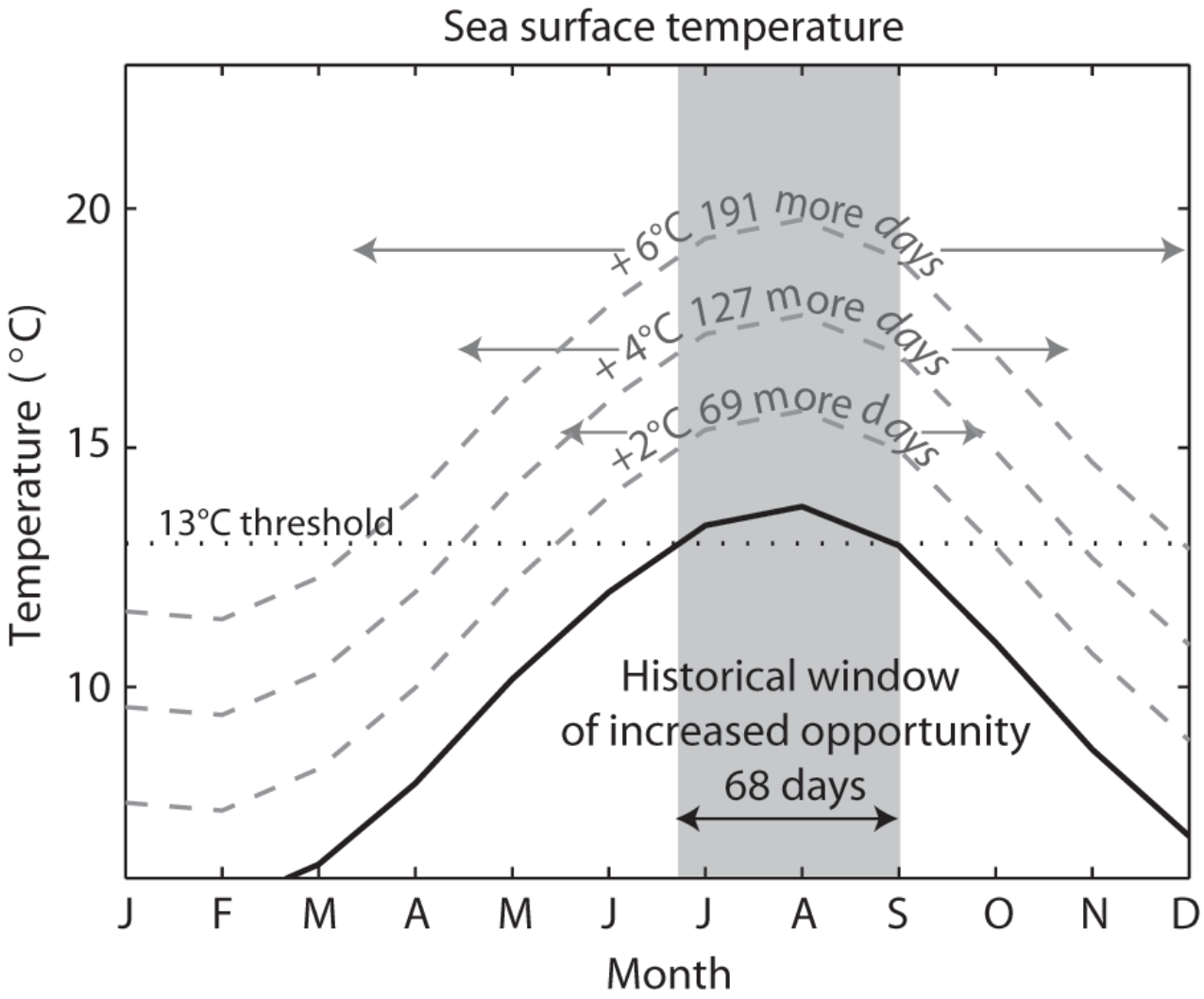
Coral bleaching

Fisheries Shifting North



Seawater warming and its implications for fisheries and aquaculture: increased risks from disease?

e.g. PSP agent *Alexandrium catenella* in Puget Sound (Moore et al., 2008)



Key concepts: vulnerability and resilience

“Vulnerability is the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence to ***capacity to adapt***” (Adger, 2006)

"Resilience" as applied to ecosystems, or to integrated systems of people and the natural environment, has three defining characteristics:

- The amount of change the system can undergo and still retain the same controls on function and structure
- The degree to which the system is capable of self-organization
- The ability to build and increase the ***capacity for learning and adaptation***

(Source: www.resalliance.org)

Vulnerability (or resilience) of what (or whom) to what?

- *Vulnerability of places* – low-lying coasts, enclosed seas, deltas, coral reefs, SIDS, LDCs
- *Vulnerability of economic activities* – agriculture, fishing, tourism, transport, habitation etc.
- *Vulnerability of people* – individuals, social groups, households, communities, provinces, nations
- *Vulnerability to particular stressors/hazards*: natural disasters, ENSO events, sea level rise, global environmental change, change in general

How vulnerable are different nations to potential climate change impacts on their fisheries sector?

(Allison et al. 2009 Fish & Fisheries)

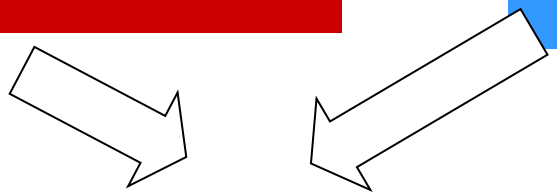
EXPOSURE

Nature and degree to which countries are *exposed* to predicted climate change

SENSITIVITY

Degree to which economies & people are likely to be affected by fishery-related changes

$$V = E + S + 1/AC$$

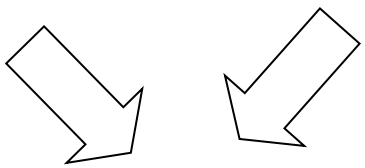


POTENTIAL IMPACTS

All impacts that may occur without taking into account planned adaptation

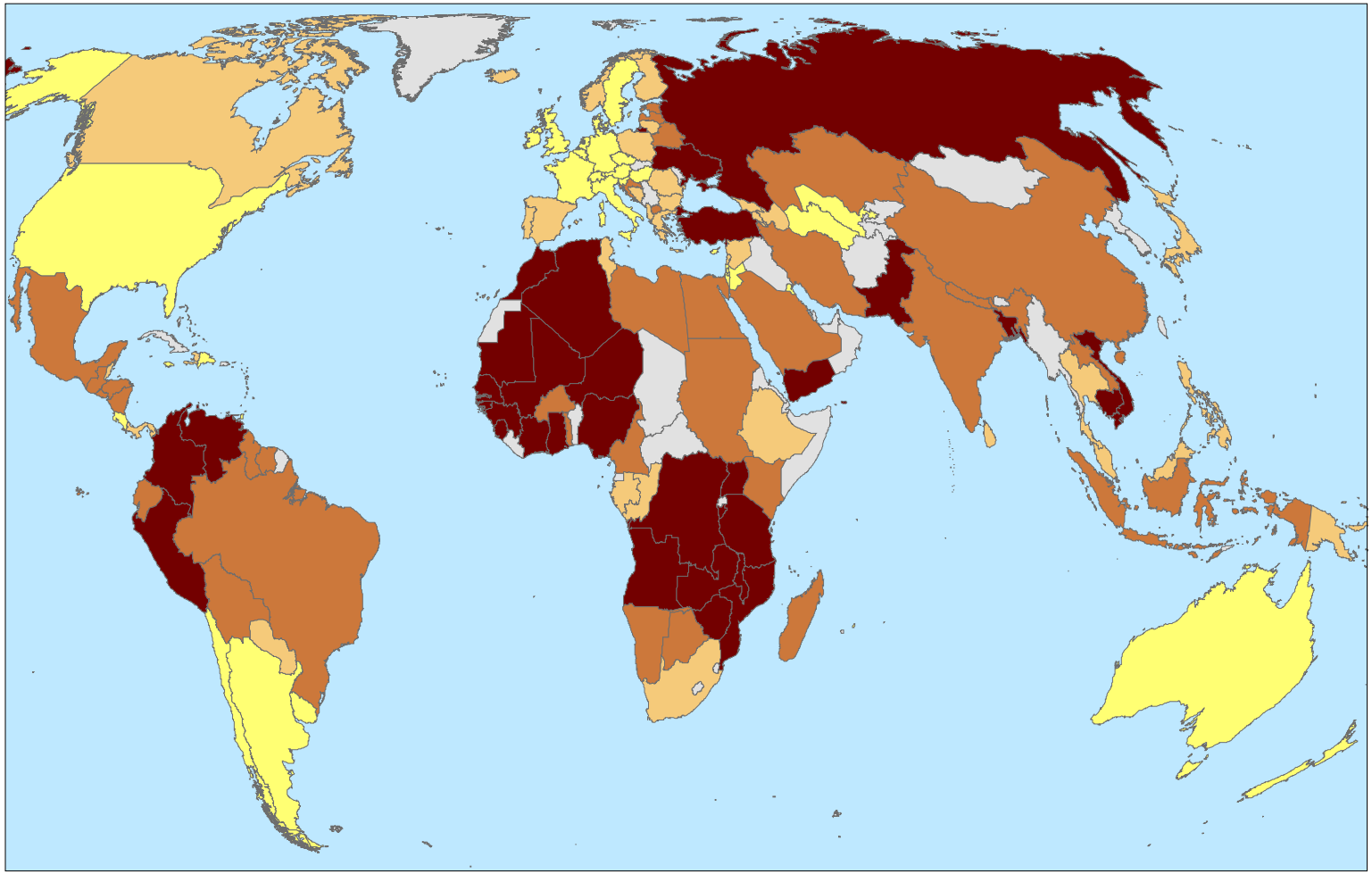
ADAPTIVE CAPACITY

Abilities and resources to cope with climate-related changes



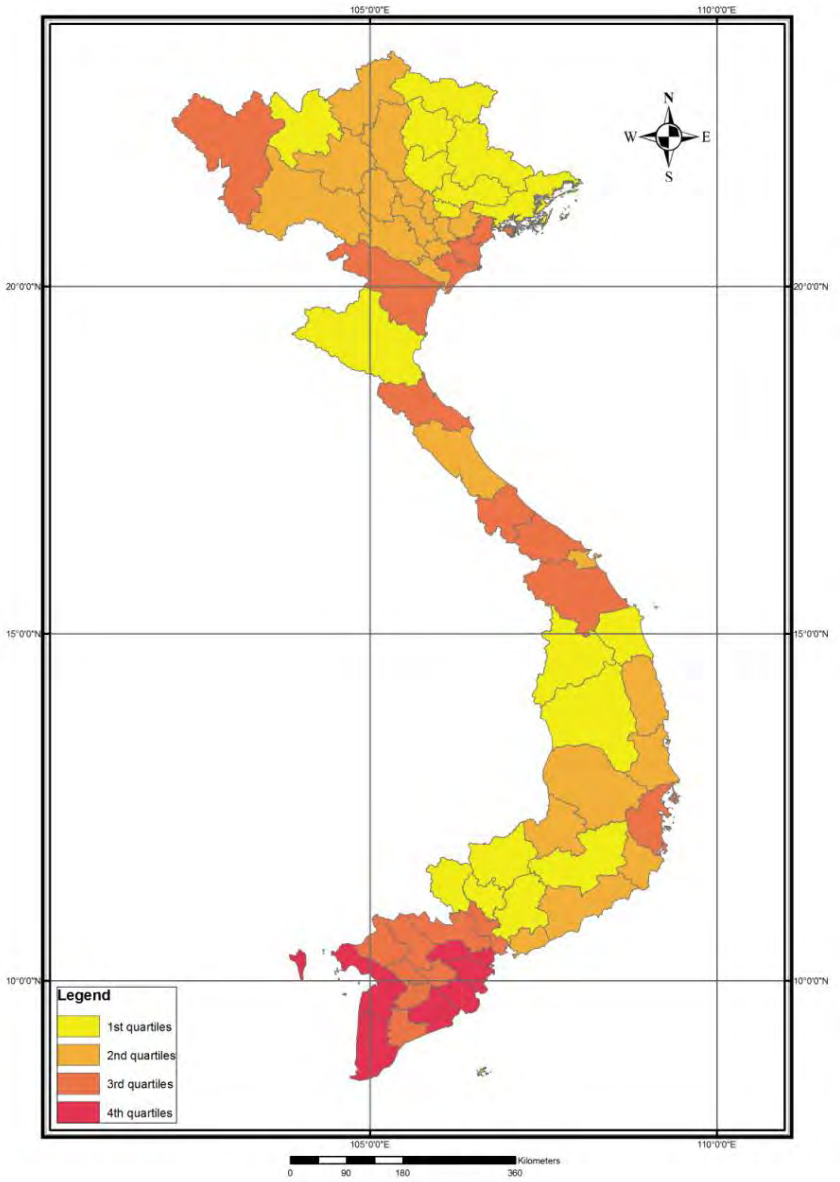
VULNERABILITY

Where in the world might fisheries be most impacted by climate change, countries most seriously affected by those impacts, and least able to deal with the economic and social consequences?



Vulnerability to the impacts of climate change on the fisheries sector under scenario SRES B2. (Allison et al 2009 Fish and Fisheries)

How vulnerable is Vietnam's aquaculture sector to climate change?

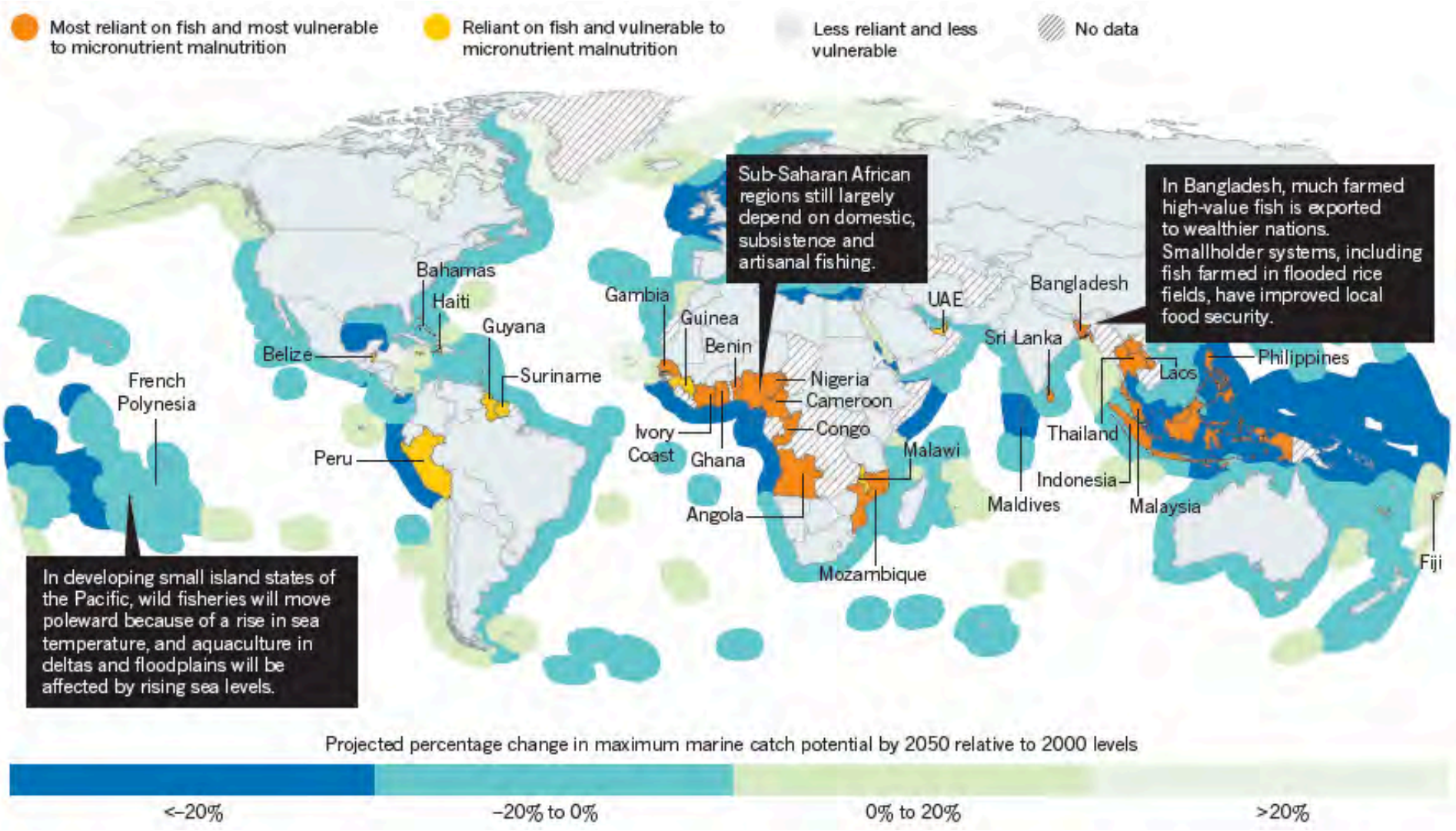


- Catfish (swai) farming industry vulnerable to freshwater flooding and saline water intrusion from sea level rise

- Shrimp industry resilient to salinity change but vulnerable to stock losses from flooding

Badjeck et al., 2012. WorldFish Center

Climate-related changes in capture fisheries potential affects populations most dependent on fish and most vulnerable to micronutrient deficiencies



Golden et al., 2016. Fall in fish catch threatens human health Nature 534: 317-320

Vulnerability analysis needs:

Clear aims: vulnerability of who/what to what stressor(s)?)

Clear understanding of impact pathways

Clear conceptualization: defined frameworks

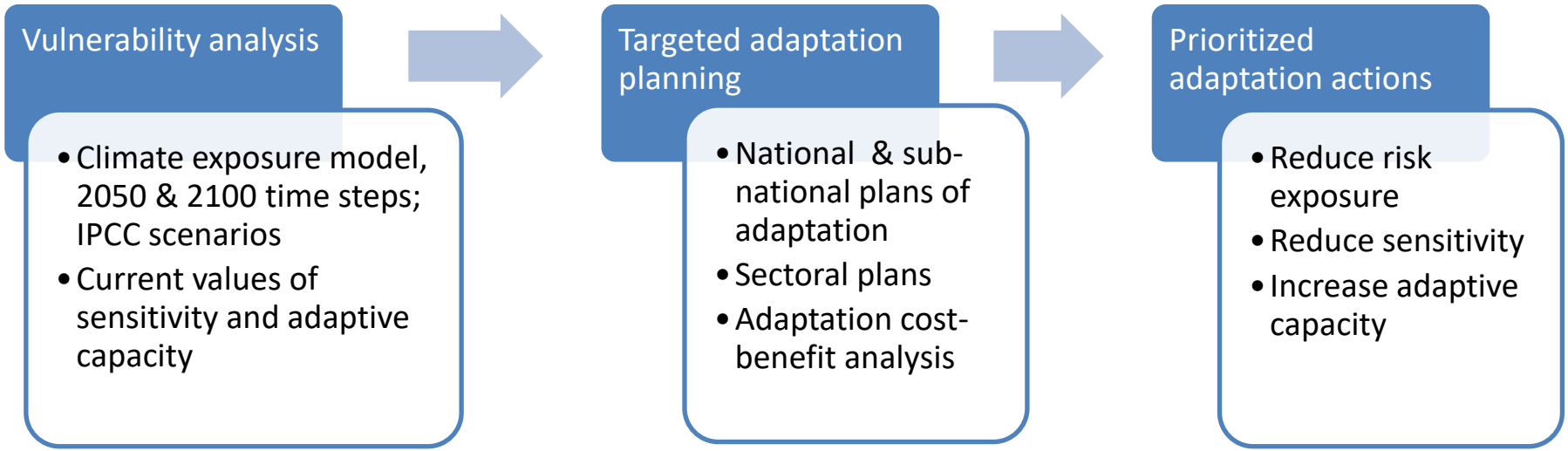
Good indicators – theoretical and empirically tested

Strong stakeholder engagement

Appropriate communication and discussion of findings

Clear recommendations for adaptation action

Linking vulnerability analysis to adaptation: the technocratic vision



The messy reality:

Planning cycles use shorter time horizons, action is therefore often deferred

Society will probably change more than climate by 2050 or 2100

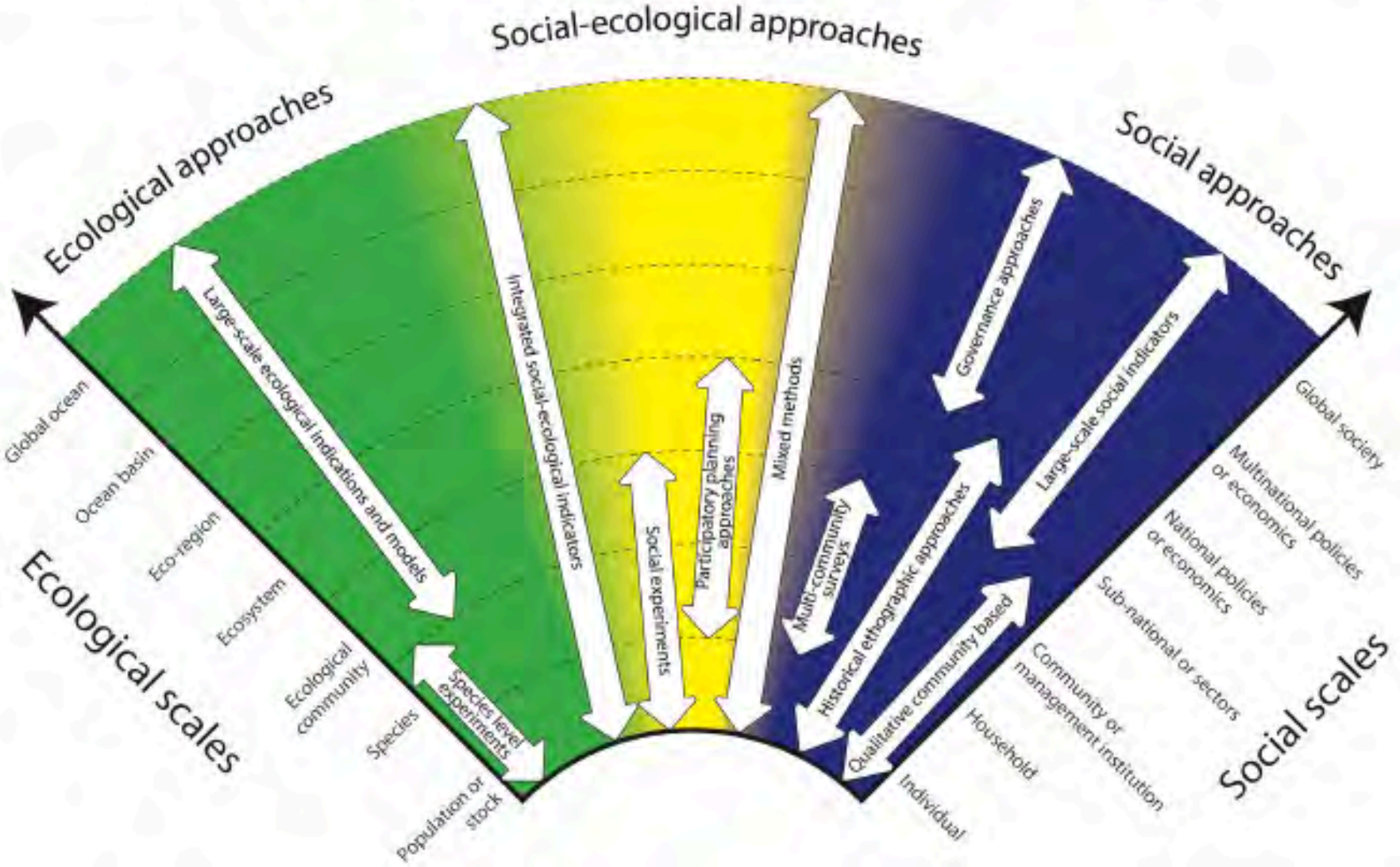
Adaptation actions respond to perception of thresholds and to multiple stressors, not distant predicted threats

Adaptation actions are often reactiveautonomous and contingent on political process, not rigorous cost-benefit analysis

3. What is adaptive capacity and how do you build it?

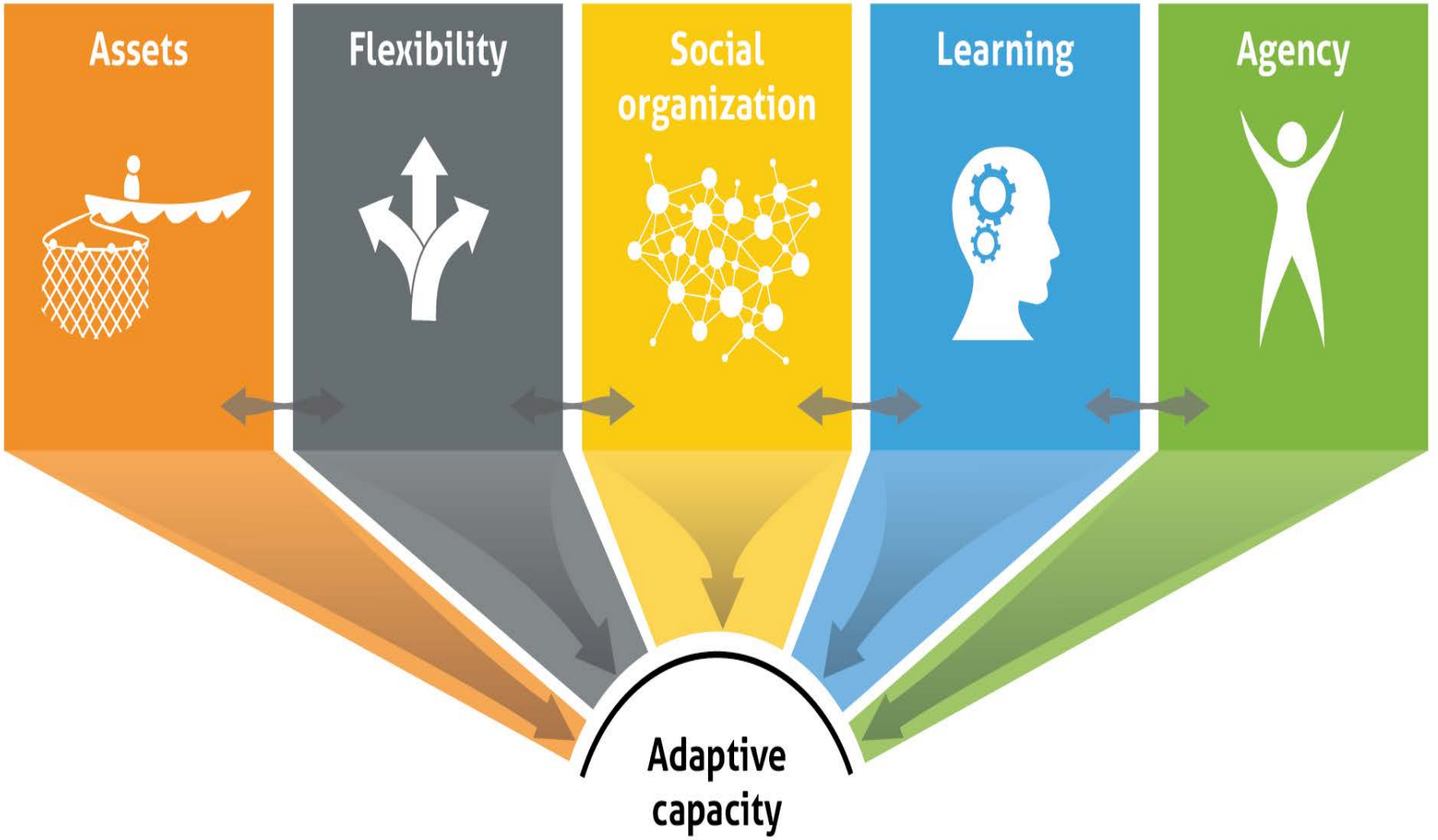
Whitney et al 2017 Ecol Soc

Fig. 1. Comparison of 11 approaches for assessing adaptive capacity at different spatial scales and with varying attention to social and ecological systems.



Components of adaptive capacity

(Cinner et al, 2018, Nature Climate Change)



Adaptation Process

(Allison et al., 2011a)

What to adapt?

Bio-physical system

Habitat Water quality Species

Social and Economic System

Employment Market Governance

Scale

Local Regional National Global

Who adapts?

Individuals	**Groups**	**Government**
Farmers	Firms	Regulatory bodies
Traders	Communities	Advisory services
Processors	Producer orgs	
Retailers		
Consumers		

How to adapt?

Drawing on Capital

Human Social Natural Physical Financial

Approaches

Autonomous Planned Flexible Mandated

Responses

Social Economic Technical

How have fishing communities and economies adapted to variability?

- Mobility and migration (e.g. artisanal fishers in Peru and West Africa)
- Household livelihood diversification; macro-economic diversification
- Acceptance of income & profit variability (multi-year planning); psychological preparedness
- Building substitutable capital assets – human, social, financial

Badjeck et al 2009 *Climatic Change*; Badjeck et al 2010 *Marine Policy*

Responding to global climate change impacts in upwelling systems: reducing vulnerability

Exposure + *Sensitivity* = Potential Impacts (IPCC, 2001; 2007)

Potential Impacts + *Adaptive Capacity* = **Vulnerability**

Reduce exposure to climate hazards	Reduce sensitivity	Increase adaptive capacity
• Vessel tie-up schemes • Relocation • Seasonal weather forecasts • Early quota-setting	• Reduce fishing pressure and other stressors on fish populations and ecosystems • Diversify livelihoods and economies • Diversify diets	• Better weather forecasting • Improved environmental monitoring and surveillance systems • Form associations, networks, societies for risk-sharing • Index-linked insurance

Adapting aquaculture systems to change: a farm level view

Exposure + *Sensitivity* = Potential Impacts (IPCC, 2001)

Potential Impacts + *Adaptive Capacity* = **Vulnerability**

Reduce exposure to climate hazards	Reduce sensitivity	Increase adaptive capacity
• Support conservation of natural sea defenses • Raise pond dykes • Upgrade pumps and sluices • Relocate	• Farm more tolerant species • Reduce dependence on wild-caught seed • Reduce dependence on fishmeal and fish oil feeds • Diversify product range • Diversify livelihoods	• Better weather forecasting • Improved disease surveillance systems • Form associations, networks, societies • Insurance • Savings

Measuring adaptive capacity

Indicators and indices are used to measure and monitor change in complex systems

Key principles for indicator choice:

- **S**pecific
- **M**easurable (and also *reliable, comparable* and *contextually appropriate*)
- **A**chievable (and also *cost effective*)
- **R**elevant
- **T**ime-bound (and also *sensitive*).

A practice-orientated adaptation research agenda...

- What shapes people's *decisions* to adapt?
- How do you *measure* adaptive capacity?
- How do you *build* adaptive capacity?
- What adaptation actions have already taken place in fisheries and aquaculture systems?
- How does the evolving coastal governance regime enable or constrain adaptation to environmental change?