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The Nippon Foundation - University of British Columbia
NEREUS PROGRAM
Predicting Future Oceans

Future sustainability of seafood production under climate change

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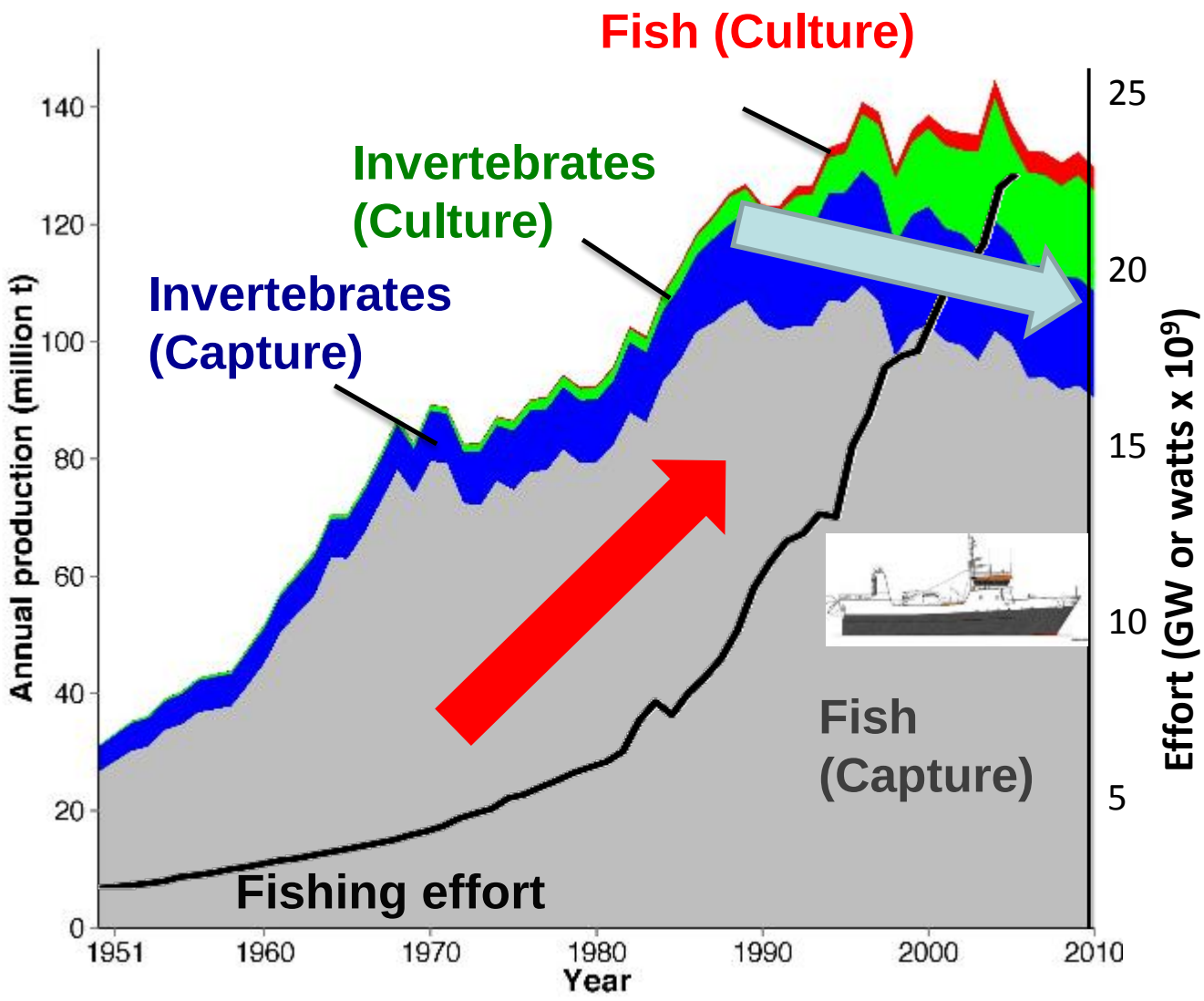
Challenge: sustainable seafood supply to the increasing demand

Based on FAO (2016) Status of the World's Fisheries and Aquaculture

Global fishing effort rises, catch declines

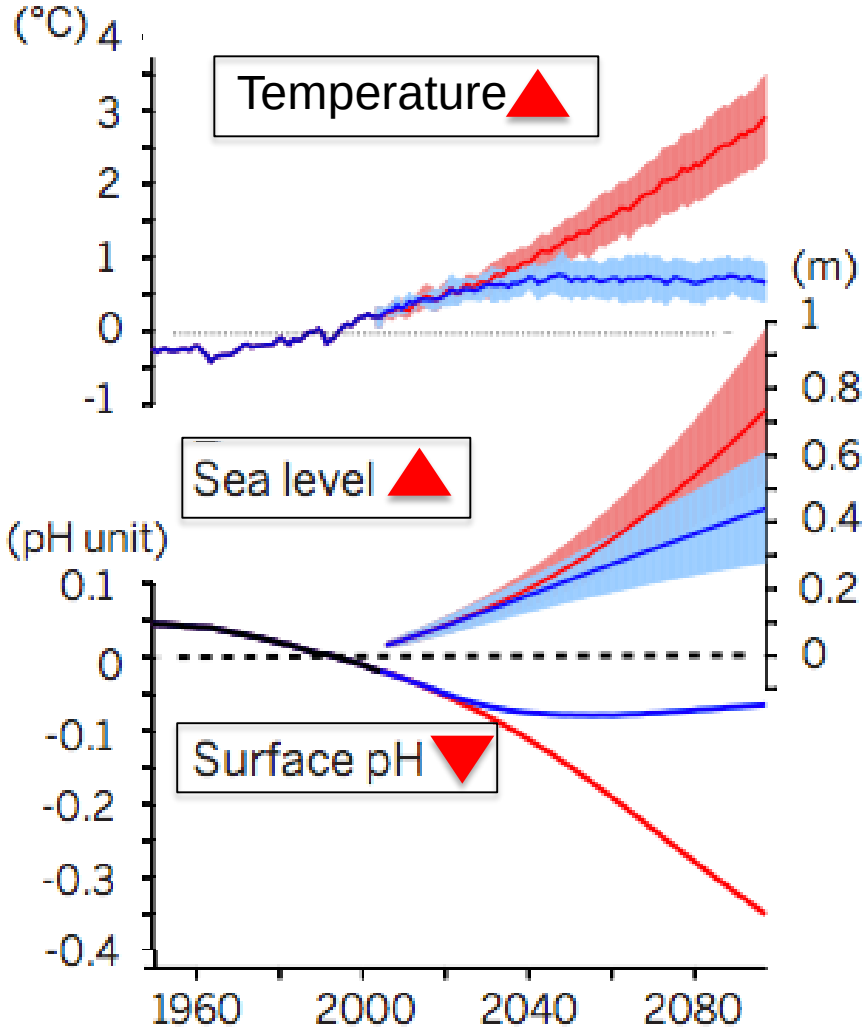


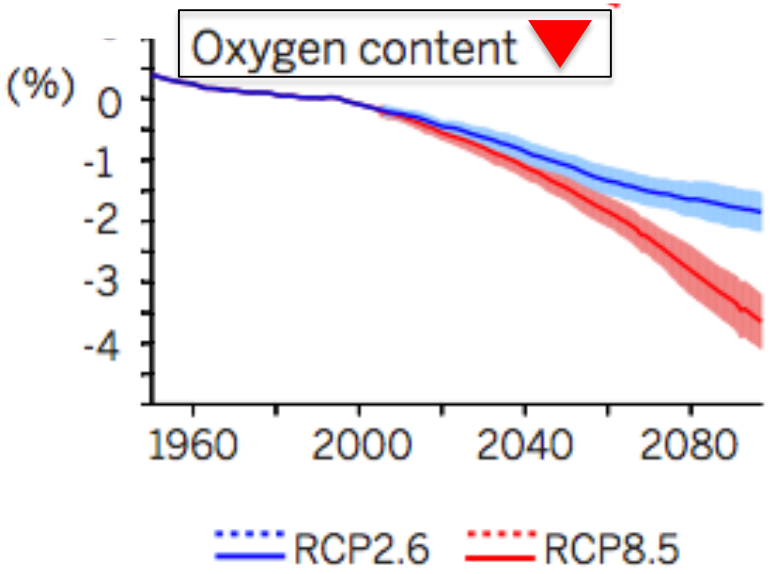
~ 30 - 60% of the stocks are over-exploited.

Data source: Pauly & Zeller (2016); Watson, Cheung *et al*. (2012)

Human impacts on marine ecosystems

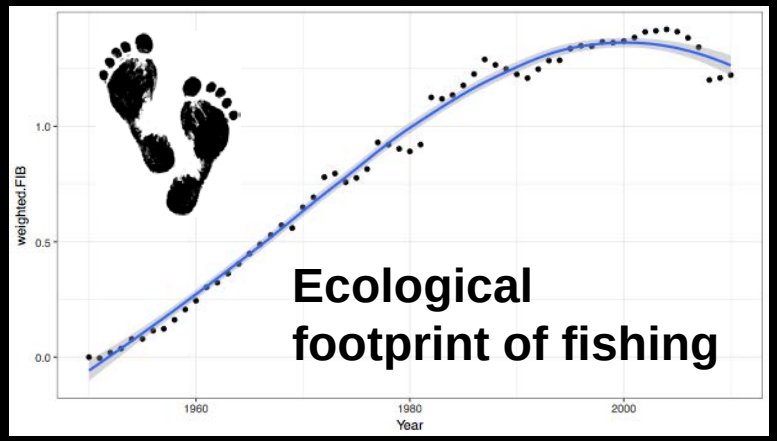
What does CO_2 emission do to the oceans?

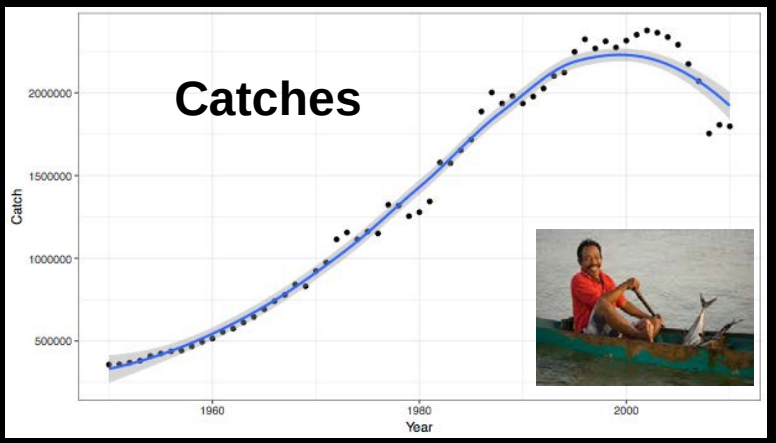


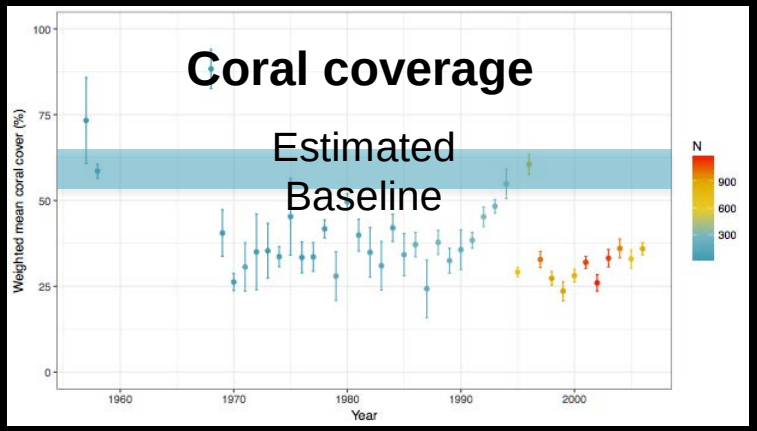


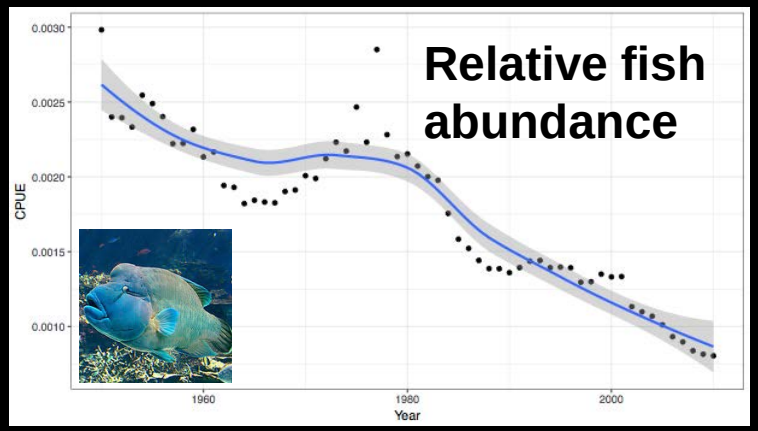
Gattuso, Magnan, Billé, Cheung, Howes, Joos, *et al*. 2015 Science.

Coral reef as an example







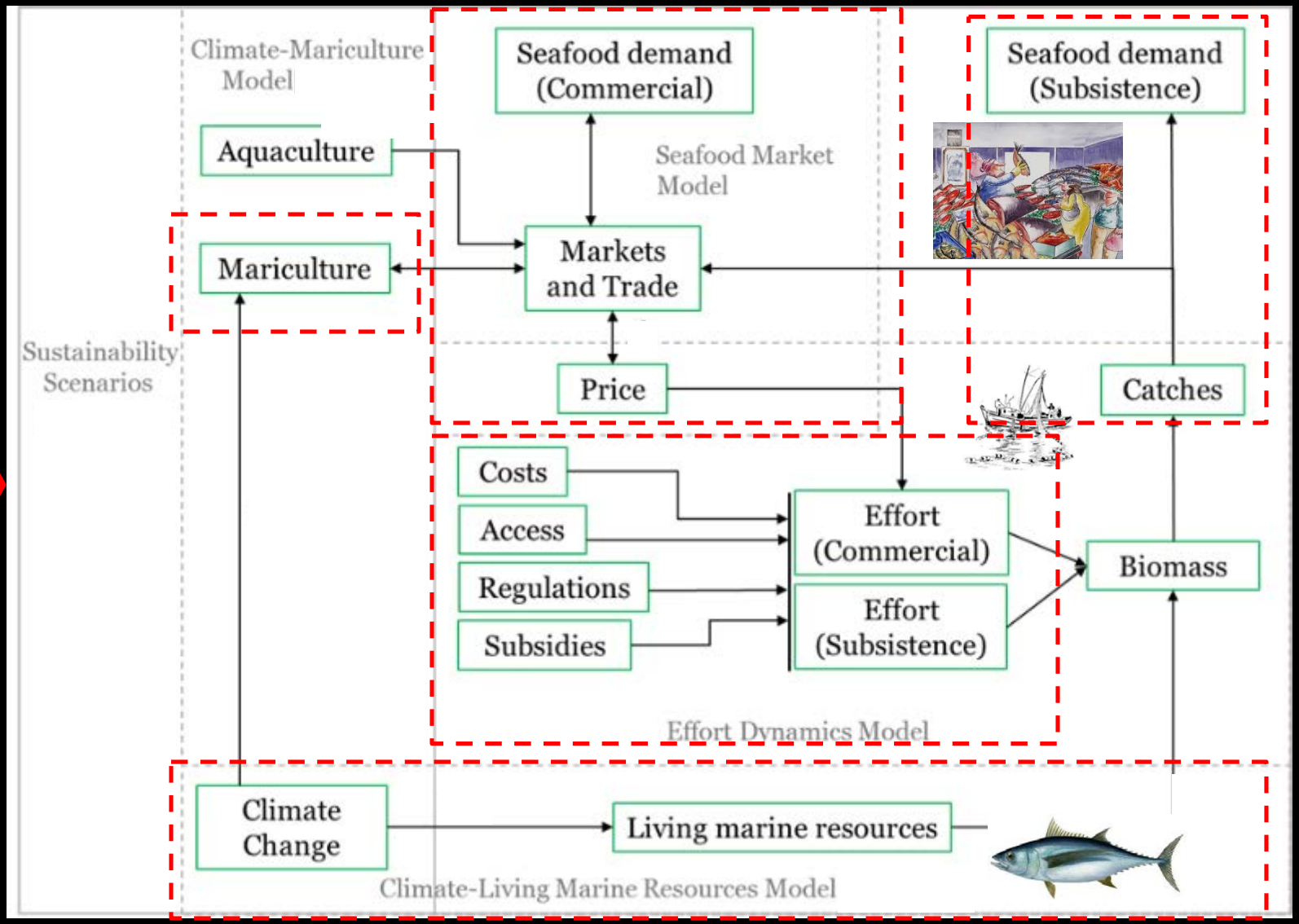


Eddie *et al*. (forthcoming)

The future ocean

Ocean Integrated Assessment Model

Scenarios (Climate & Shared Socio-economic Pathway)



Cheung *et al.* (in prep)

FISHERIES & MARINE ECOSYSTEM

FISH-MIP

MODEL INTERCOMPARISON PROJECT

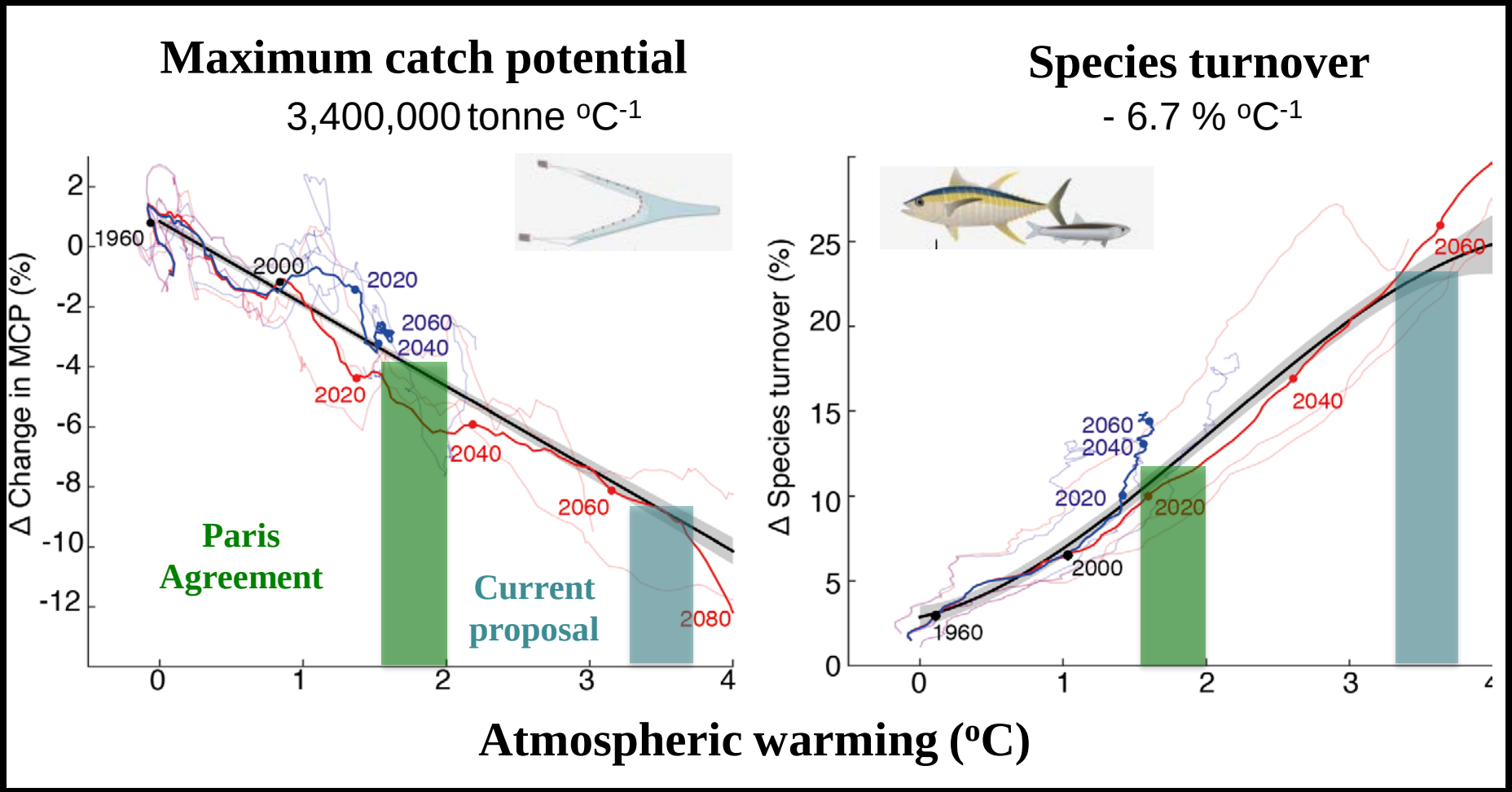
GLOBAL models

1. POEM
2. BOATS
3. EcoOcean
4. DBEM
5. Madingley
6. Macroecological model
7. DBPM
8. SS-DBEM
9. APECOSM
10. SEAPODYM

REGIONAL models

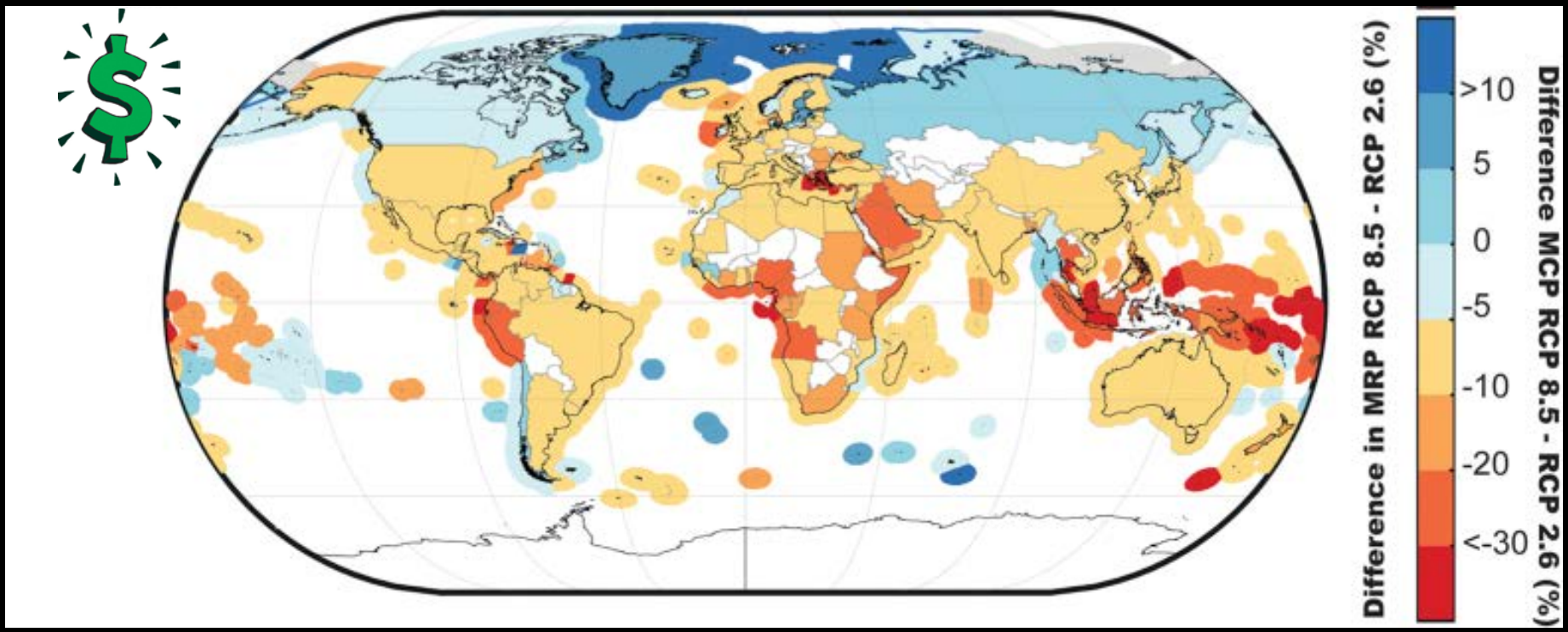
1. EwE (Ecopath with Ecosim)
2. Atlantis
3. OSMOSE
4. Size-structured
5. End-to-End

Fisheries impacts under climate change



Cheung, Reygondeau, Frölicher (2016) Science

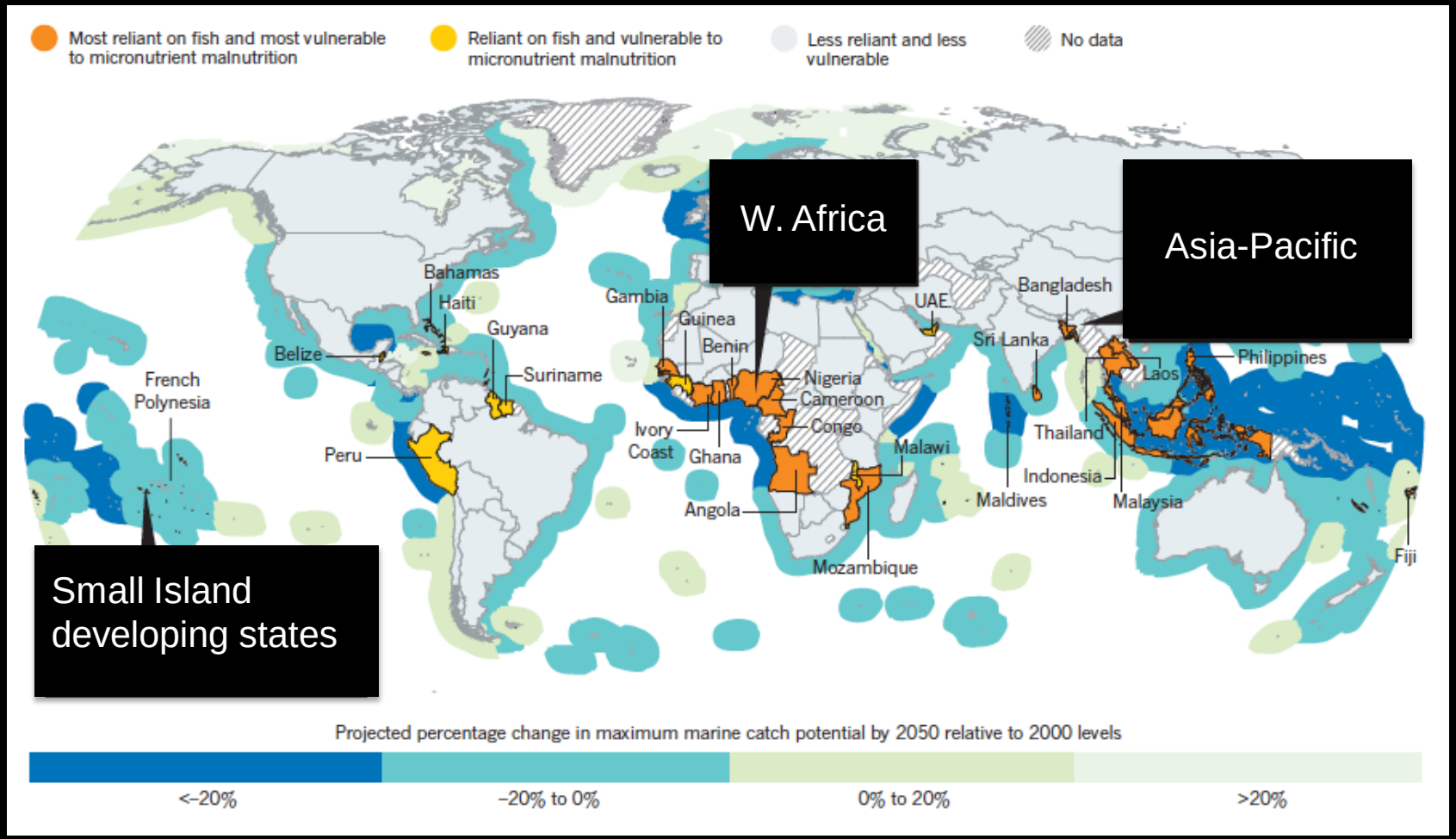
Implications for fisheries revenues



Changes in fisheries revenues is 35% more than catches

Lam, Cheung, Reygondeau, Sumaila. (2016) Scientific Report

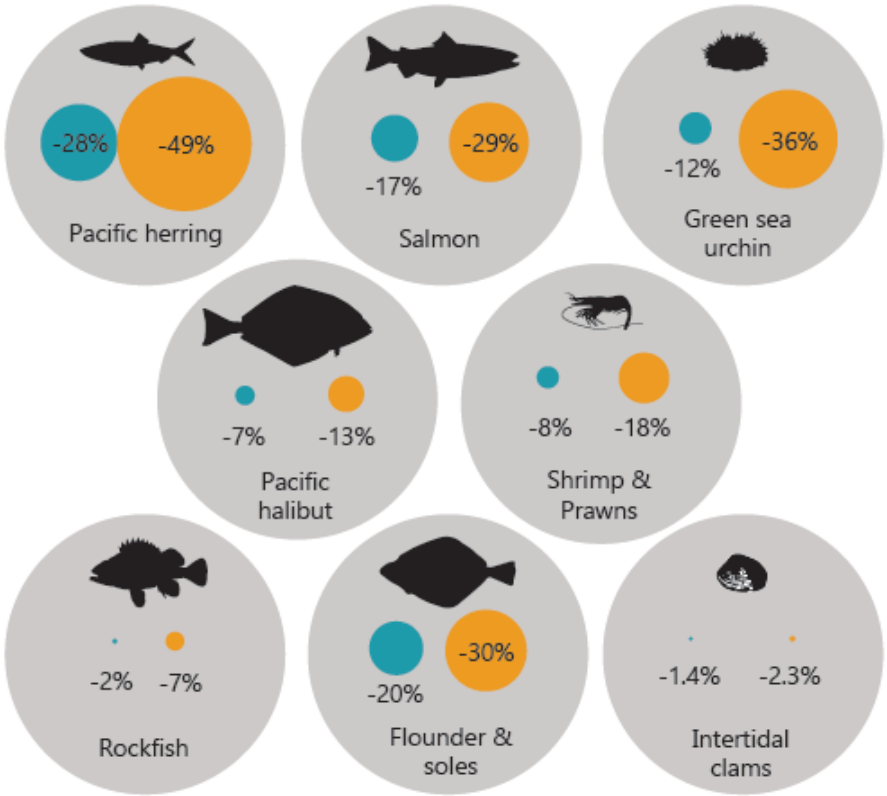
Implications for food security
Nutritional vulnerability to climate change

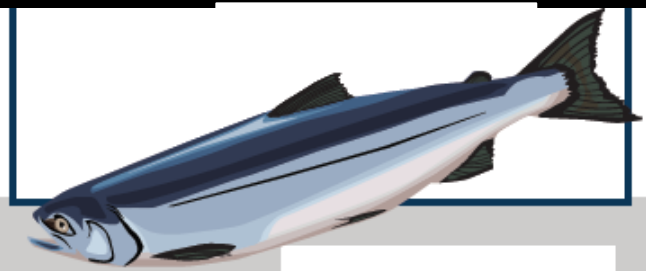


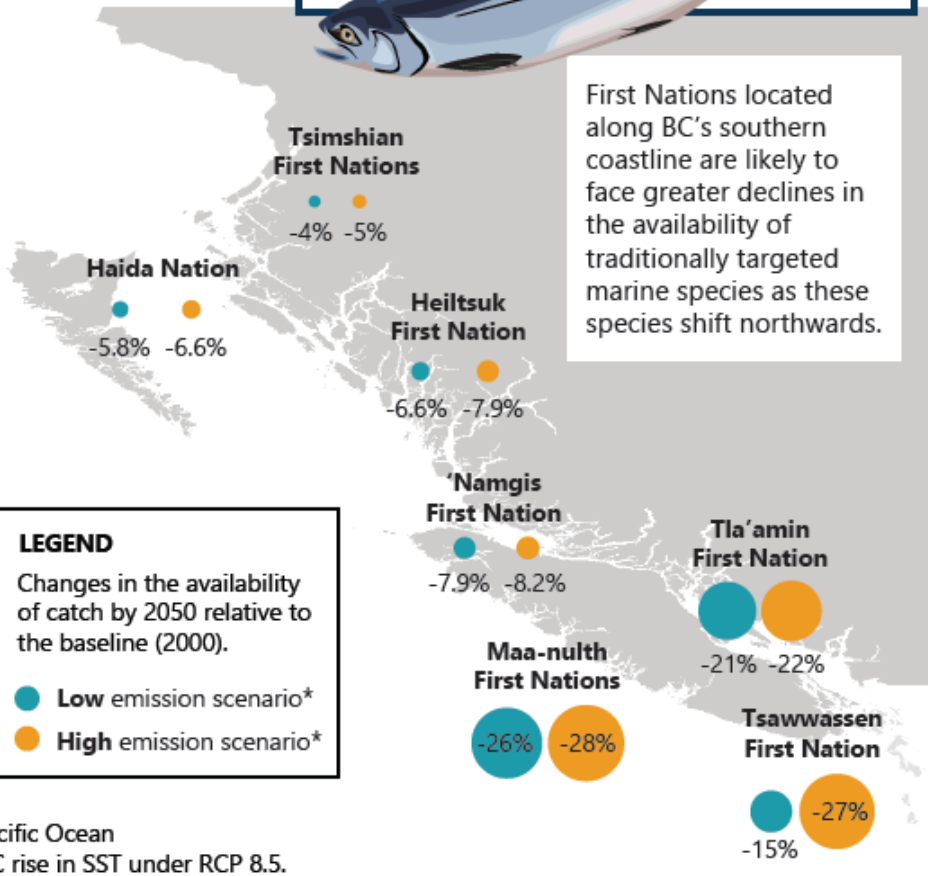
Golden, Allison, Cheung *et al.* (2016) Nature

Implications for coastal indigenous people food supply and culture

How might declines in catch availability by 2050 differ by fishery and by region?







First Nations located along BC's southern coastline are likely to face greater declines in the availability of traditionally targeted marine species as these species shift northwards.

LEGEND

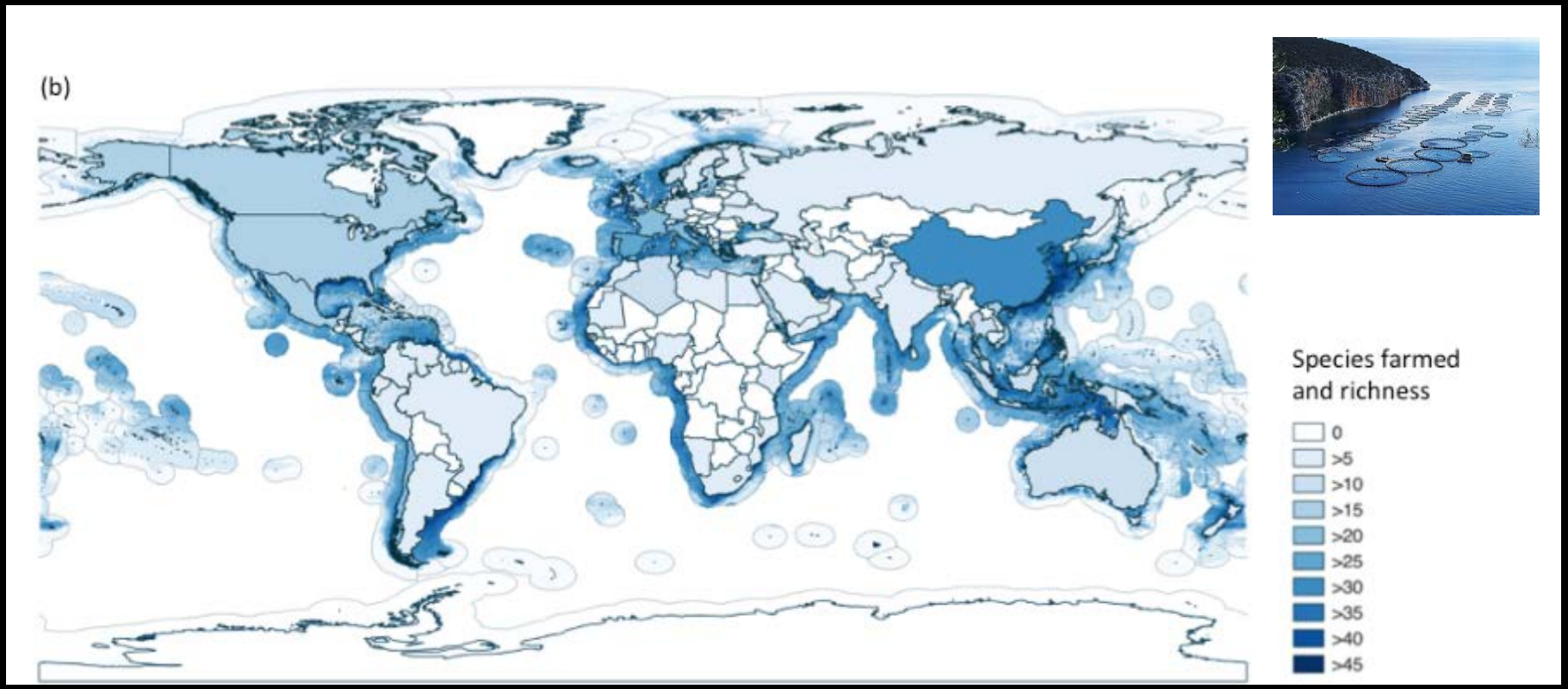
Changes in the availability of catch by 2050 relative to the baseline (2000).

- **Low** emission scenario*
- **High** emission scenario*

*Low emission scenario = 0.5°C rise in sea surface temperature (SST) in the Northeast Pacific Ocean (under Representative Concentration Pathway [RCP] 2.6) | High emission scenario = 1.0°C rise in SST under RCP 8.5.

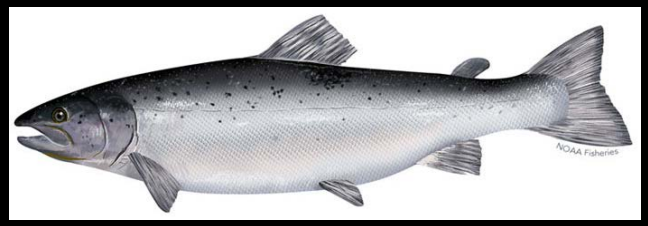
Weatherdon, Ota, Close, Cheung (2016) PLoS One

Projected global mariculture potential



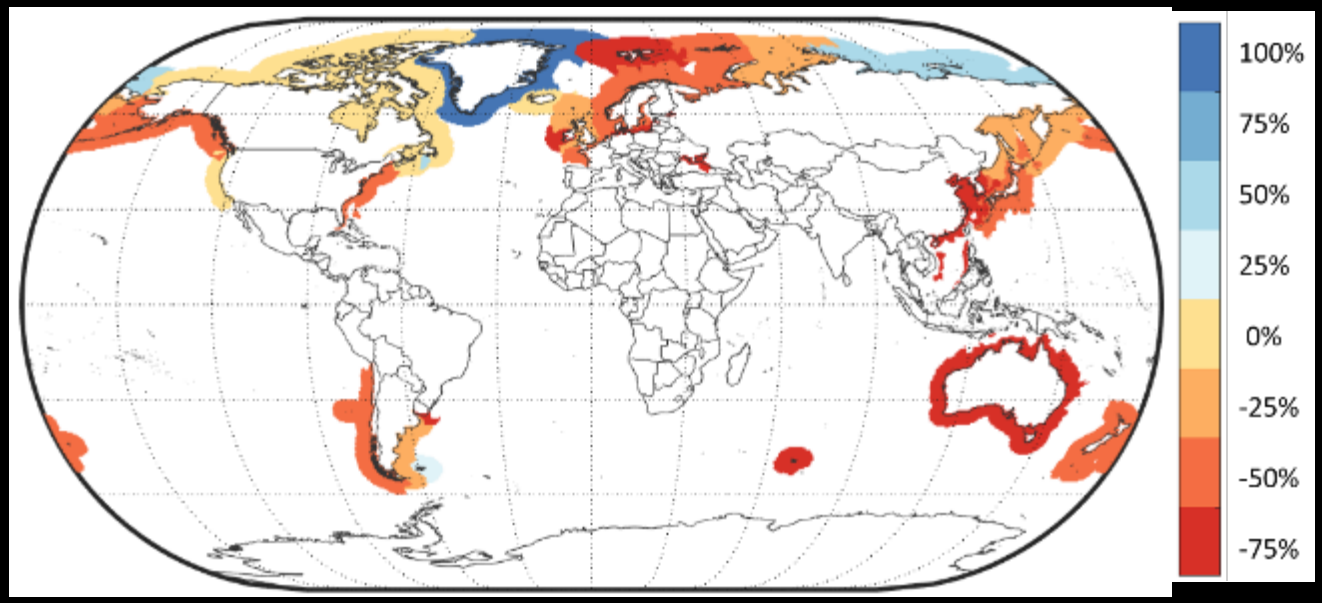
Oyinlola *et al*. (in revision) PLOS ONE

E.g., Atlantic salmon



RCP 8.5

Percentage change in projected mariculture production potential (MPP)



Oyinlola *et al*. (in prep)

Ocean Integrated Assessment Model

Scenarios (Climate & Shared Socio-economic Pathway)

Sustainability Scenarios

Climate-Mariculture Model

Aquaculture

Mariculture

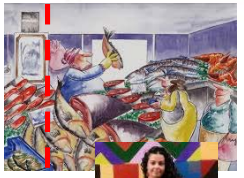
Seafood demand (Commercial)

Seafood Ma Model

Markets and Trade

Price

Seafood demand (Subsistence)



Catches

Costs

Access

Regulations

Subsidies

Effort (Commercial)

Effort (Subsistence)

Biomass

Effort Dynamics Model

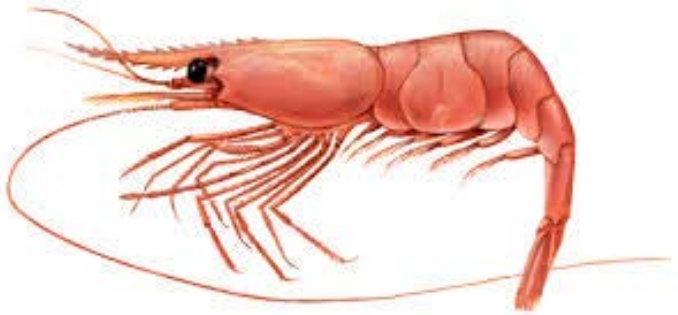
Climate Change

Living marine resources

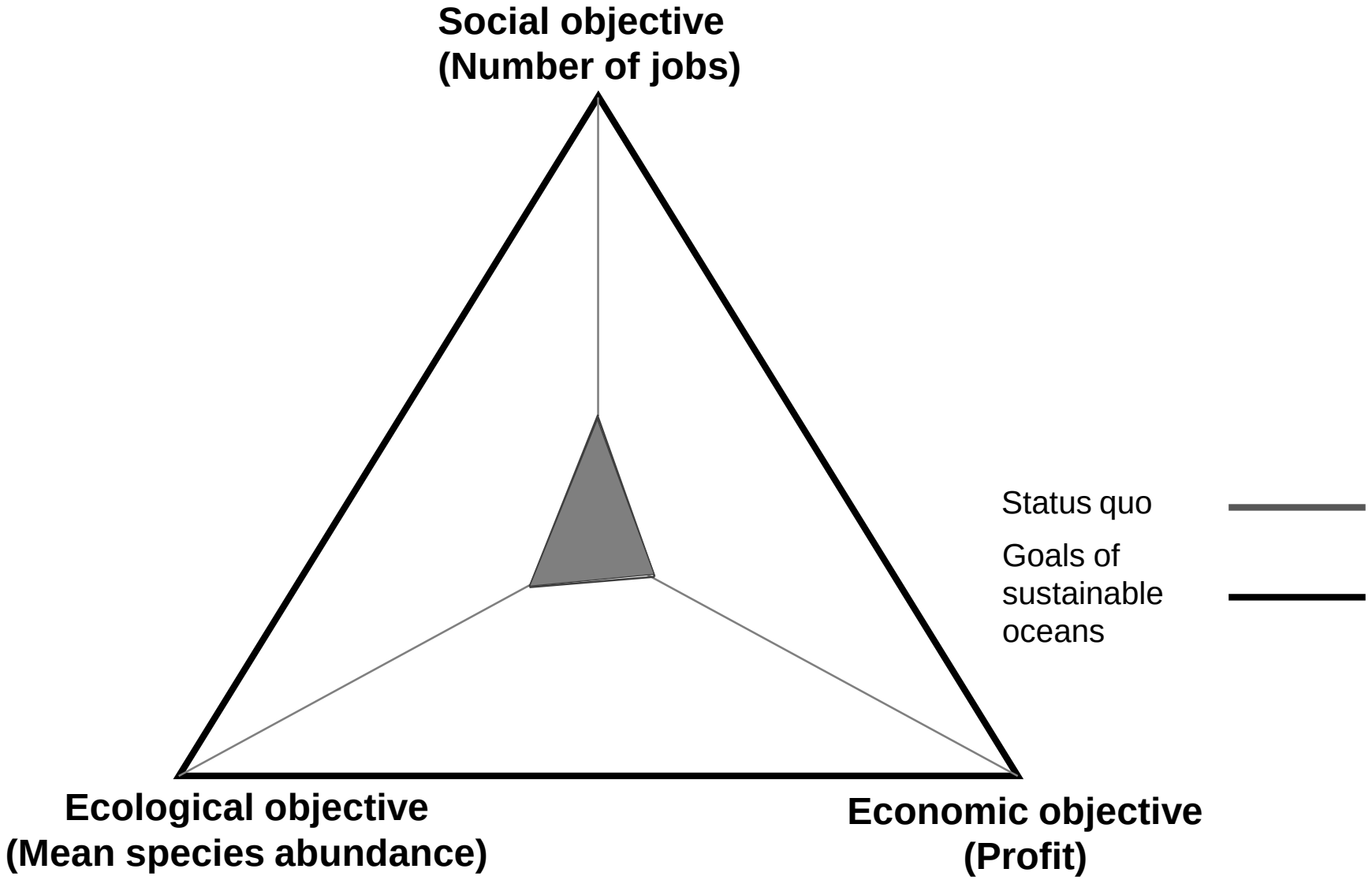
Climate-Living Marine Resources Model

Cheung *et al.* (in prep)

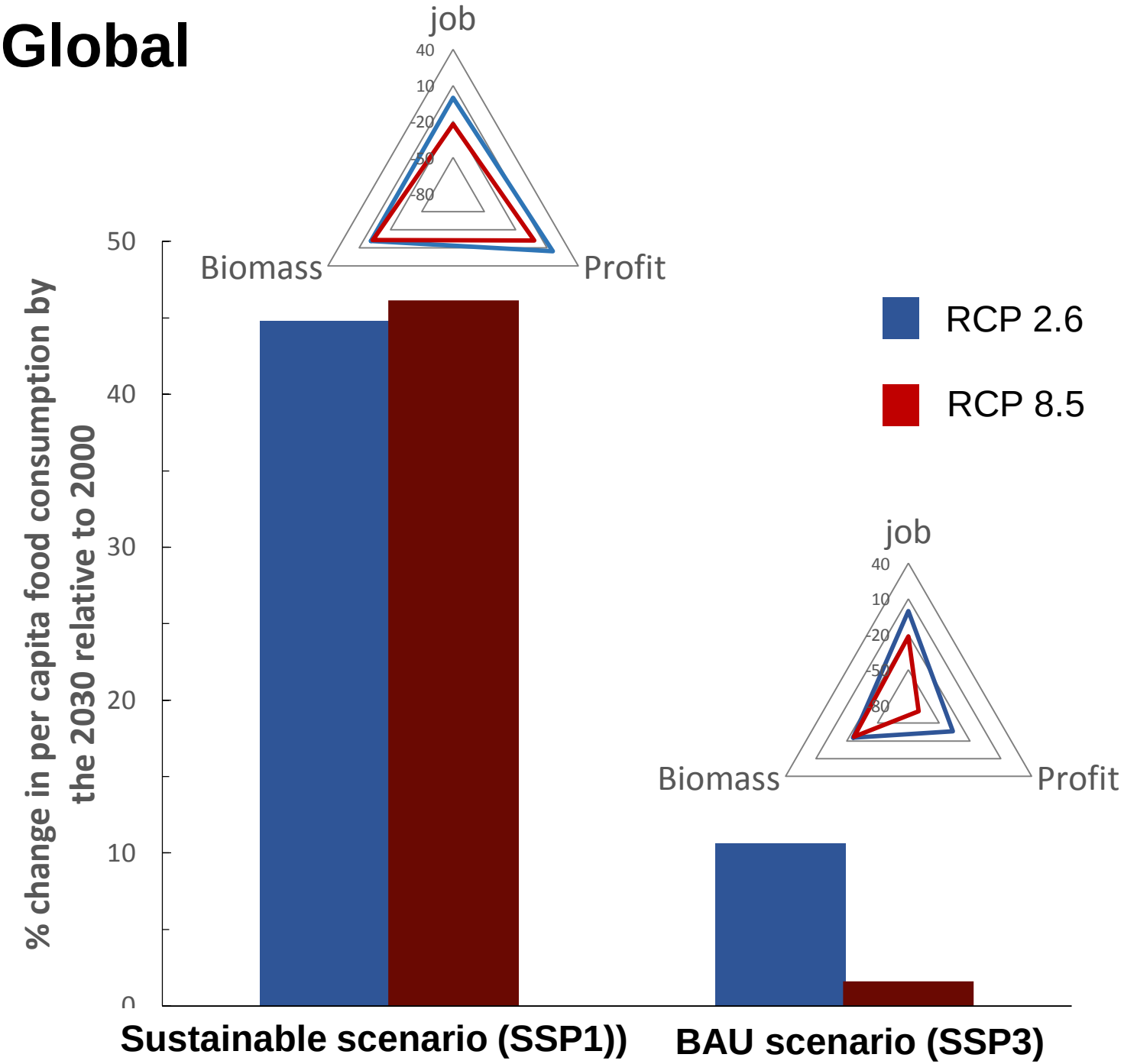
Preliminary case study



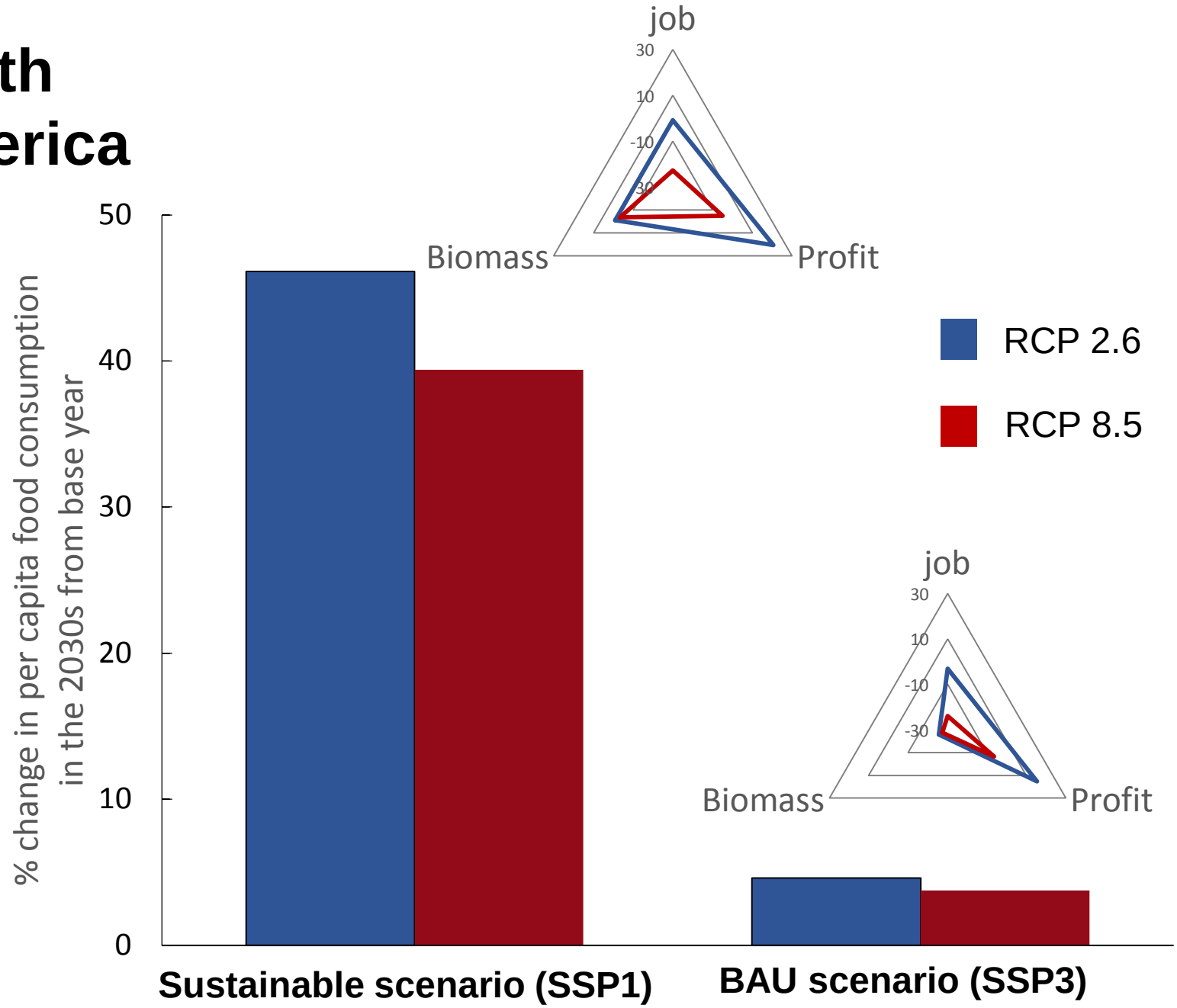
Climate-impacts on ocean sustainability



Global

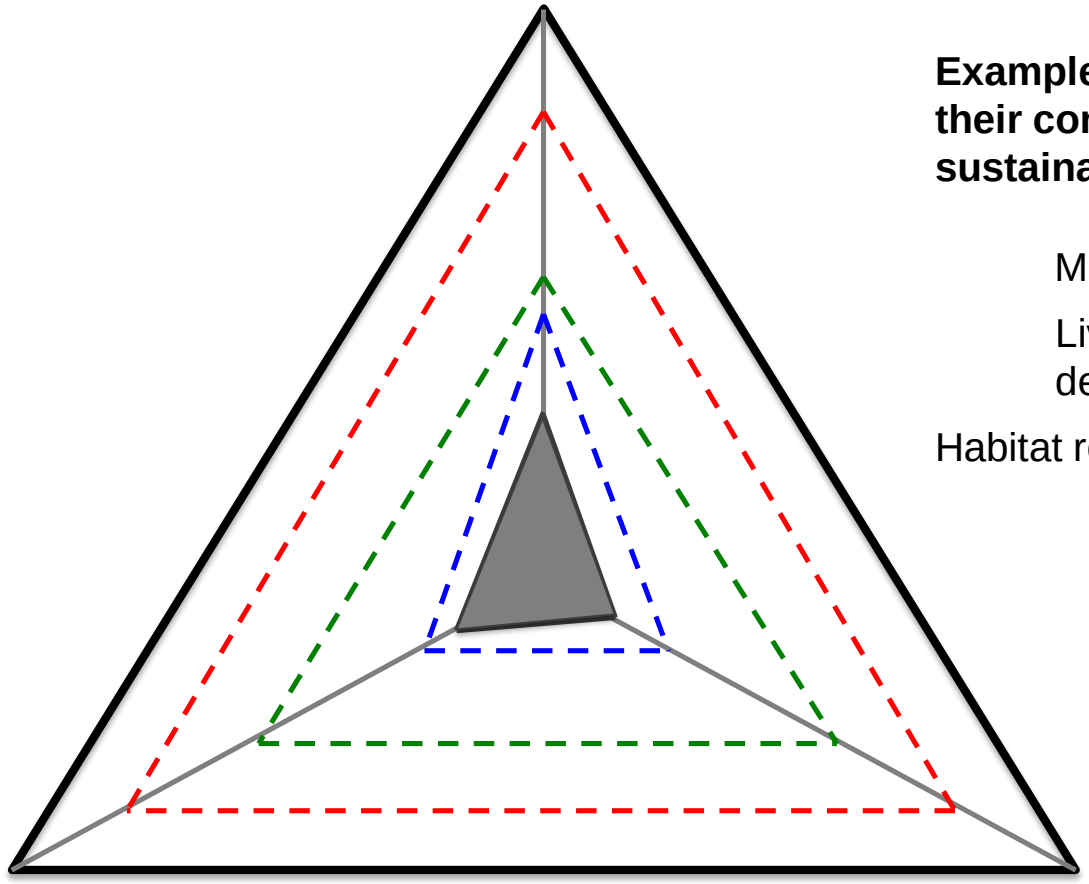

job
40
10
-20
-50
-80
Biomass
Profit
RCP 2.6
RCP 8.5
% change in per capita food consumption by the 2030 relative to 2000
50
40
30
20
10
0
Sustainable scenario (SSP1))
BAU scenario (SSP3)

North America



Exploring solutions

Ocean solution ‘wedges’



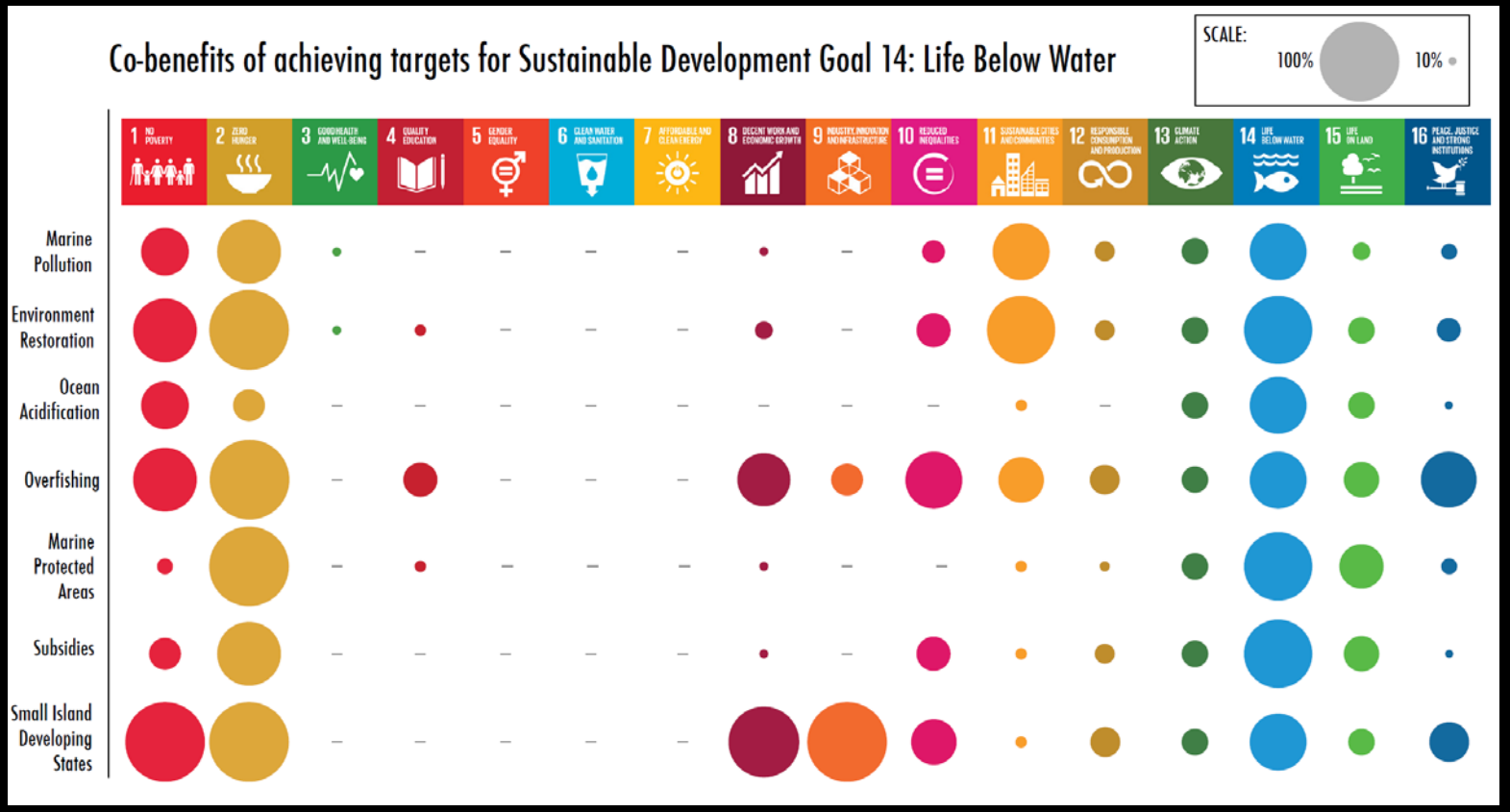
Examples of potential solutions and their contributions to achieving sustainable development objectives

MPA

Livelihood development

Habitat restoration

Trade-offs and co-benefits to Sustainable Development Goals



Singh *et al.* (2017) Marine Policy

State-of-the-art in climate impact assessment for marine fish and fisheries

- Linking ecological and human impacts highlight vulnerable regions and communities;

- The development of Ocean Integrated Assessment Model provide a formal way to integrate climate change and other human drivers;

- The use of impact models to explore solution options to achieve ocean sustainability under climate change.

Thank you
















Thank you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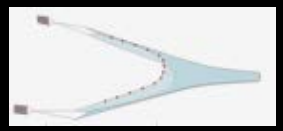
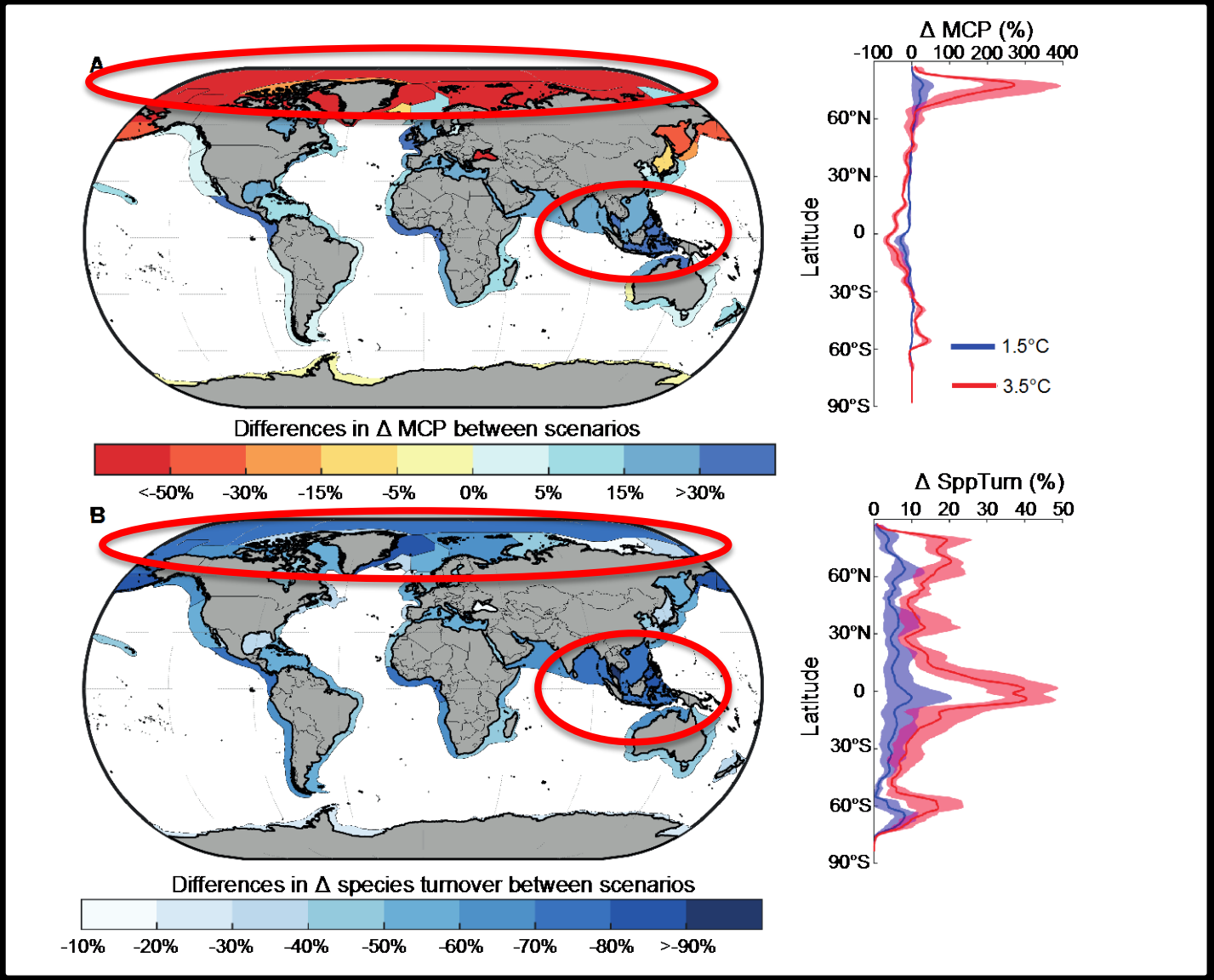
Regional variation in sensitivity to atmospheric warming



Maximum catch potential

Species turnover



Cheung, Reygondeau, Frölicher (2016) Science