National Data and Integrated Scenarios (NDIS) WG

William Cheung & Rashid Sumaila

Ocean Canada Meeting

Halifax, September, 2018

OCEAN CANADA

Members











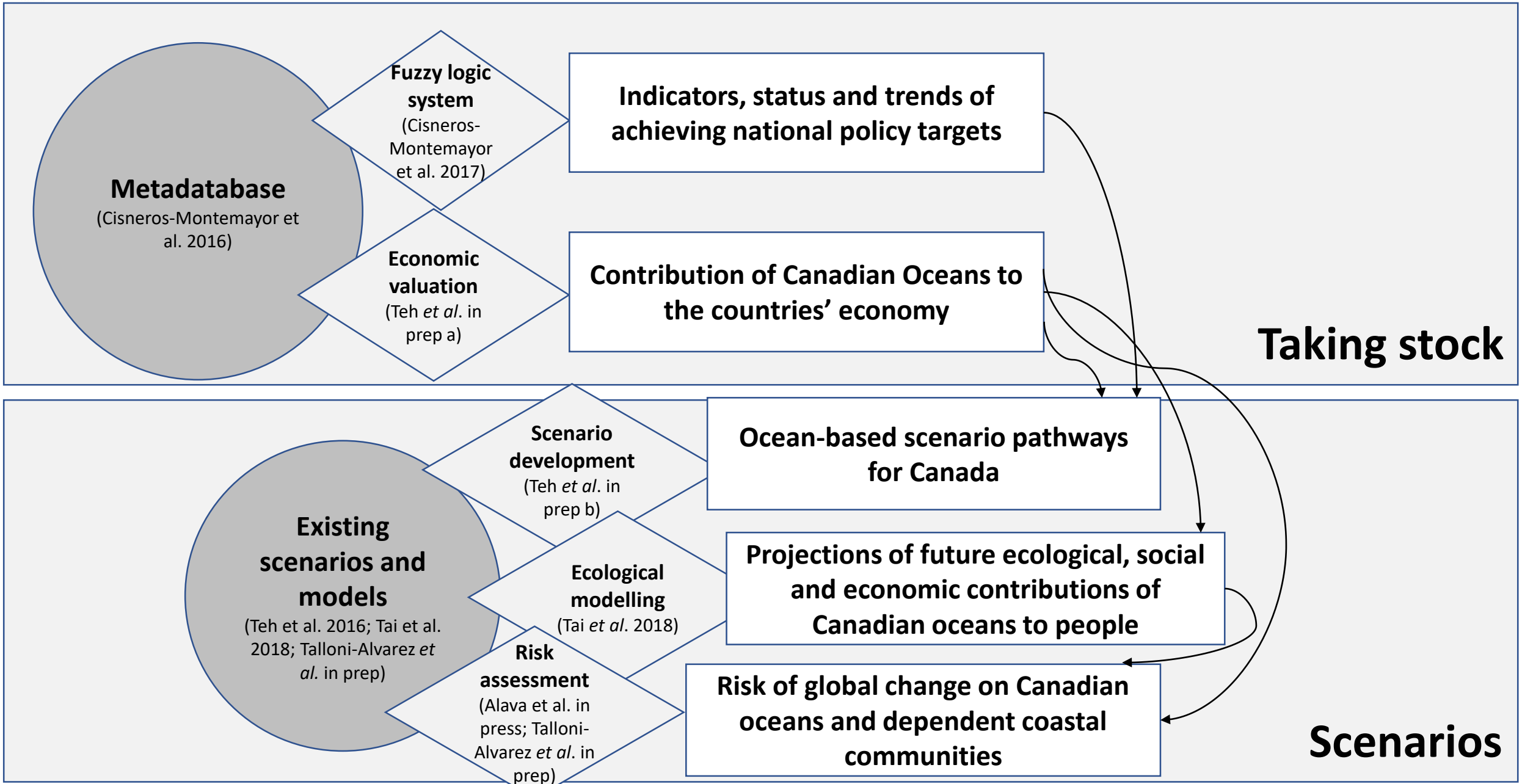



NDIS Objectives

1. Establish database of existing social, cultural, governance, economic and environmental data to help researchers more easily assess and monitor trends related to the health of Canada's three coastal-ocean environments;

2. Mapping the potential pathways to human and environmental sustainability within Canada's coastal-ocean regions and appraising their associated opportunities and risks.

Key components



Cross-cutting

1. **Changing Ocean CCT**
   - Arctic Ocean-ocean acidification

2. **Law and policy WG**
   - Transboundary fisheries management

3. **Knowledge mobilization WG**
   - Climate service portal

4. **Cross-cutting case study: Gender issue is resource management**

5. **Others:**
   - Assessing pathways for rebuilding Canadian fisheries
   - Exploring ocean-based climate solutions for Canada.

Outline

1. Taking stock: Economic contributions of Canadian's Ocean – BC case study (presented by Rashid Sumaila)

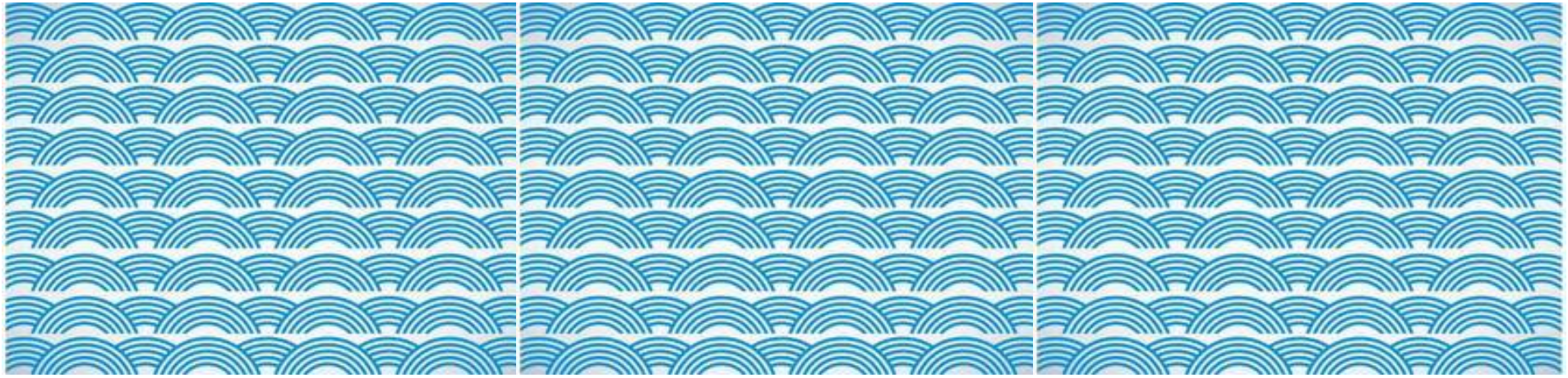
2. Ocean Canada metadatabase: current status, application and future development (presented by Juliano Palacios-Abrantes)

3. Scenarios: (presented by Nicolas Talloni-Alvarez)
   - National Ocean Canada Scenario development
   - Climate risk assessment for Canadian coastal living marine resources and communities

4. Cross-cutting topic: Indigenous women respond to fisheries conflict and catalyze change in governance on Canada' Pacific Coast (presented by Sarah Harper)

OCEAN CANADA

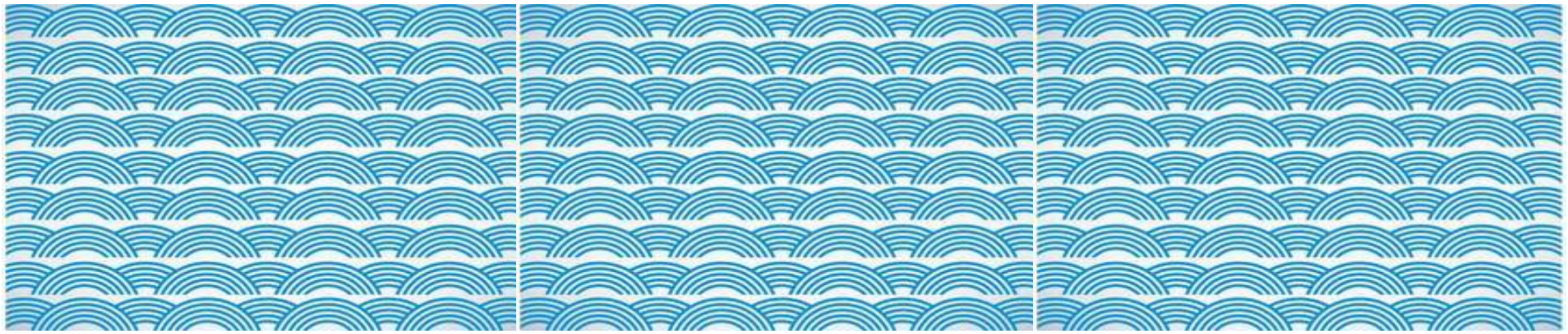
Economic contribution of BC's ocean



Lydia Teh, Rashid Sumaila, William Cheung
OceanCanada Partnership

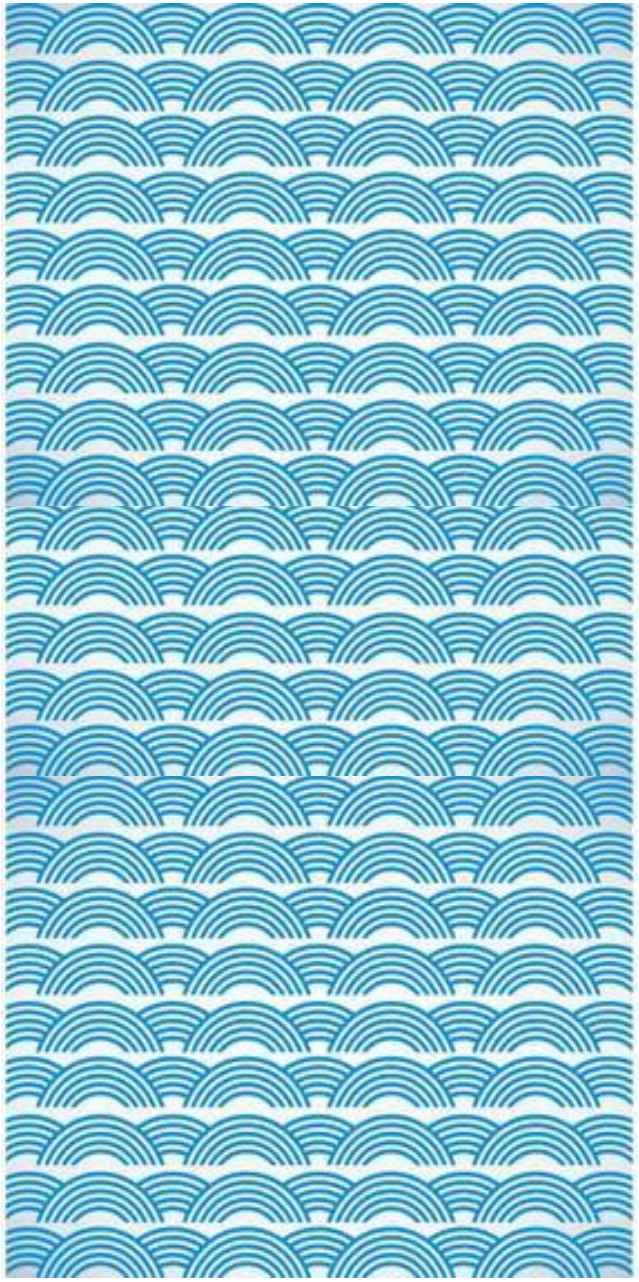
Objectives

1. Estimate economic benefits from BC's ocean
2. Provide pragmatic framework for conducting rapid economic impact assessment for non-economics specialists



Ocean sectors

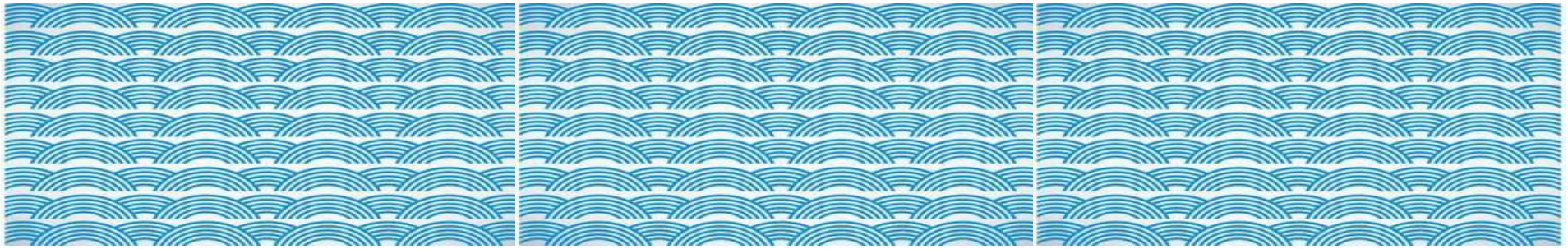
1. Marine recreation
    - Coastal activities
    - Whale watching
    - Cruise tourism
    - Recreational fishing
2. Capture fisheries
3. Seafood processing
4. Marine transport
    - Passenger transport
    - Marine shipping
    - Support services



Economic impact

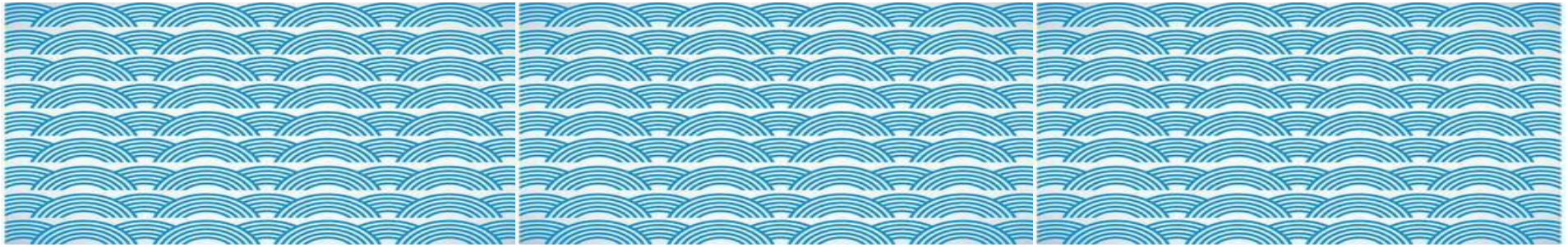
Measured by:

i. Total revenues – how much money the sector generates
ii. GDP contribution – value added by the sector (revenues – cost of inputs)
iii. Employment – how many jobs in the sector
iv. Labour income (wages & benefits) – how much people earn



Method

1. Find out how much money each sector generates (output or revenue)
2. Derive GDP by estimating the component of output that is ‘value added’
3. Use Statistics Canada input-output tables to estimate number of jobs and labour income from sector output
4. Use multipliers to estimate indirect and induced impacts in the province (additional activities in other sectors generated by activity in one sector)



Framework for economic impact assessment

Sector	Variables for calculating revenue	Calculation	Data source
Recreational fishing	Recreational catch (tonnes) (a)	a*b	Sea Around Us catch database
	Angling expenditure ($/tonne) (b)		
Capture fisheries	Fisheries catch (tonnes) (a)	a*b	Sea Around Us catch database
	Fish price ($/tonne) (c)		Ex-vessel price database
Seafood processing	Landed value ($) (a)	a * (1+b)	Sea Around Us catch database
	Processing value added (%) (b)		Independent surveys
Marine transport			
Marine shipping	Total cargo handled (tonnes) (a)	a*b	Port statistics
	FTE/tonnage (no. of jobs/tonne) (b)		Independent surveys
Support services	Extracted from Statistics Canada		Statistics Canada

OCEAN CANADA

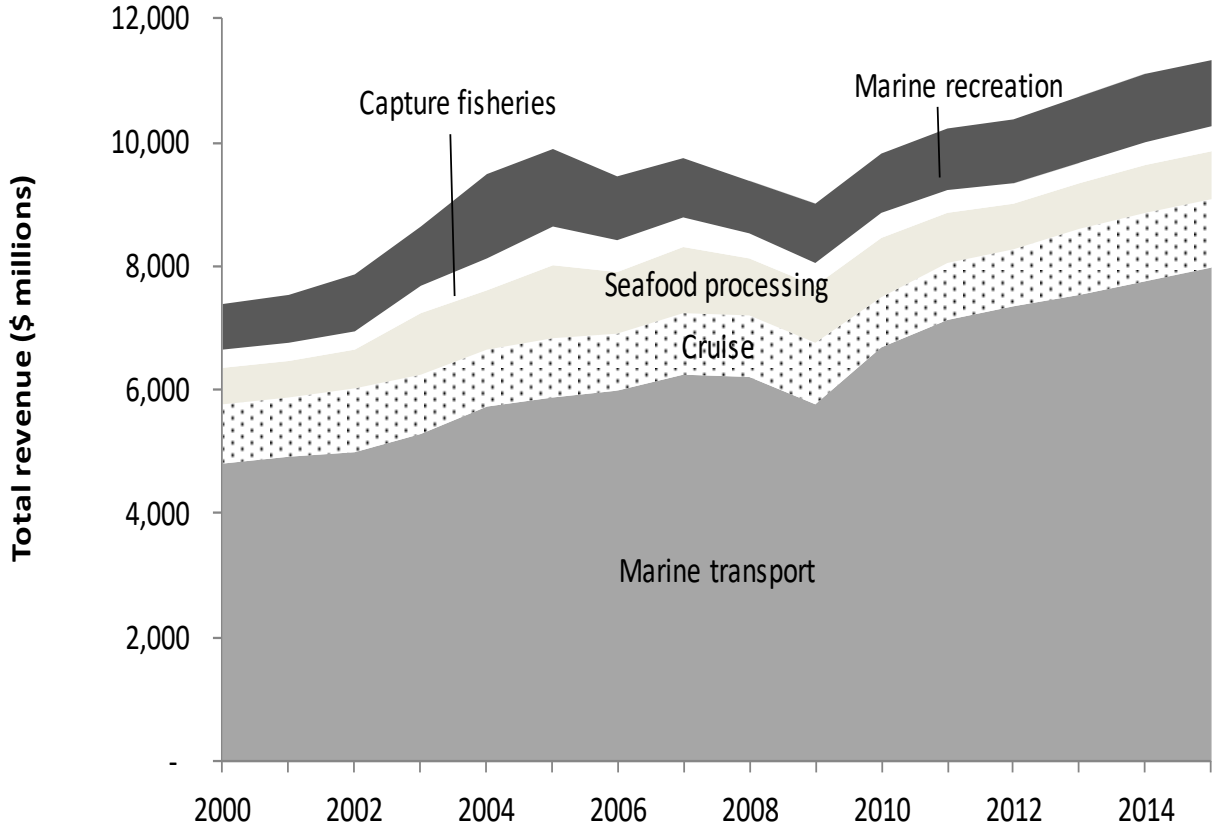
Sector	Variables for calculating revenue	Calculation	Data source
Marine recreation & tourism			
Whale watching	No. of participants (a)	a * b	Tourism statistics, independent surveys
	Expenditure/participant ($/person) (b)		Independent surveys
Coastal tourism	No. of tourist arrivals (a)	a * b * c	BC Stats tourism statistics
	% of tourists motivated by 'sea' (b)		Proxy indicator from independent surveys
	Expenditure/tourist ($/person) (c)		Provincial tourism statistics/ technical reports
Beach activities (locals)	BC residents in coastal area >15 years of age (a)		BC Stats population statistics
	Participation rate (%) in beach activities (b)		Independent survey
	Average expenditure/ participant ($/person/day) (c)		Author's estimate
Kayaking (self-guided, locals)	BC residents in coastal area >15 years of age (a)	a * b * c * d	BC Stats population statistics
	Participation rate (%) in kayaking (b)		Independent survey
	Average expenditure/ participant ($/person/day) (c)		Independent survey
	Number of days/year of kayaking (d)		Independent survey
Cruise tourism	Annual # of cruise vessels (a)	(a*b) + (c*e*g) + (d*f*h)	Port statistics
	Avg vessel expenditure (b)		Independent survey
	Annual passenger arrivals (c)		Provincial tourism statistics
	Annual # of crew (d)		Independent surveys
	% of passengers that disembark (e)		Independent surveys
	% of crew that disembark (f)		Independent surveys
	Avg spending/passenger ($/person) (g)		Independent surveys
	Avg spending/crew ($/person) (h)		Independent surveys

OCEAN CANADA

Results

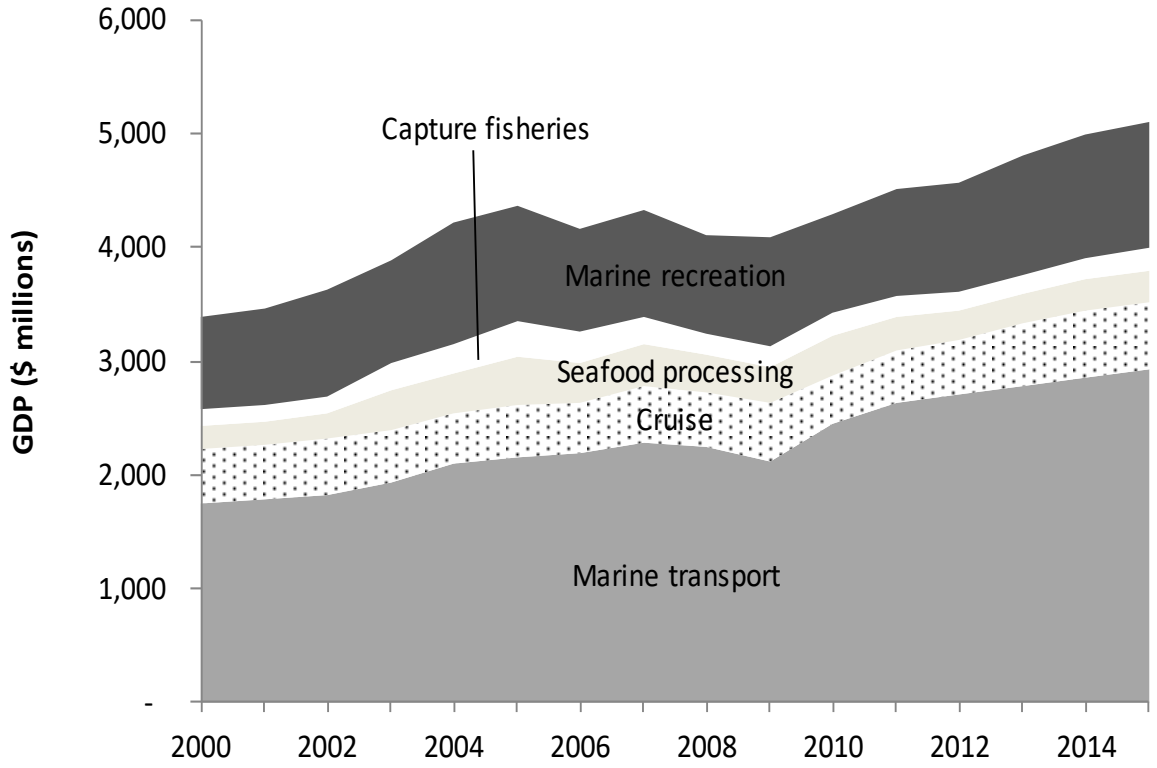
OCEAN CANADA

Revenue



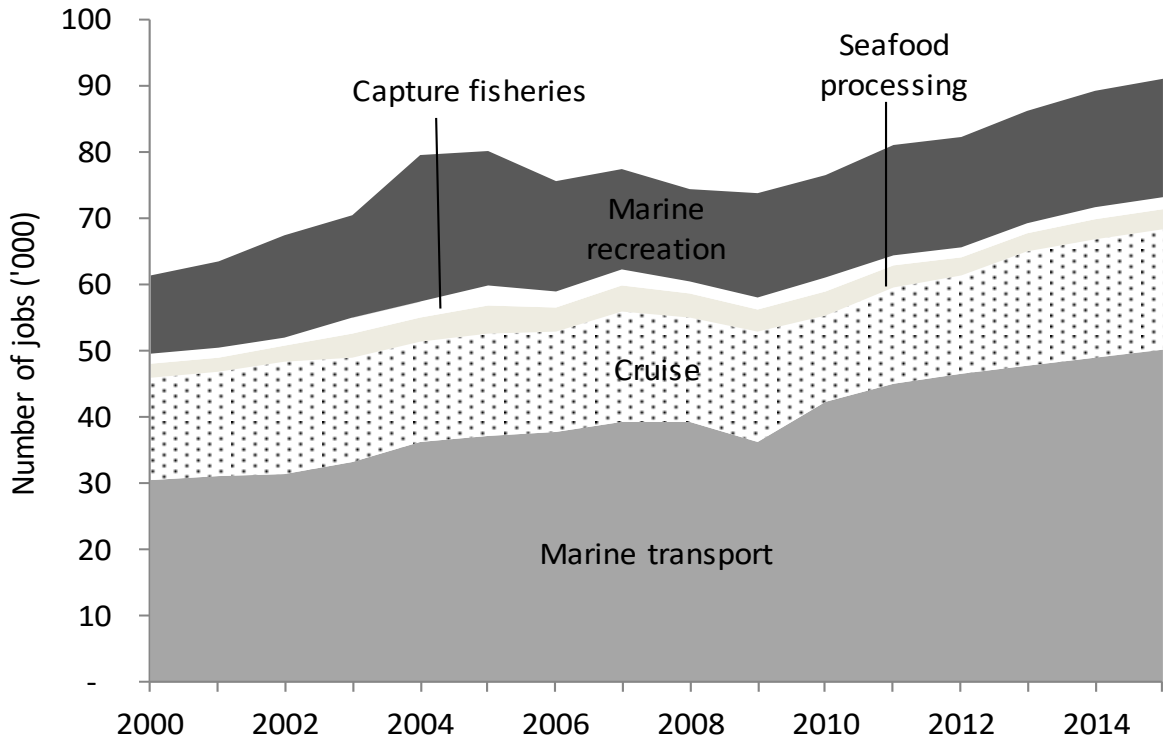
OCEAN CANADA

GDP



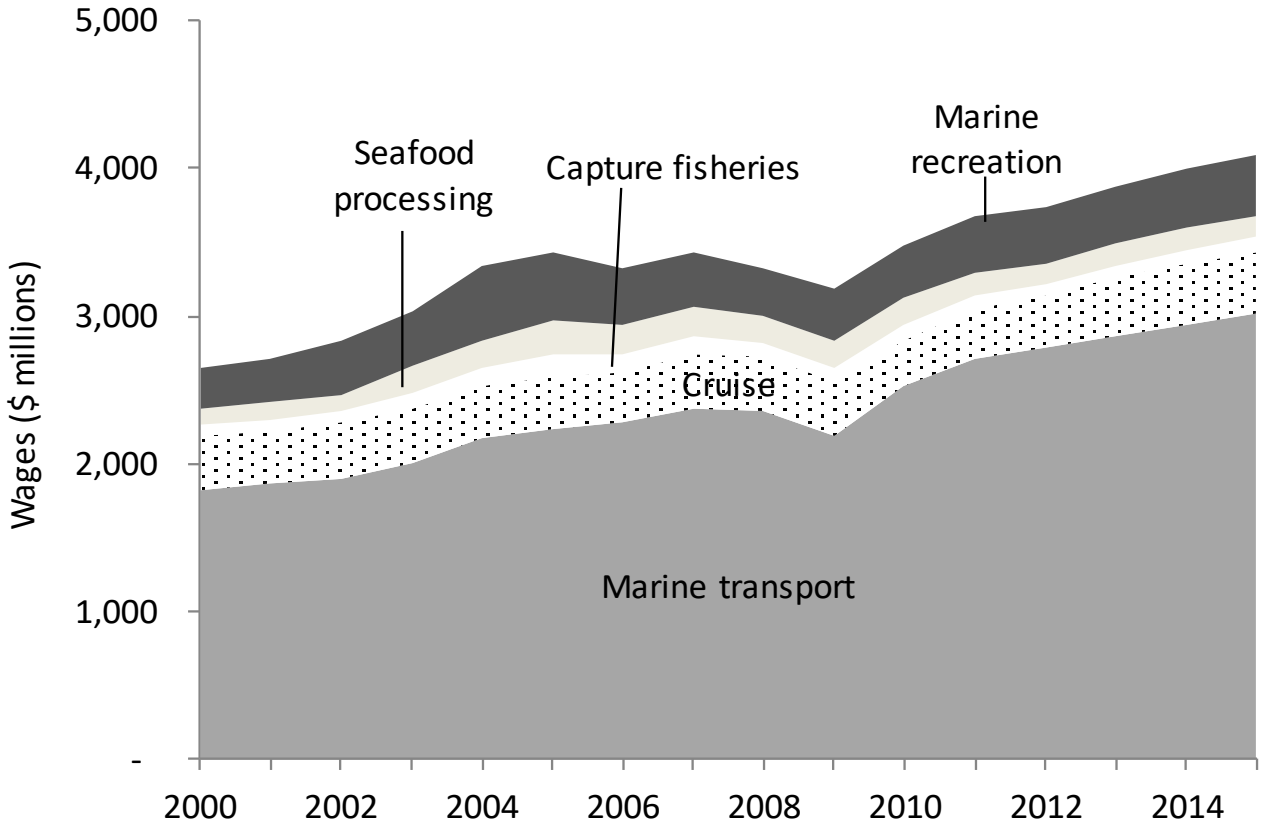
OCEAN CANADA

Number of Jobs (FTE)

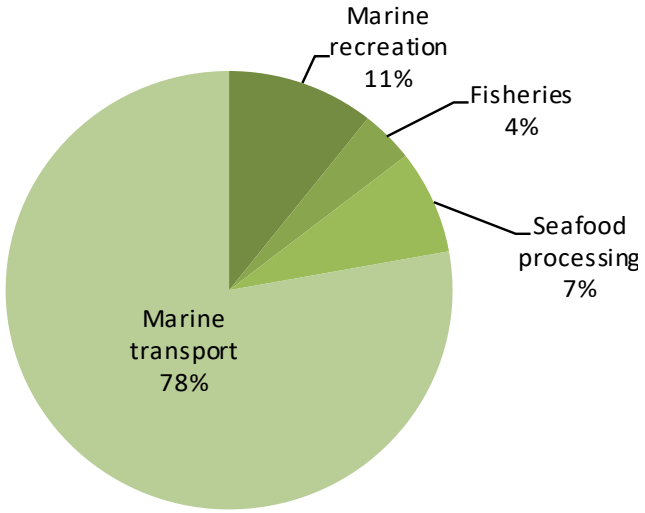


OCEAN CANADA

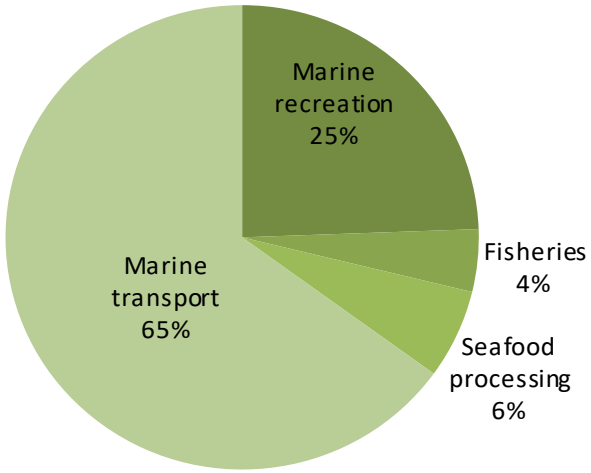
Wages



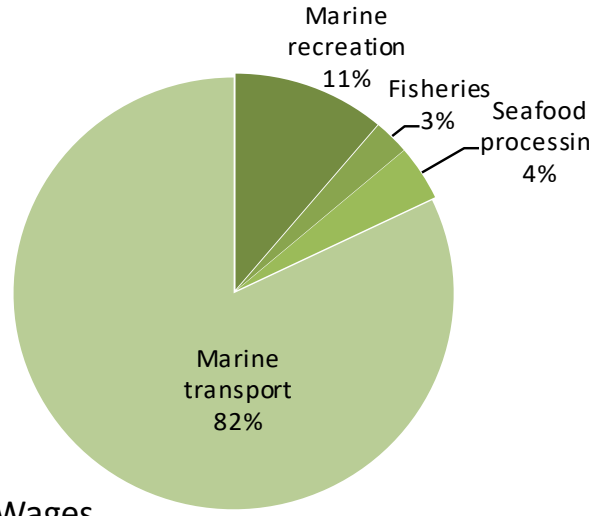
Economic contribution by sector in 2015



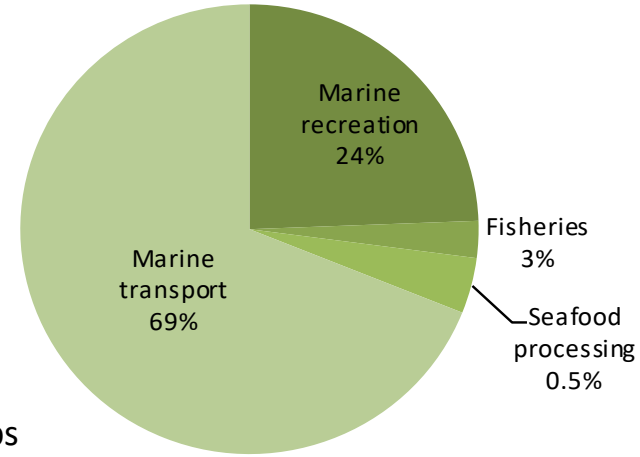
(a) Revenue



(b) GDP

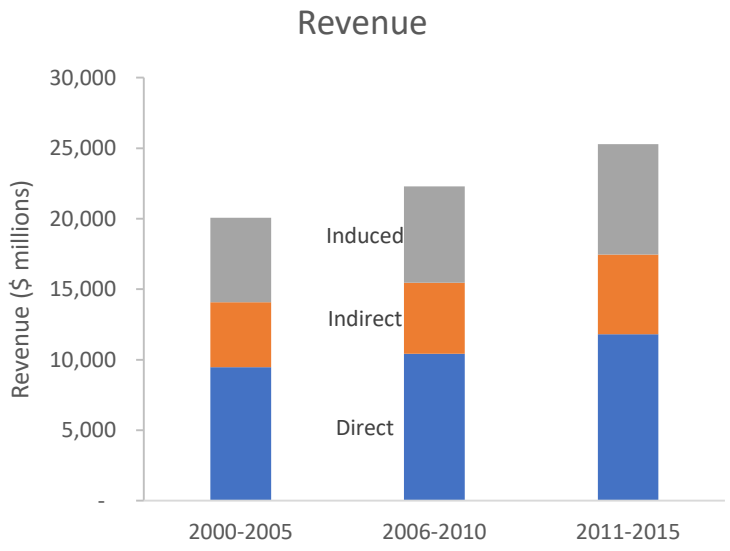


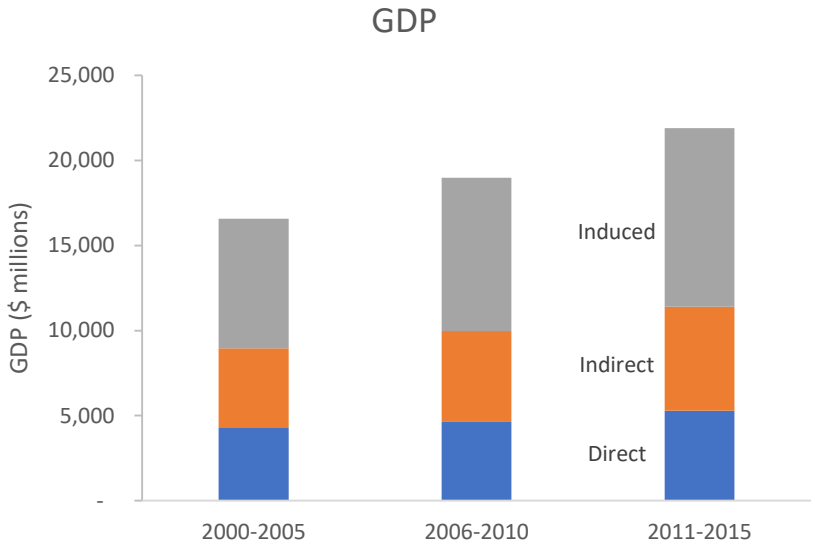
(c) Wages

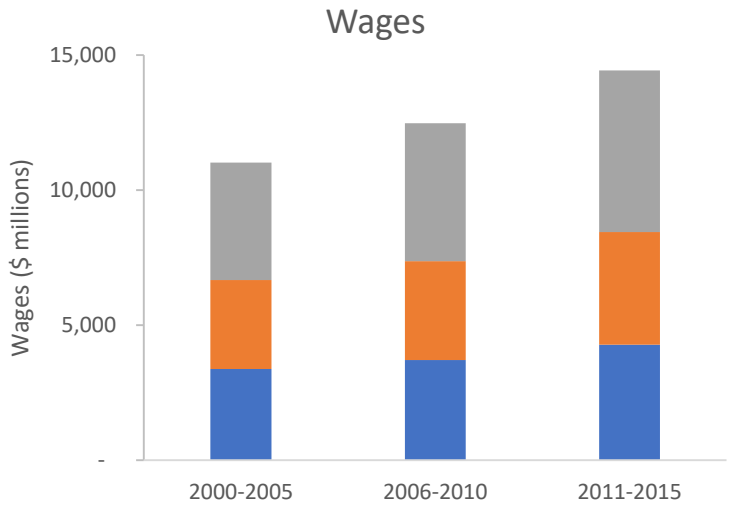


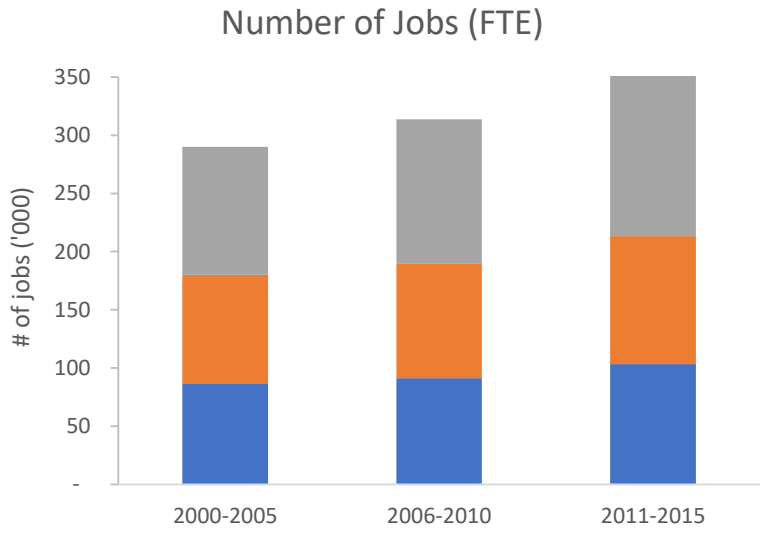
(d) Jobs

Total Economic Impact, 2015









OCEAN CANADA

Applications of an Ocean Metadatabase for Canada

Juliano Palacios-Abrantes, Andres Cisneros-Montemayor, William Cheung, Rashid Sumaila

National Data Integration and Scenarios WG

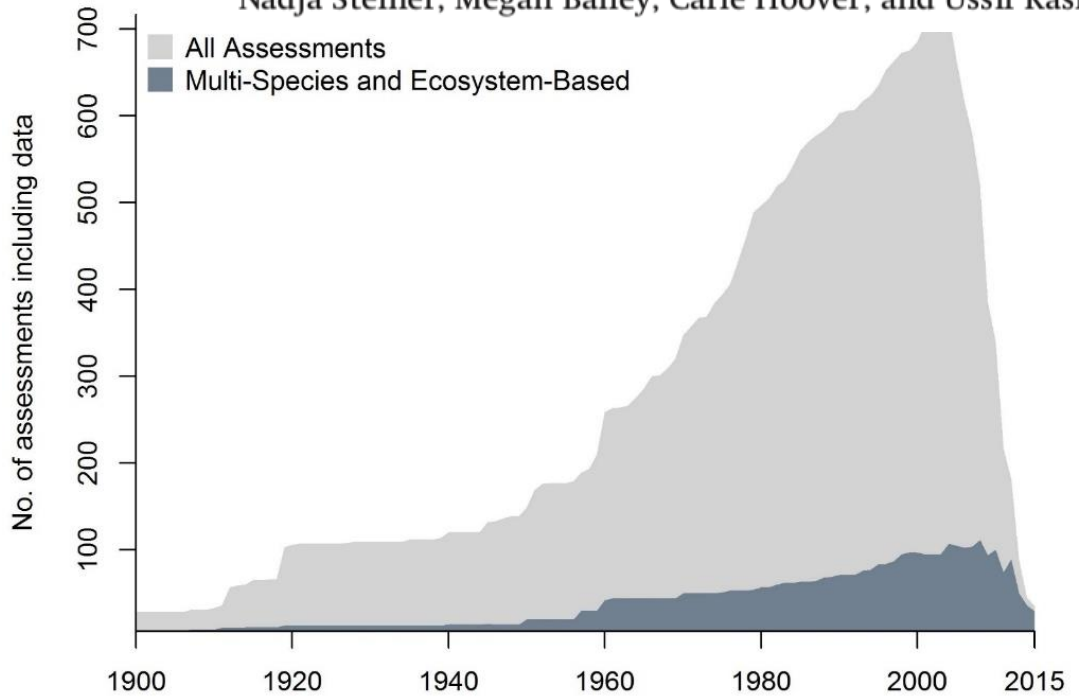
The Metadatabase

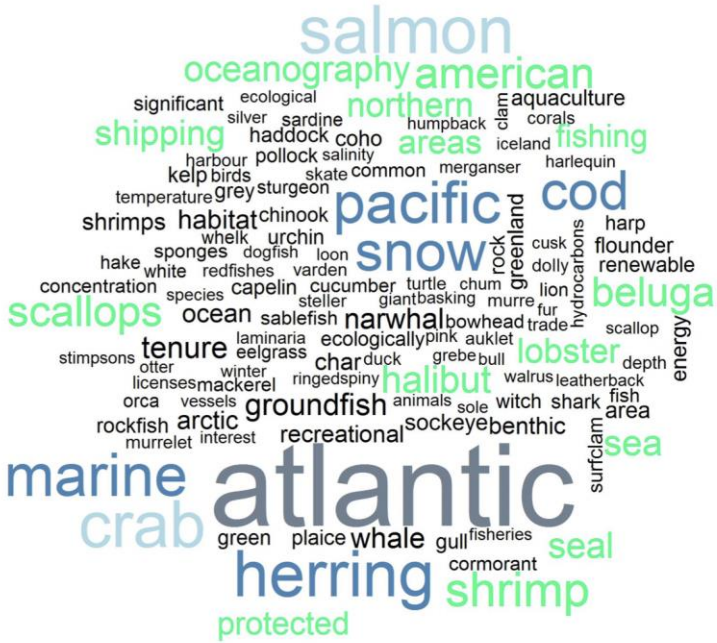
NRC Research Press

ARTICLE

Towards an integrated database on Canadian ocean resources: benefits, current states, and research gaps

Andrés Miguel Cisneros-Montemayor, William Wai Lung Cheung, Karin Bodtker, Louise Teh, Nadja Steiner, Megan Bailey, Carie Hoover, and Ussif Rashid Sumaila

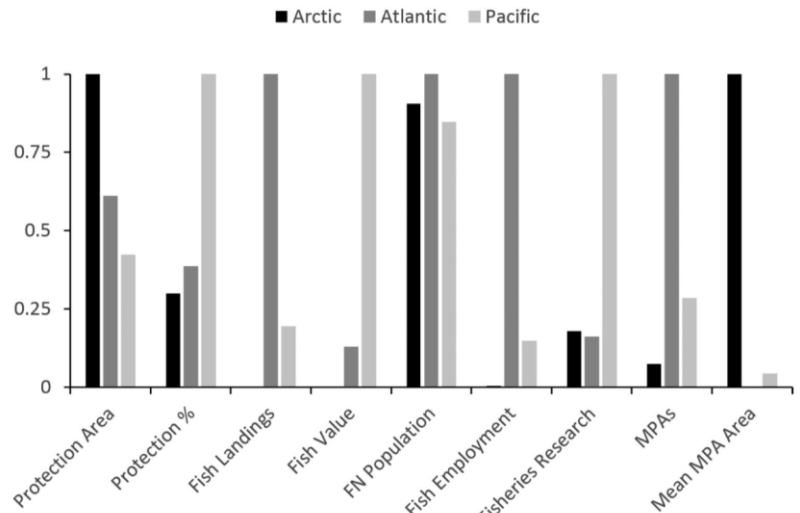




Slide from Cisneros-Montemayor; Cisneros-Montemayor et al. 2016 CJFAS

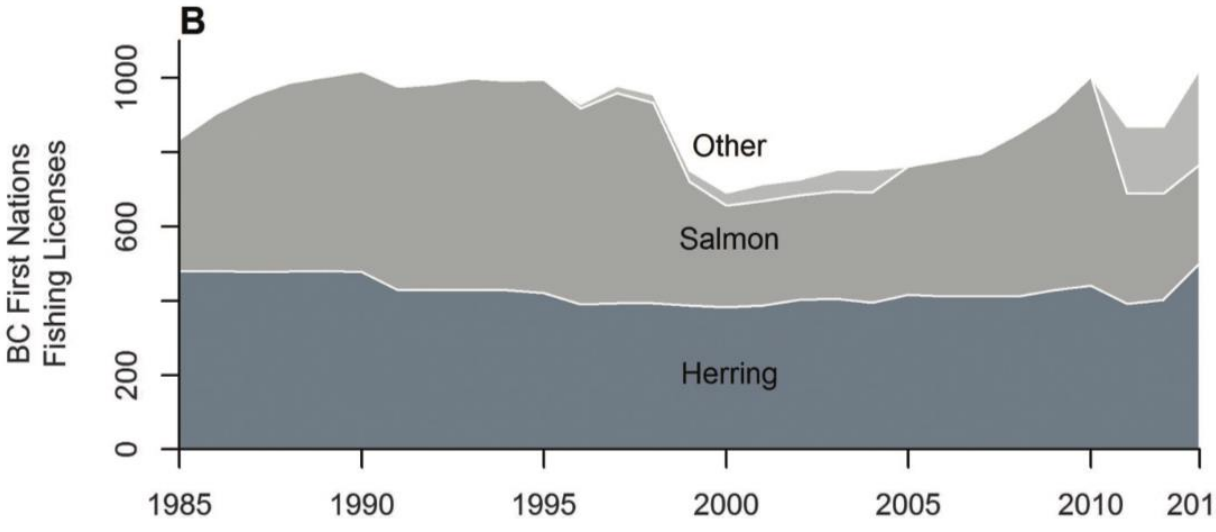
Metadatabase Applications

- **MPA establishment factors**
  - *Data on MPAs in each of Canada's oceans show an inverse relationship between the total MPA area and the area protected as a percentage of total ocean area*



Cisneros-Montemayor et al. 2016 CJFAS

- **Herring fisheries of Heiltsuk First Nation**
  - *It is important to recognize the legal rights to harvest and importance of herring to the Heiltsuk.*
  - *Integrated data can be highly useful for local cases.*

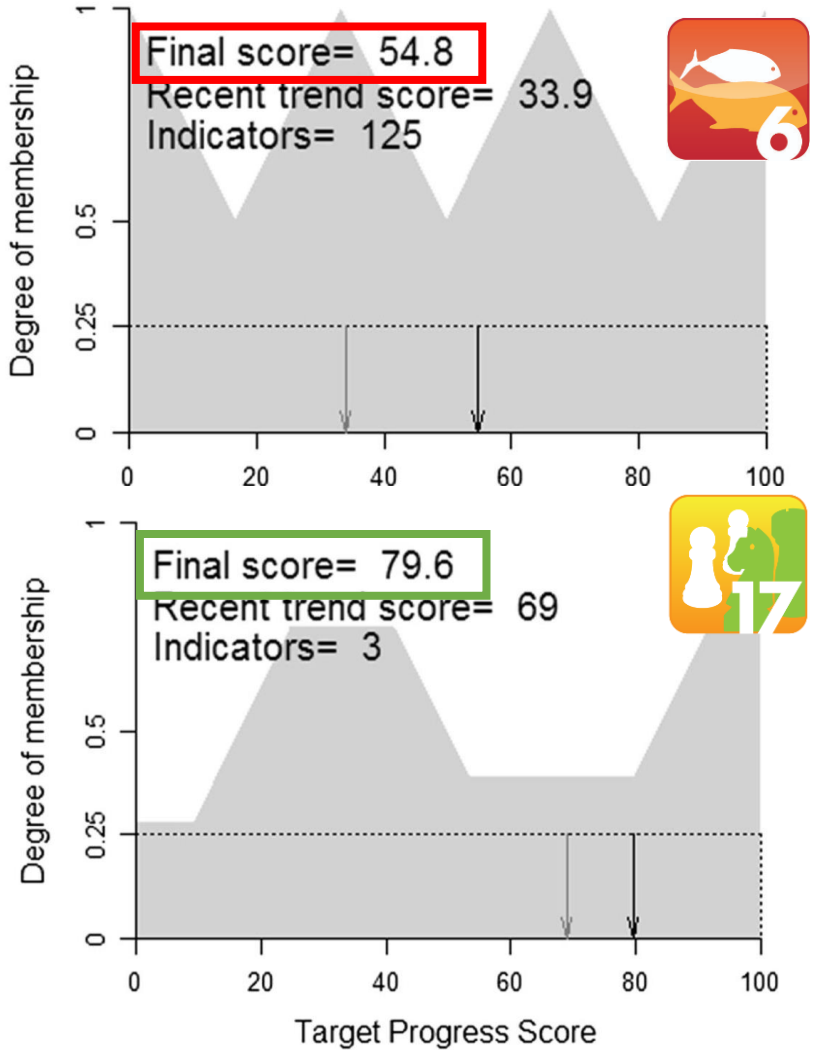


OCEAN CANADA

Using fuzzy logic to analyze Aichi Targets

- Objective
  - Evaluate Canada's progress towards the 2020 Aichi Biodiversity Targets (CBD)
- Method
  - Metadata database + Fuzzy logic
- Conclusions
  - Method allows for evaluating progress towards sustainability policy goals,
  - Highlights key factors in progress, and prioritizes research and collection of information.

- Results

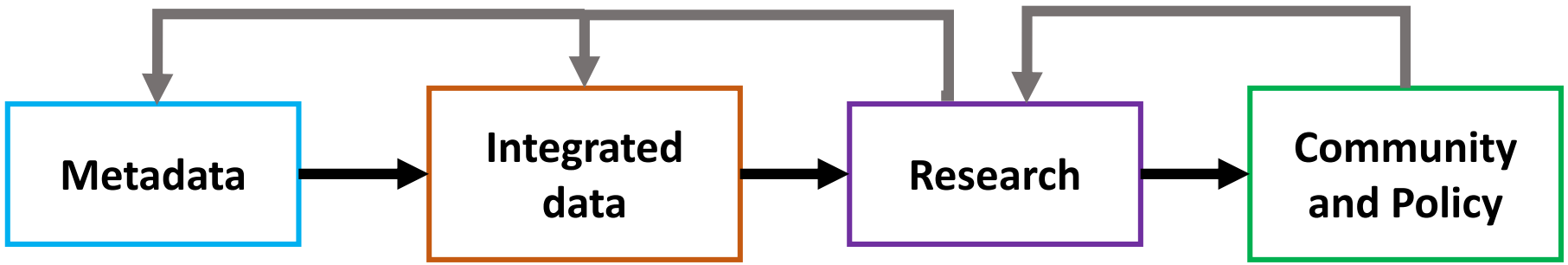


Cisneros-Montemayor, A. M., Singh, G. G. & Cheung, W. W. L. AMBIO: 319, 1–13 (2017).

OCEAN CANADA

Next steps

- Use metadata database and fuzzy logic methodology to Evaluate Canada's Oceans
- Accessibility is key for metadata records and corresponding data
  - Make the database "directly" available to everyone
  - Interactive web apps *(Mexico metadataset example)*



https://jepa.shinyapps.io/marm

Juliano

Secure | https://jepa.shinyapps.io/marmetadatamexeng/

Home | The Project | Metadata | Preliminary Results | **Collaboration** | Language

Collaborate in the Development of Marine Research in Mexico

We are looking for any available information regarding marine research in Mexico, regardless of the source. It can be your thesis data, grey literature, or citizen science!

The project depends on wide collaboration to populate the database, so we invite anyone interested in collaborating with the project to contact us and share information about their data.

It is important to mention that **we are not gathering hard data, but rather information about them.**

The more people involved, the better we can reflect the state of marine research in Mexico

Data Points collected:
916786
Last updated:
2018-08-24

Three Ways to Collaborate

1. Share

In order for the project to better reflect marine research in Mexico, it is necessary to have as much information as possible. Remember that we are not collecting raw data, we are collecting information about what data exists

Download Template | Metadata Key

2. Inform

We are looking for any source of information relevant to marine research in Mexico. No matter the source, they can be data from dissertations, publications, monitoring programs, gray literature or official reports

Email: j.palacios@oceans.ubc.ca

3. Communicate

We believe that in Mexico there is a lot of existing information relevant to the marine environment, however a small group of people are not able to capture all the information. The more people are involved, the more information we can collect and the better we can reflect the current state of marine research in Mexico, as well as highlight fields with limited information.

Benefits of Collaborating

Data information sharing has many benefits to both individuals and society. Having your data information included in the Metadata will increase the visibility of your research. Your data could be potentially be useful for other researchers to answer different questions, and they would contact you directly. This will ultimately foster collaboration among national and international researchers that could result in important advances for the country (Michener 2006).

As a community committed to research of Mexico's marine environment, sharing our data brings important benefits. Building systems for managing and sharing data ensures preservation, stewardship and access to information (Fridell et al., 2014). It will also allow us to understand what information is out there, and identify fields of research that need to be further developed

People and Institutions Collaborating

While the vast majority of the information collected so far is publically accessible online, we have started receiving data information from unpublished or otherwise not readily-available sources

Institutions

Show [ ] entries Search:

Institution	Repository
All	All
Arizona-Sonora Desert Museum	Macrofauna Golfo Project
CIBNOR	Datos Abiertos Mx
CICESE	Baja California Salps During Enso
CICESE	Changes In Dominance Of Copepods Off Baja California During The 1997-1999 El Nino And La Nina
CICESE	Imecocal

Showing 1 to 5 of 146 entries Previous 1 2 3 4 5 … 30 Next

People

Show [ ] entries Search:

Author	Repository
All	All
Abarca Arenas, L.G.	Ecobase
Acosta Gonzalez, G.	Catalogo De Metadatos Geograficos (Conabio)
Acuario de Veracruz, A.C.	Obis Data For Mexico
Agern, A.L.	Datamares
AGRRA	Obis Data For Mexico

Showing 1 to 5 of 291 entries Previous 1 2 3 4 5 … 59 Next

Palacios-Abrantes et al., (Under rev.)

NDIS Working Group

SCENARIOS

OCP Scenarios

Objectives

- Integrated social-ecological perspective about alternative futures for Canada's oceans

- Drivers and thresholds for addressing specific research questions relevant to Canadian oceans

NDIS Scenario Workshop, UBC

Objectives

- How Cross Cutting Themes can be better integrated into national scenarios

- How to link national scenarios to regional and local scales

NDIS Scenario Workshop, UBC

Outcomes

- Challenges to carry-out local, on-site scenarios
- Use national level outcomes to stimulate thinking about local drivers at community level
- Development of multi-scale scenarios for Canadian oceans
- Issues that are relevant across scales (e.g. food security, gender/governance), while at the same time capture local/regional nuances that are important to consider for policy implementation.

Achieving the Paris Agreement: Implication for species, fisheries and Canadians

- Meeting the PA target could mitigate projected declines in potential global fisheries catch (Cheung et al. 2016; Sumaila *et al*. in press)
- How Canada's seafood supply could be impacted by 1.5° and 3.5°C warming target scenarios (Talloni et al. in prep.)
- Potential effects of implementing the Agreement on both domestic catches and the top 10 source countries of Canada's seafood imports

Cross-cutting topic:
Indigenous women respond to fisheries conflict and catalyze change in governance on Canada's Pacific Coast

Sarah Harper, Anne Salomon, Dianne Newell,
Hilistis (Pauline) Waterfall, Kelly Brown,
Leila Harris & **U. Rashid Sumaila**

Pacific herring crisis & conflict

Research questions

- How did Heiltsuk women respond to the 2015 herring fishery crisis and conflict on the Central Coast of BC?

- What role did Heiltsuk women play in the process of transforming fisheries governance?

Herring Crest by Nusi (Ian) Reid. Raven represents the head chief, the noblewoman represents Heiltsuk matriarchs & life-givers.

Policy implications

- Positioning women at the forefront of resource governance brings attention to intergenerational care & equity;

(Harper et al., In press, *Maritime Studies*)

Policy implications

- Positioning women at the forefront of resource governance brings attention to intergenerational care & equity;

- Recognizing & supporting Indigenous women in fisheries leadership & decision-making important to decolonizing fisheries governance and to reconciliation;

(Harper et al., In press, *Maritime Studies*)

Policy implications

- Positioning women at the forefront of resource governance brings attention to intergenerational care & equity;
- Recognizing & supporting Indigenous women in fisheries leadership & decision-making important to decolonizing fisheries governance and to reconciliation;
- Intergenerational transfer of knowledge key to resilience & sustainability in fisheries.

(Harper et al., *In press*, Maritime Studies)

Outlook

1. Quantified economic contributions of all Canadian Oceans;

2. Report on the successes and gaps of Canada in achieving ocean-related sustainable development targets;

3. Identified future pathways of achieving sustainable ocean development;

4. Informed federal and provincial government in developing international, national and regional ocean-related policies e.g., Convention on Biological Diversity – Beyond 2020 targets, climate actions, fisheries rebuilding.

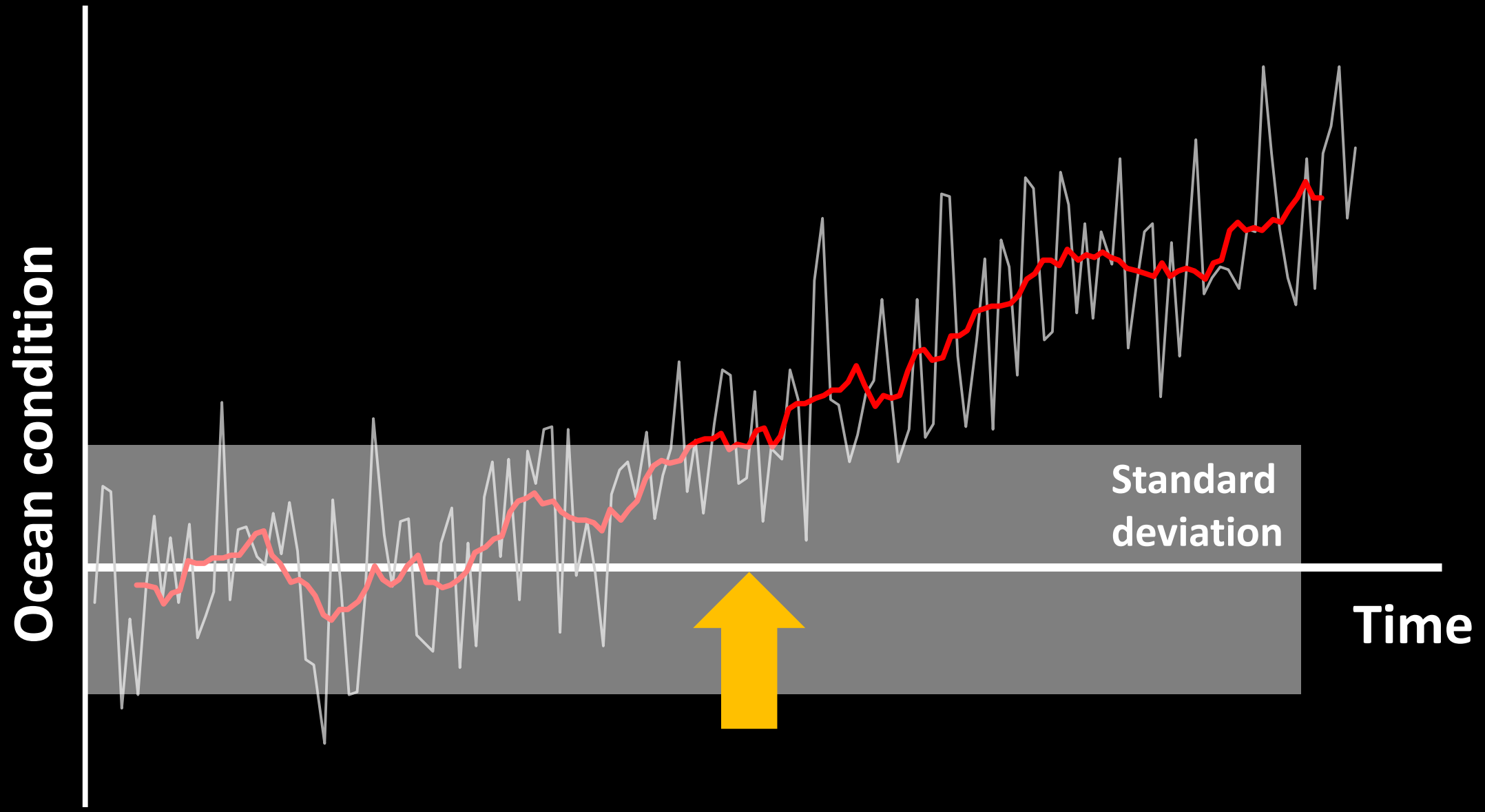
OCEAN CANADA

Changing Oceans Cross-cutting Theme

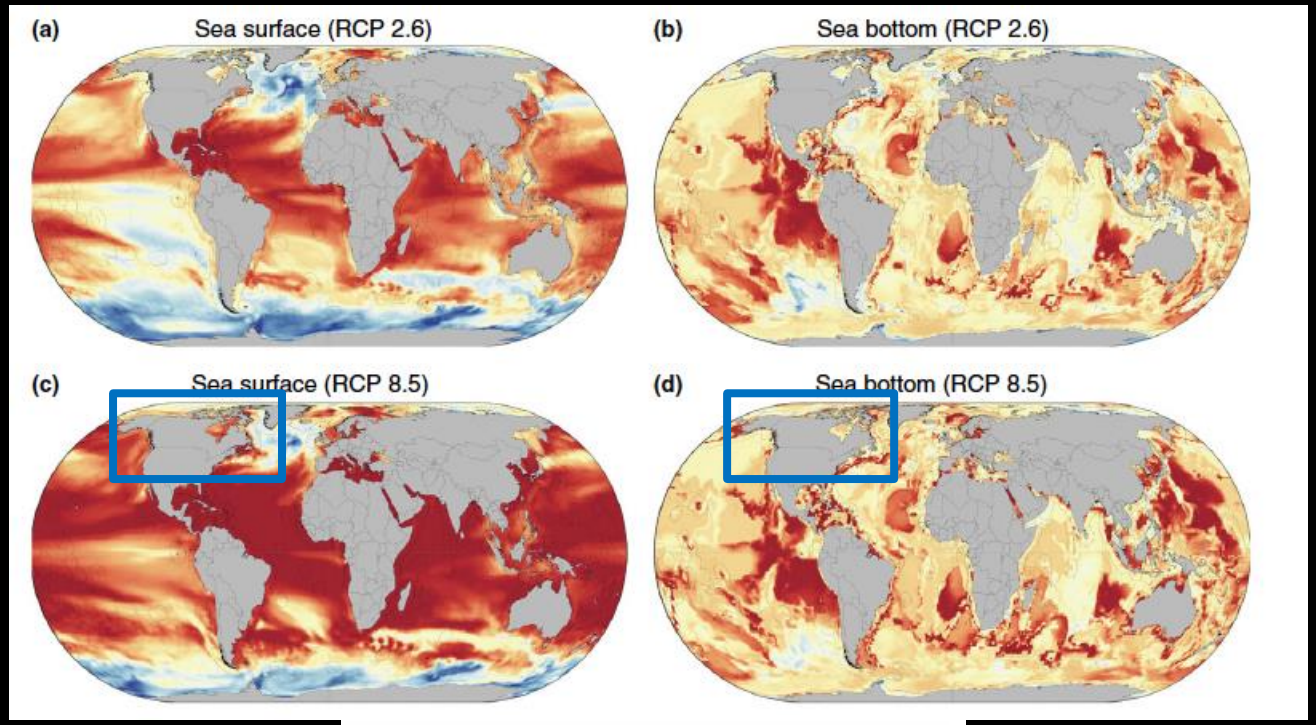
Ocean Canada Meeting

Halifax, September, 2018

Beyond adaptation to historical variability

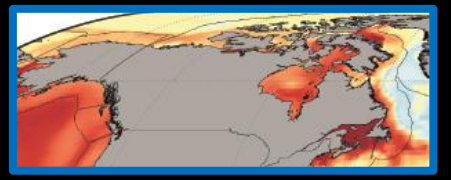


Exploited species' exposure to climate hazard by 2041-2060 (temperature, pH, oxygen, net primary production)

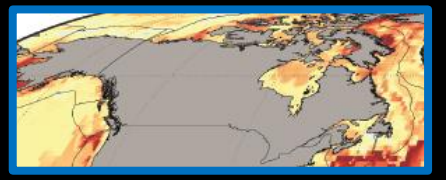


RCP 8.5

Sea surface



Sea bottom



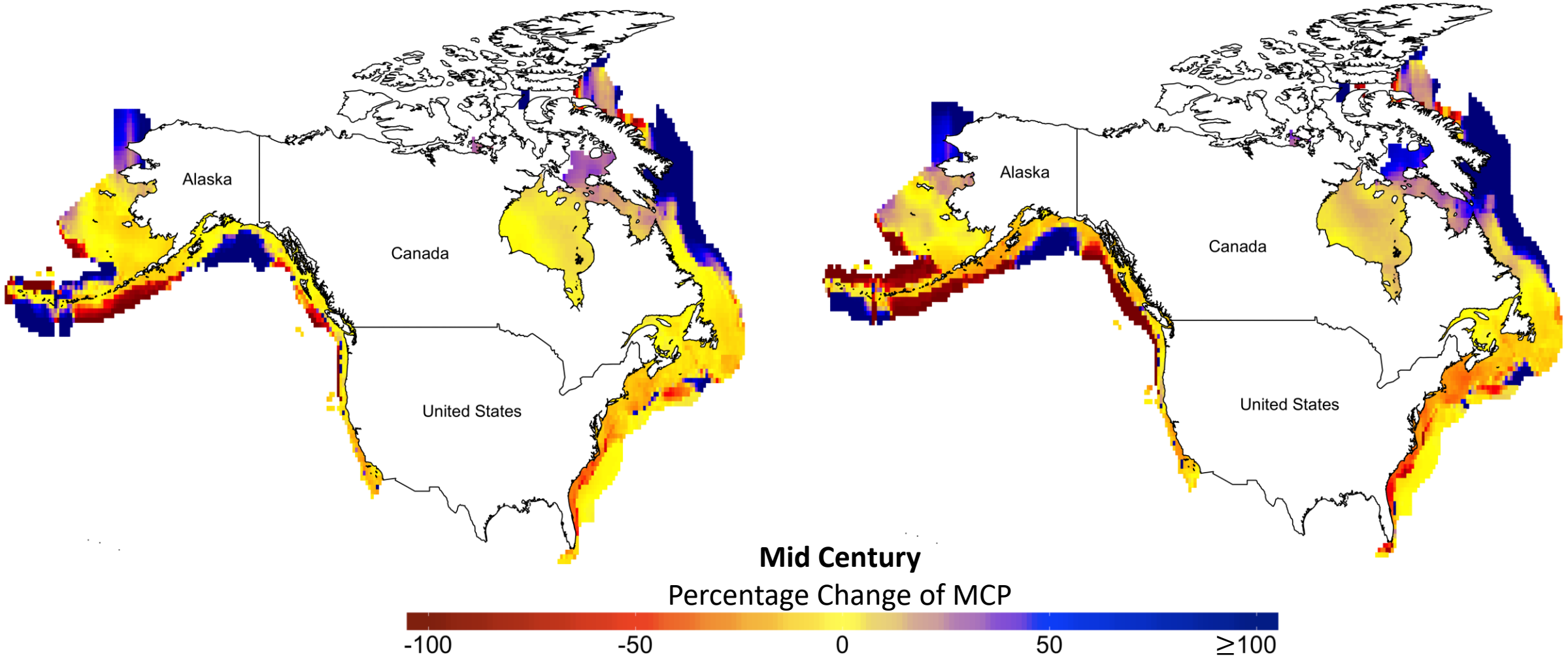
Cheung, Jones, Reygondeau, Frölicher (2018) Global Change Biology

OCEAN CANADA

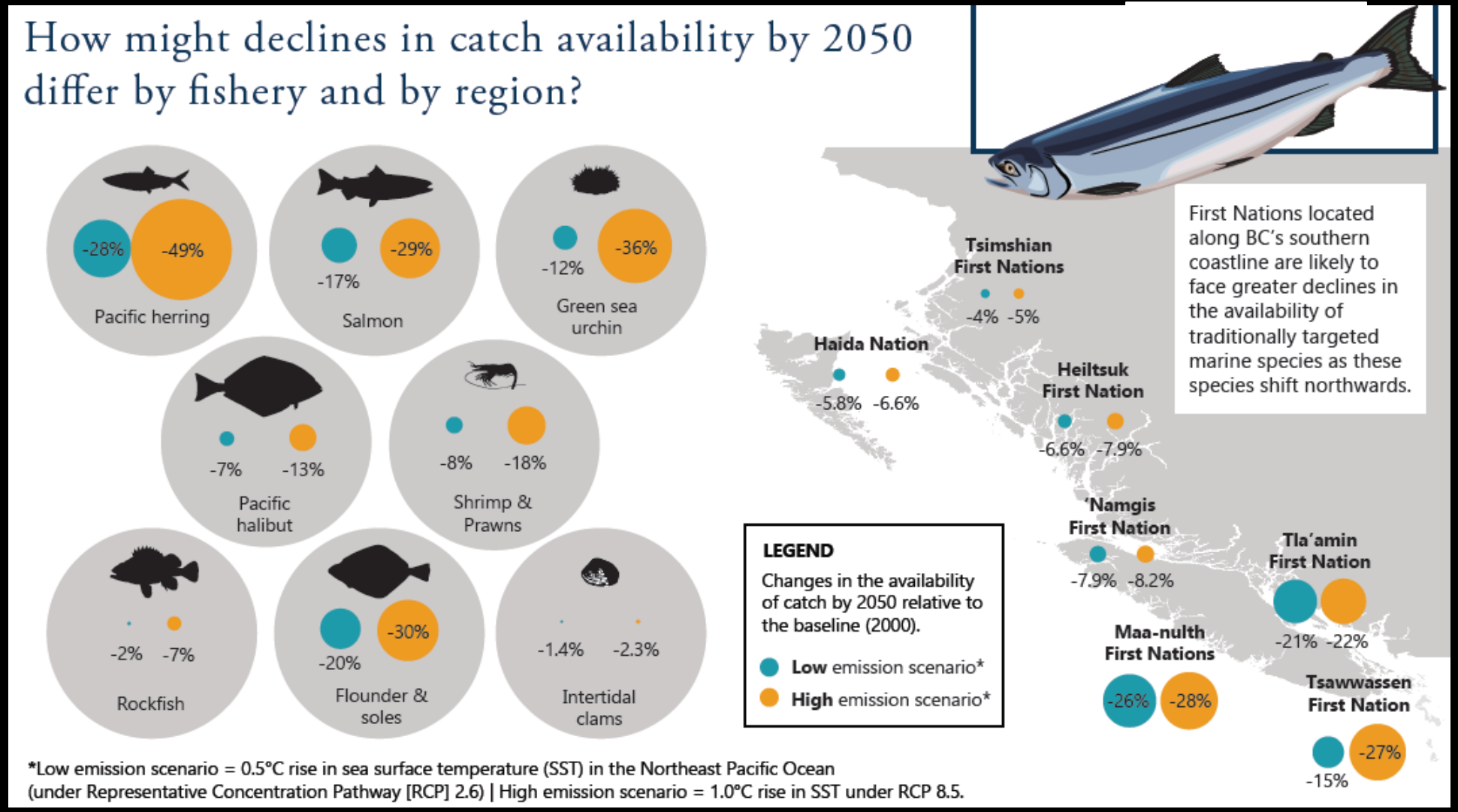
Results | Different RCP and coast (Mid 21st Century)

RCP 2.6

RCP 8.5



Implications for coastal communities

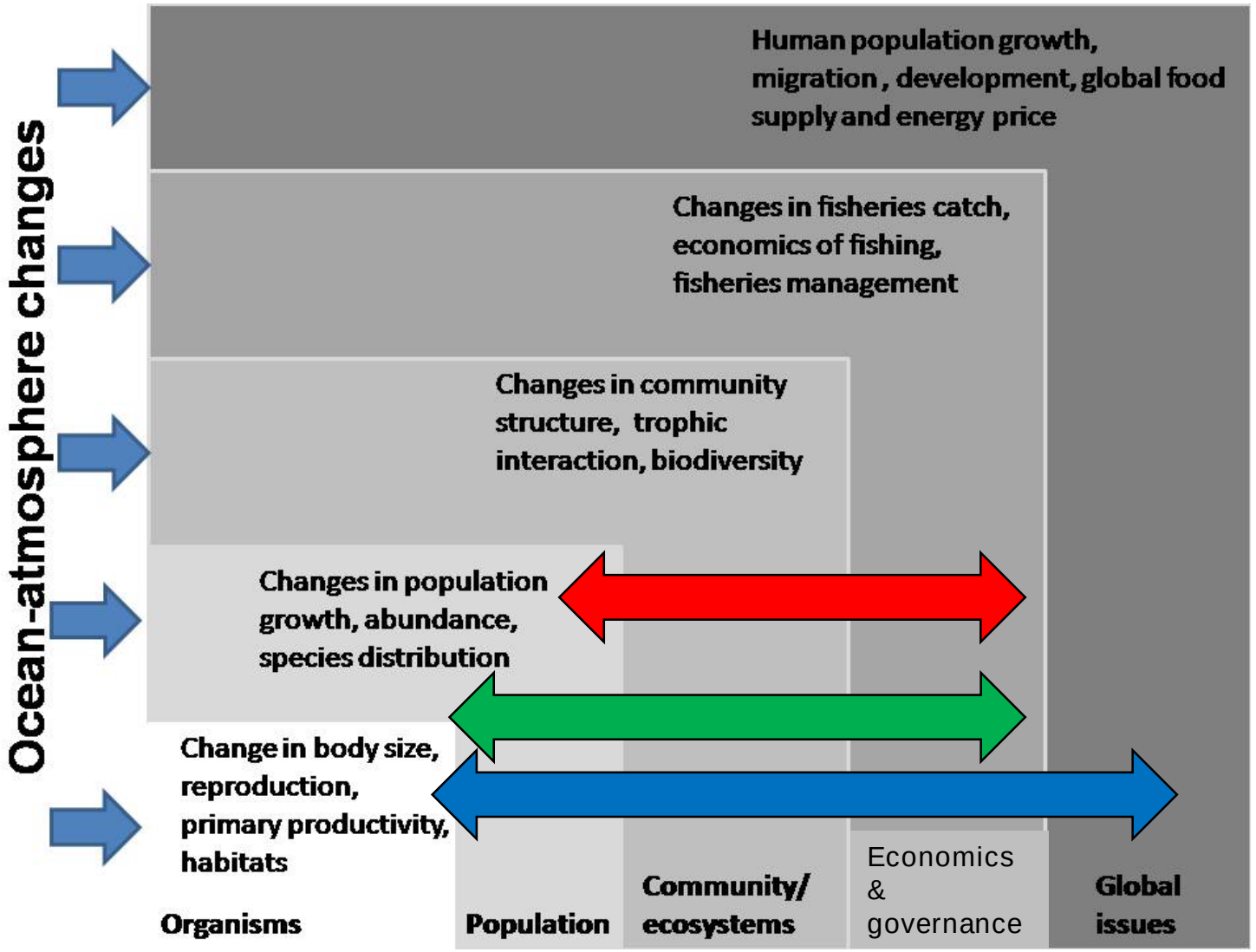


Weatherdon, Ota, Close, Cheung (2016) PLoS One

Objectives

1. Quantification of contributions of coastal habitats and resources to current and past community well-being;
2. Changes in ocean and socio-economic drivers in Canada under global change;
3. Effects of changing oceans on coastal habitats and resources;
4. Socio-economic, policy and governance responses to changing habitats and resources;
5. Future of coastal community well-being under global change;
6. Development of conceptual models to explore high-level health and ocean health linkages.

Key components



Transboundary fisheries
(NDIS + Law & Policy)

Arctic Ocean Acidification
(NDIS & Law & Policy)

OceanCanada book
(all WGs and CCTs)

Outline

1. Arctic Ocean Acidification project (presented by Travis Tai and Nadja Steiner)

2. Transboundary fisheries management (presented by William Cheung)

3. Outlook

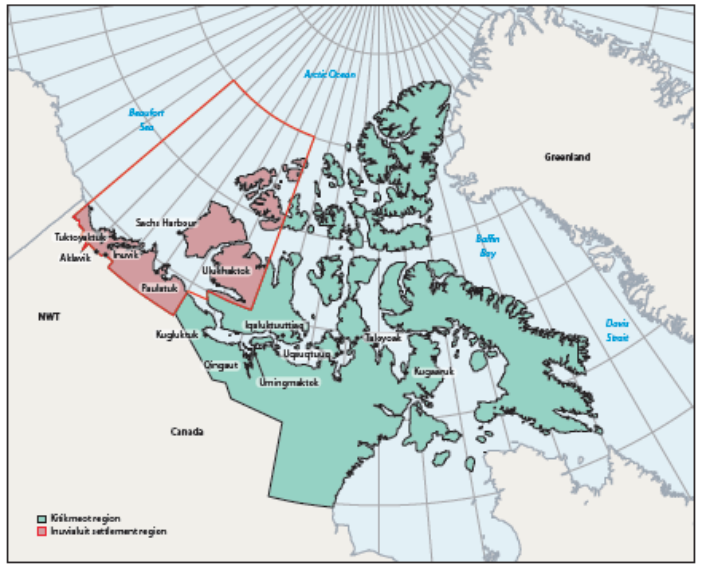
Changing oceans – Arctic

- Define vulnerable areas and impacts due to changing oceans
  - Physical, ecological, social, economic, governance

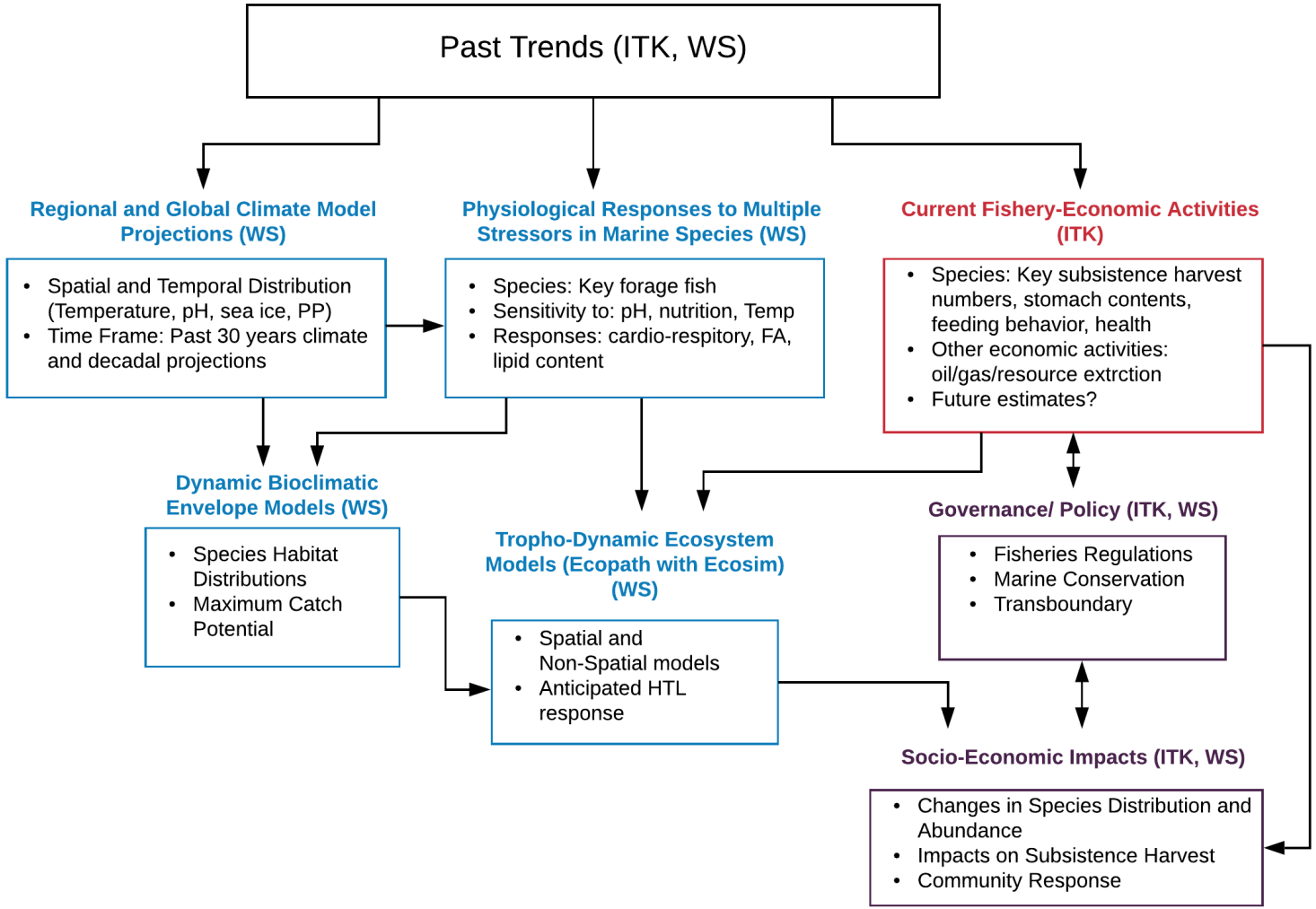
- Current working projects and analyses
  - AMAP report
  - Canada’s current and future Arctic fisheries

AMAP report

- Arctic Monitoring and Assessment Programme
- Linking climate model projections to subsistence fisheries
- Beaufort Sea focus
- Arctic cod case study



Integrated framework



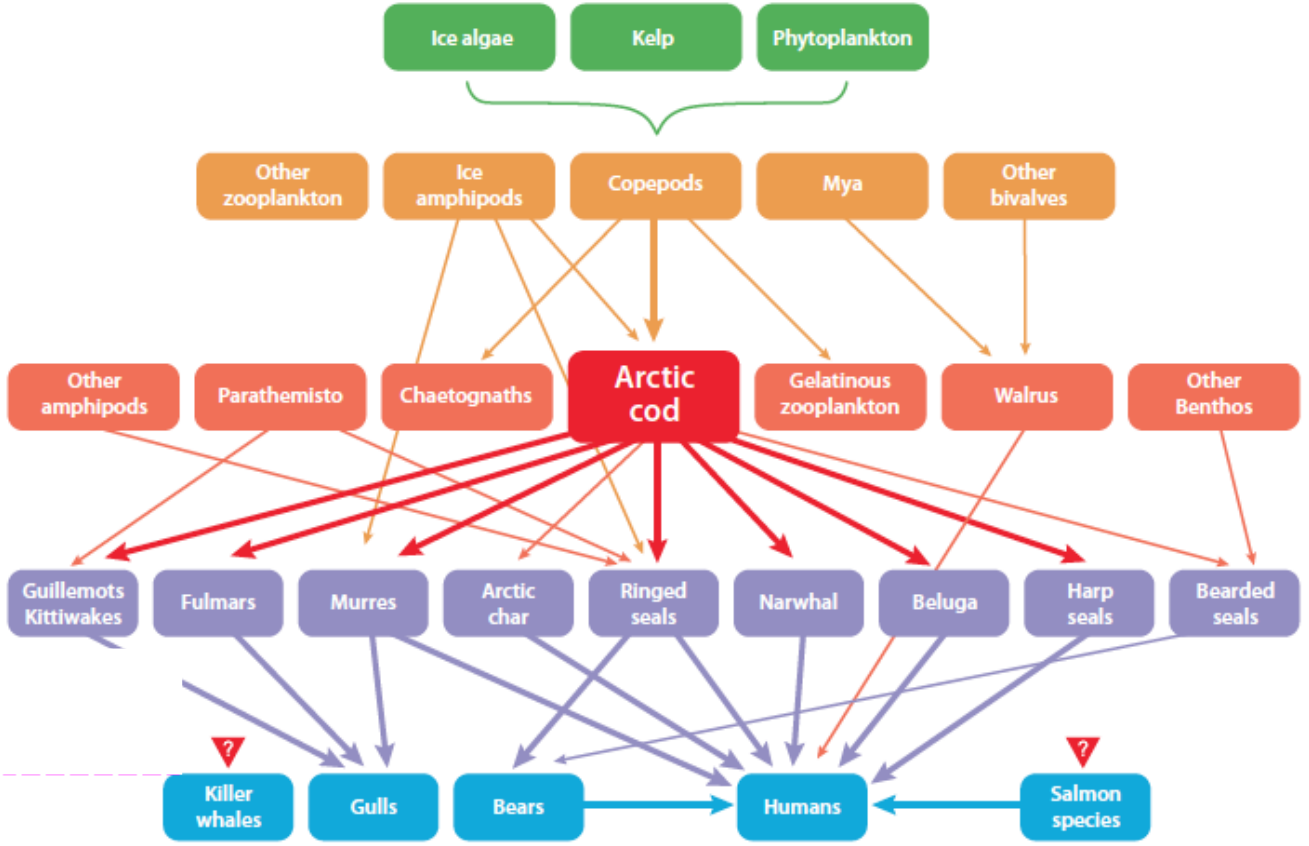
Taking stock

- Physiological responses to temperature and pH

Species common name:	Temperature limits (°C)				pH
	Critical lower	Lower pejus	Upper pejus	Critical upper	Critical/Pejus/Optimum
Pacific herring		Adults = 4.7C		Spawning = 10C Larvae= 13.3C (at 25ppm)	
Spot prawn	Adults = 3C	Adults = 5C	Eggs = 13-15C	Adults = 21C Larvae = 15.2C	
Arctic cod	-1.4C	Adults = 0.2C	Spawning = 3.5C Adult heart rate (T_{max}) = 10.8C	Adult Loss of equilibrium (LOE) = 14.9C	No difference in proton leak and ATP production efficiency between groups acclimated at 400 µatm vs. 1170 µatm of CO_2
Arctic char	0C	Eggs < 3C	Adults = 16C Adults Growth freshwater = 15.1C T_{max} (heart rate) = 23C	larvae feeding = 22C Alevins, fry and parr (acclimation 5C) = 23-3, 25-1 and 25-7C	Pejus = CO_2 <10 mg/L optimum 10-20 mg/L
Capelin	-1.5C	0C	Juveniles= 10C Adults= 14C		
Calanus glacialis (copepod)			Stage IV = 10C or = 5C with 3000 µatm added stress		Hatching delay: 6.9 pH Copepodites stage IV: 7.87 pH
Limacina helicina (pteropod)	Adults = -1.9C	Adults = -0.4	Adults = 7C		Adult: 28% decrease in calcification at 760 µatm. Ω ~ 0.8 = severe damage

Taking stock

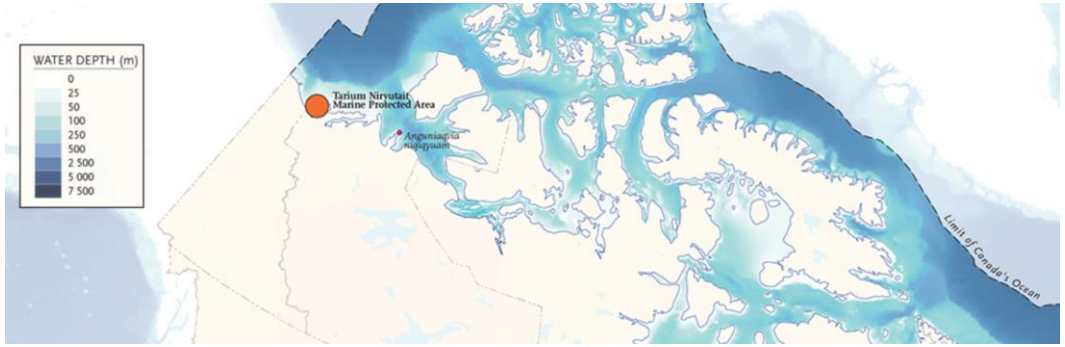
- Beaufort Sea ecosystem structure



Taking stock

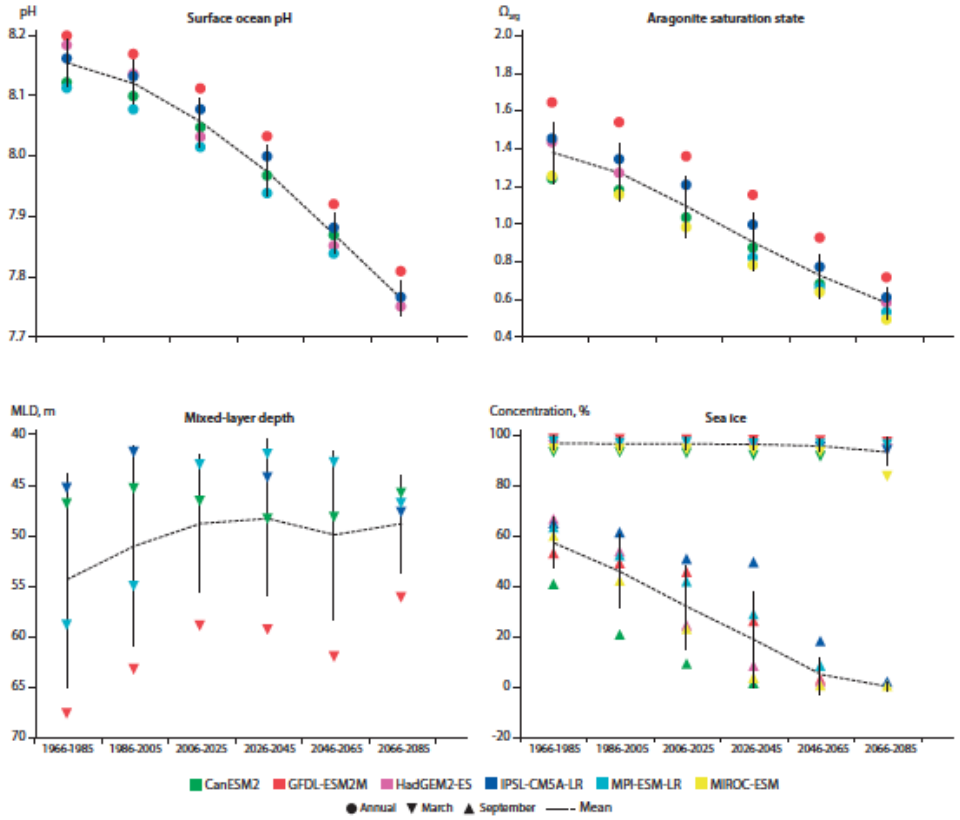
- Current fisheries catch and landed value
- MPA networks

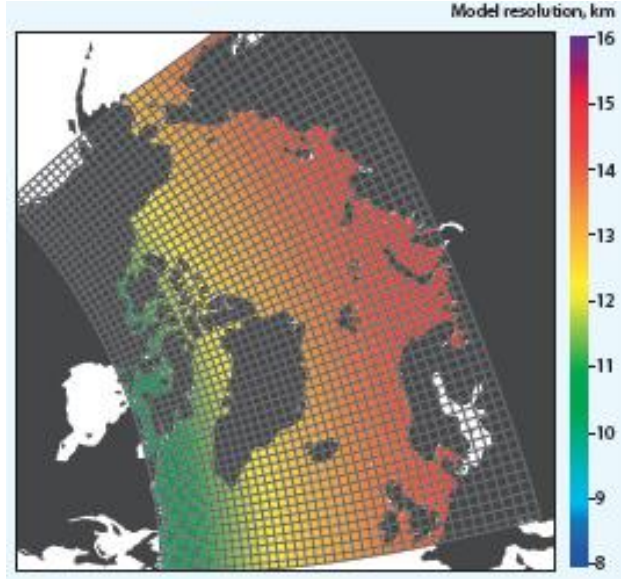
	Current (2001–2010)	
	Catch	Landed value
Arctic cod (*Boreogadus saida*)	4600	3240,000
	(2810 – 5800)	(1980,000 – 4090,000)
Capelin (*Mallotus villosus*)	4,310	1150,000
	(1260 – 6490)	(337,000 – 1740,000)
Navaga (*Eleginus nawaga*)	103	69,300
	(69.4 – 144)	(46,700 – 96,800)
Atlantic halibut (*Hippoglossus hippoglossus*)	10.5	77,700
	(1.90 – 16.4)	(14,100 -121,000)
Lemon sole (*Microstomus kitt*)	9.42	45,500
	(6.81 – 11.3)	(32,900 – 54,500)
Arctic char (*Salvelinus alpinus alpinus*)	3.50	13,200
	(1.17 – 5.39)	(4410 -20,300)
Greenland cod (*Gadus ogac*)	0.300	756
	(0 – 0.895)	(0 – 2290)
Total	**9029**	**4599,000**
	(4150 – 12,500)	(2410,000 – 6120,000)



Future scenarios

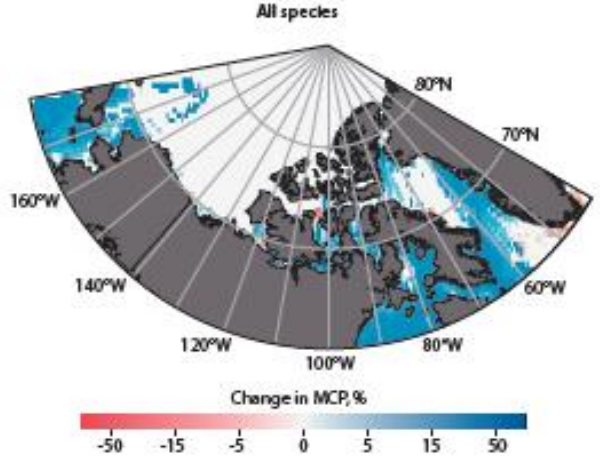
- Regional and global climate model projections
- High climate change scenario (RCP 8.5)

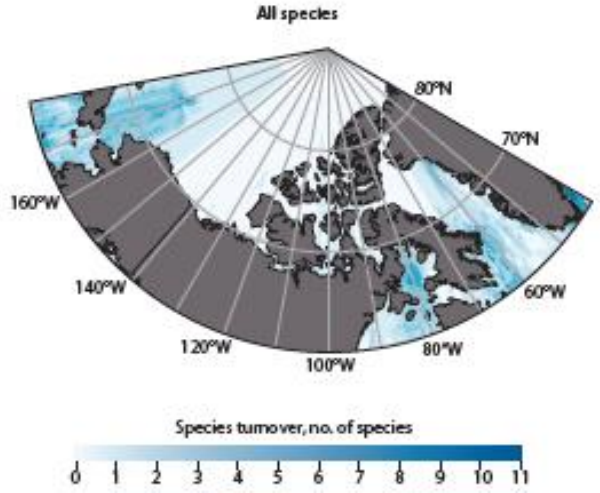




Future scenarios

- Dynamic bioclimate envelope model
  - High climate change (RCP 8.5)
  - Distribution and catch potential
  - Species turnover
- Tropho-dynamic ecosystem model
  - Ecopath with Ecosim (EwE)
- Economic impacts
  - Prices and to determine potential fisheries value



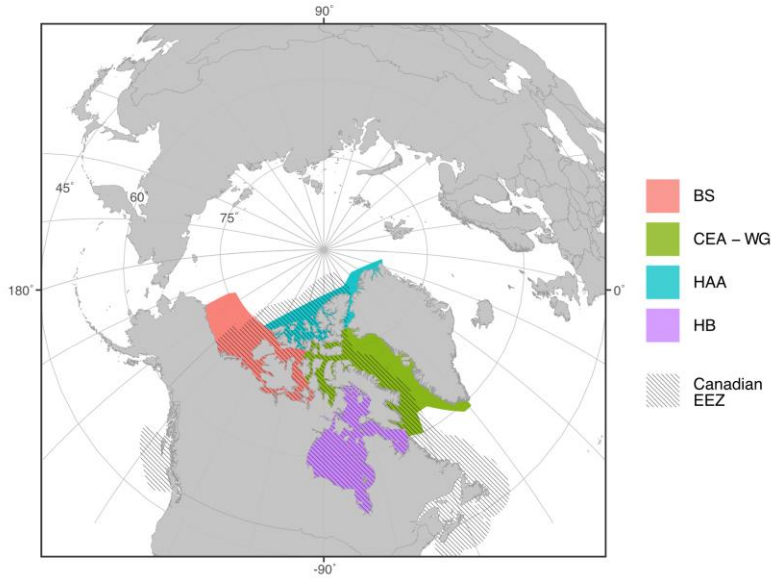


Next steps

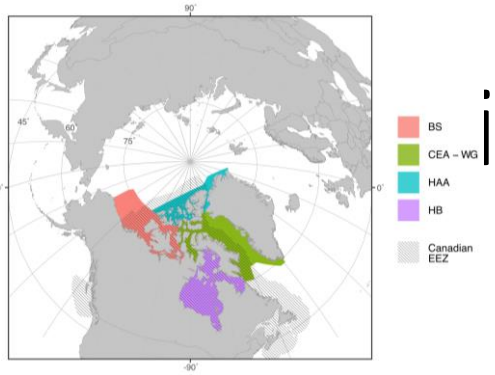
- Governance and policy implications
  - Adaptation strategies to cope with change
  - National and pan-Arctic MPA networks are needed
  - Caution with possible opening of commercial fisheries

Canada's Arctic fisheries

- Estimates of current and future fisheries catch and value potential
- Canada's 4 major Arctic Large Marine Ecosystems
- Historical catch comparisons



Car ic fish



Historical (2005-2014)

- 189,000 tonnes
- $560 M dollars

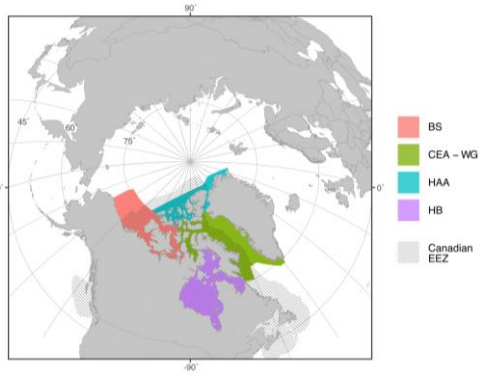
- More high value species
  - E.g. northern prawn

Current potential (modelled)

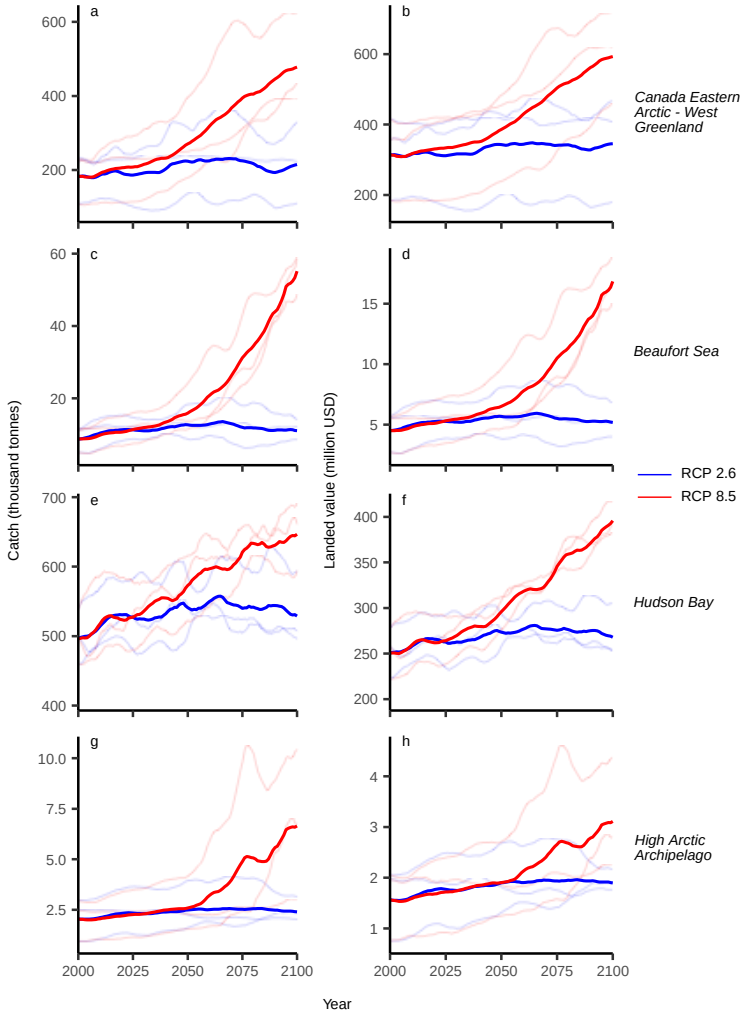
- 710,000 tonnes
- $578 M dollars

- More low value species
  - E.g. capelin

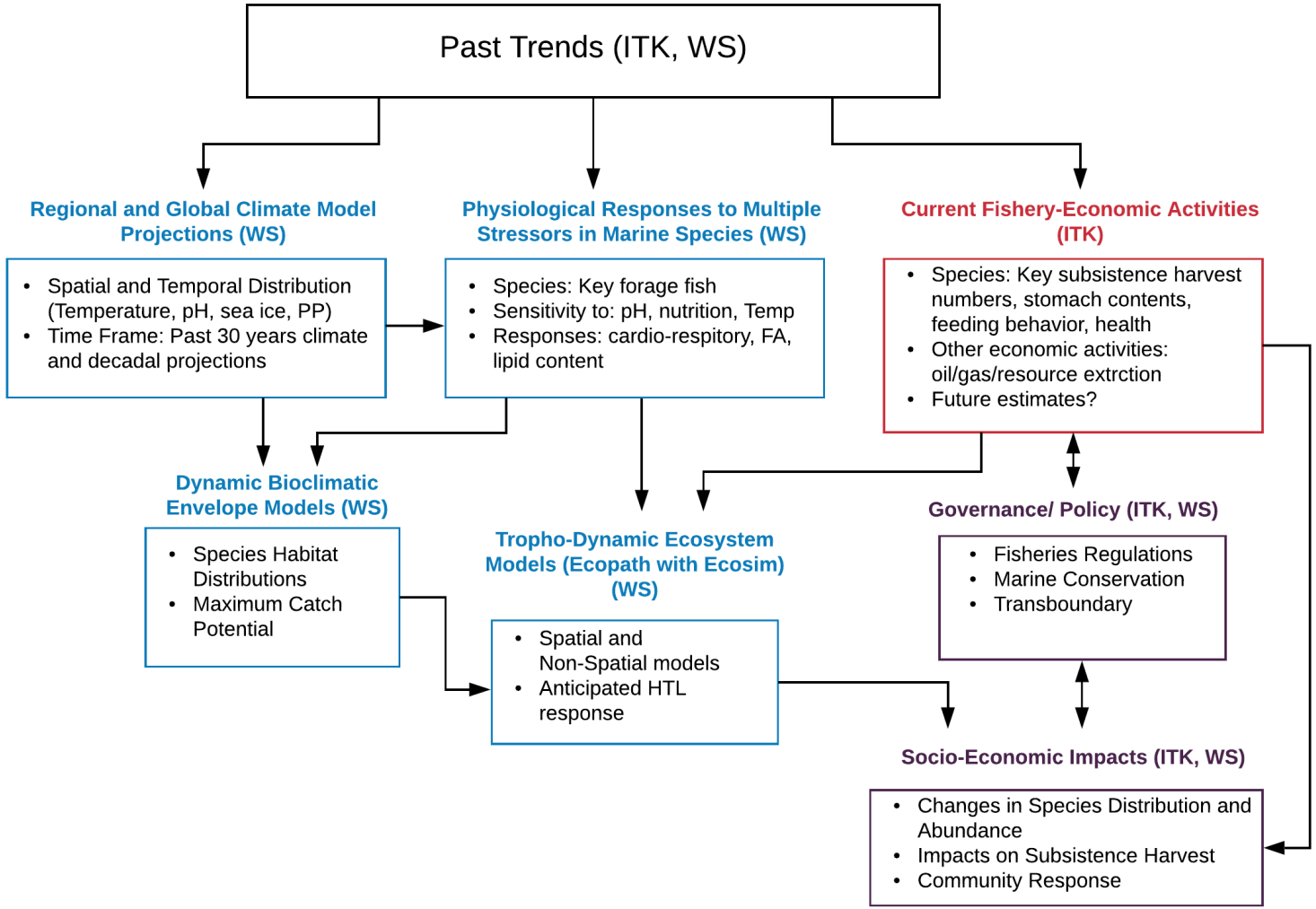
Car ic fish



- Significant increases in catch and value with increased CO_2
- Trends are largely the same across all earth system models

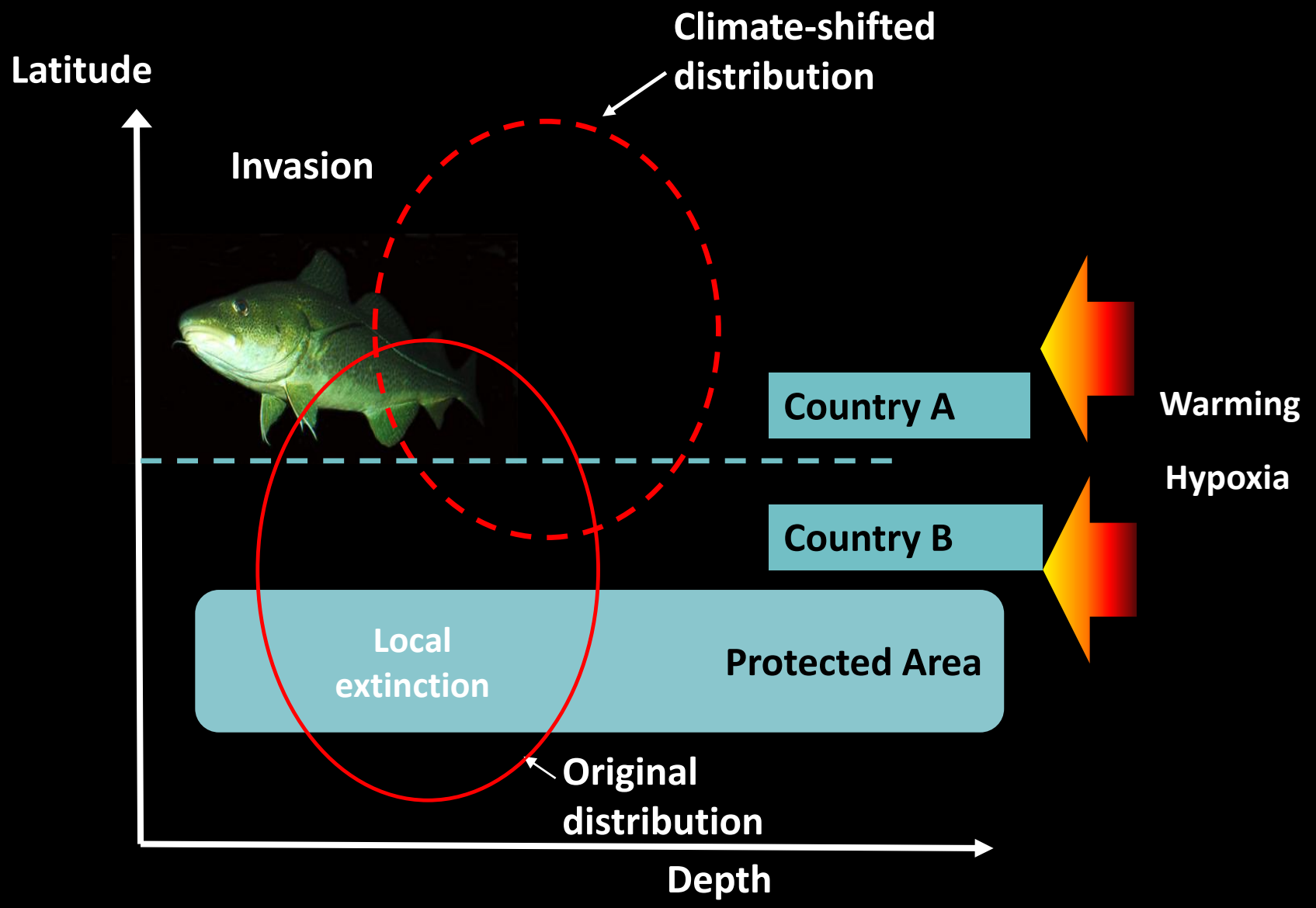


Integrated framework

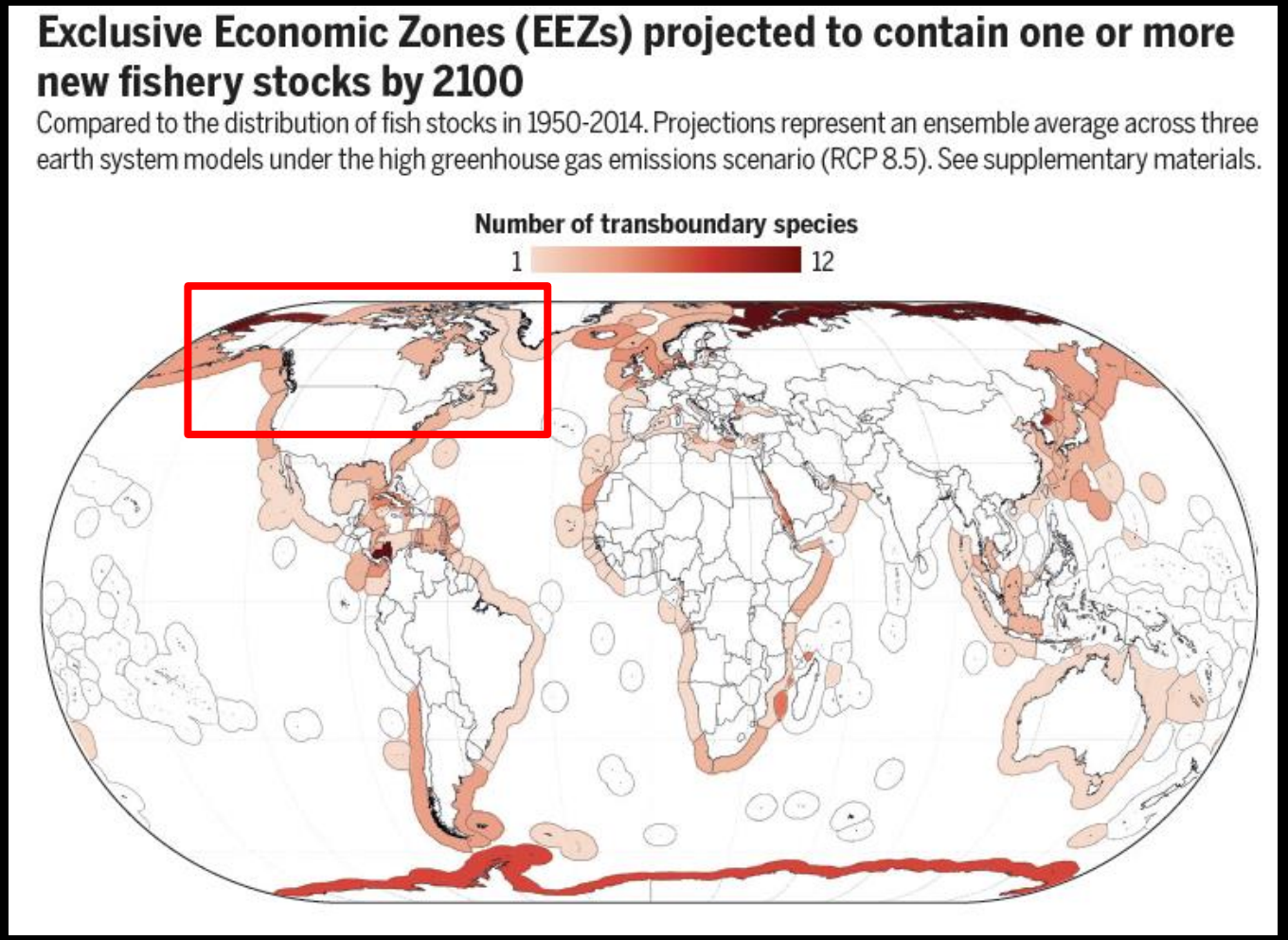


OCEAN CANADA

Current State and Future Scenarios for Transboundary Fisheries Management on Changing Oceans of Canada and United States

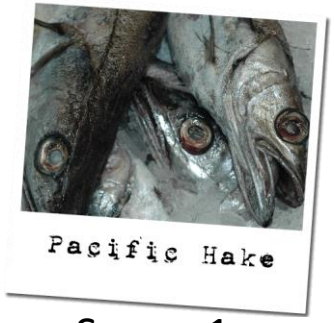

Latitude
Climate-shifted distribution
Invasion
Country A
Warming
Hypoxia
Country B
Local extinction
Protected Area
Original distribution
Depth

Implications for transboundary fish stock management



Pinsky, Reygondeau, Caddell, Palacios-Abrantes, Spijkers, Cheung (2018) Science

Methods | Treaties Under the Spotlight



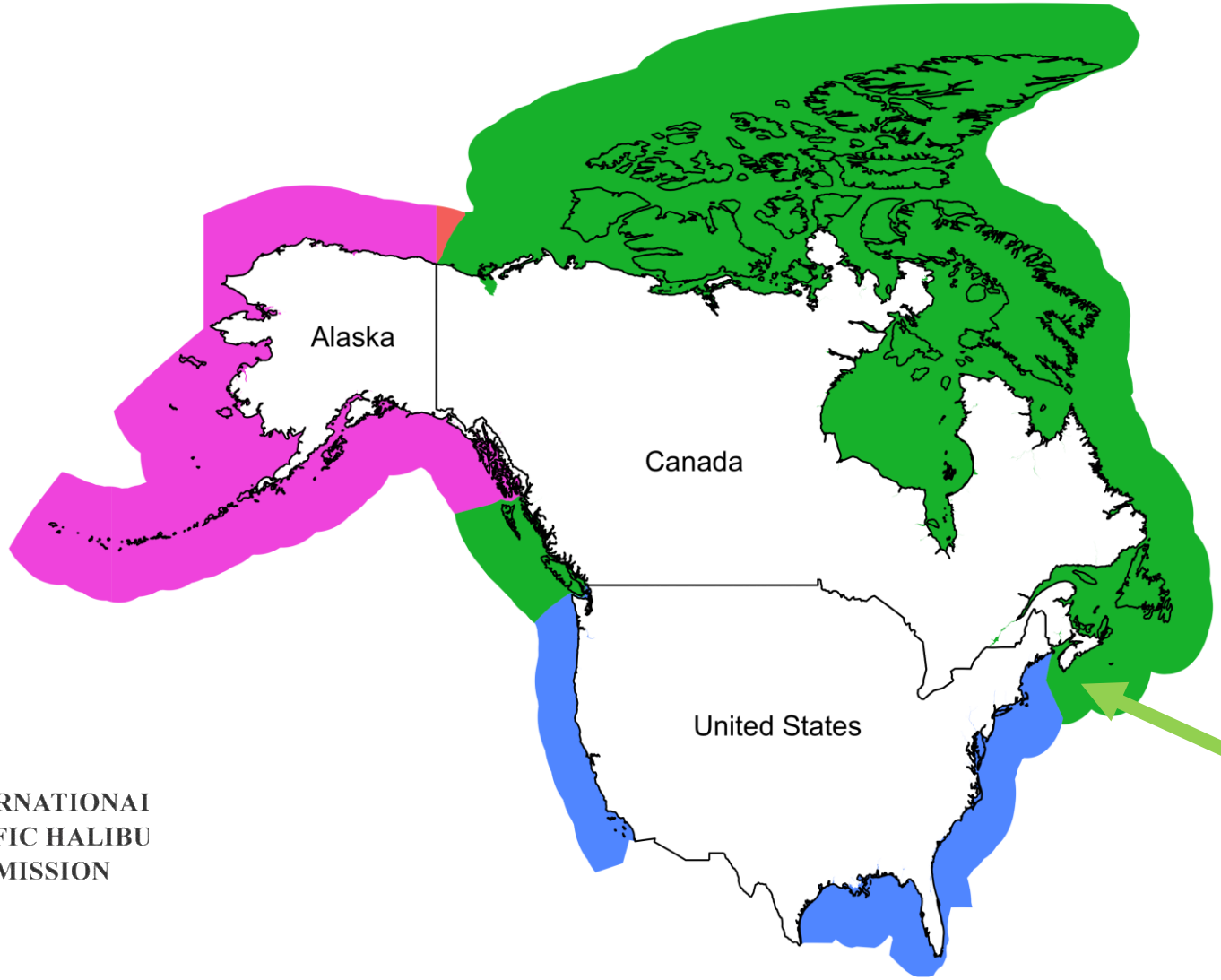
Spp. = 1

PACIFIC SALMON COMMISSION

Spp. = 5

INTERNATIONAL PACIFIC HALIBUT COMMISSION

Spp. = 2



Total Spp. = 31

NAFO

Spp. = 20

Gulf of Maine
"gentlemen's" Agreement (CIA, 2012)

Spp. = 3

Main Question

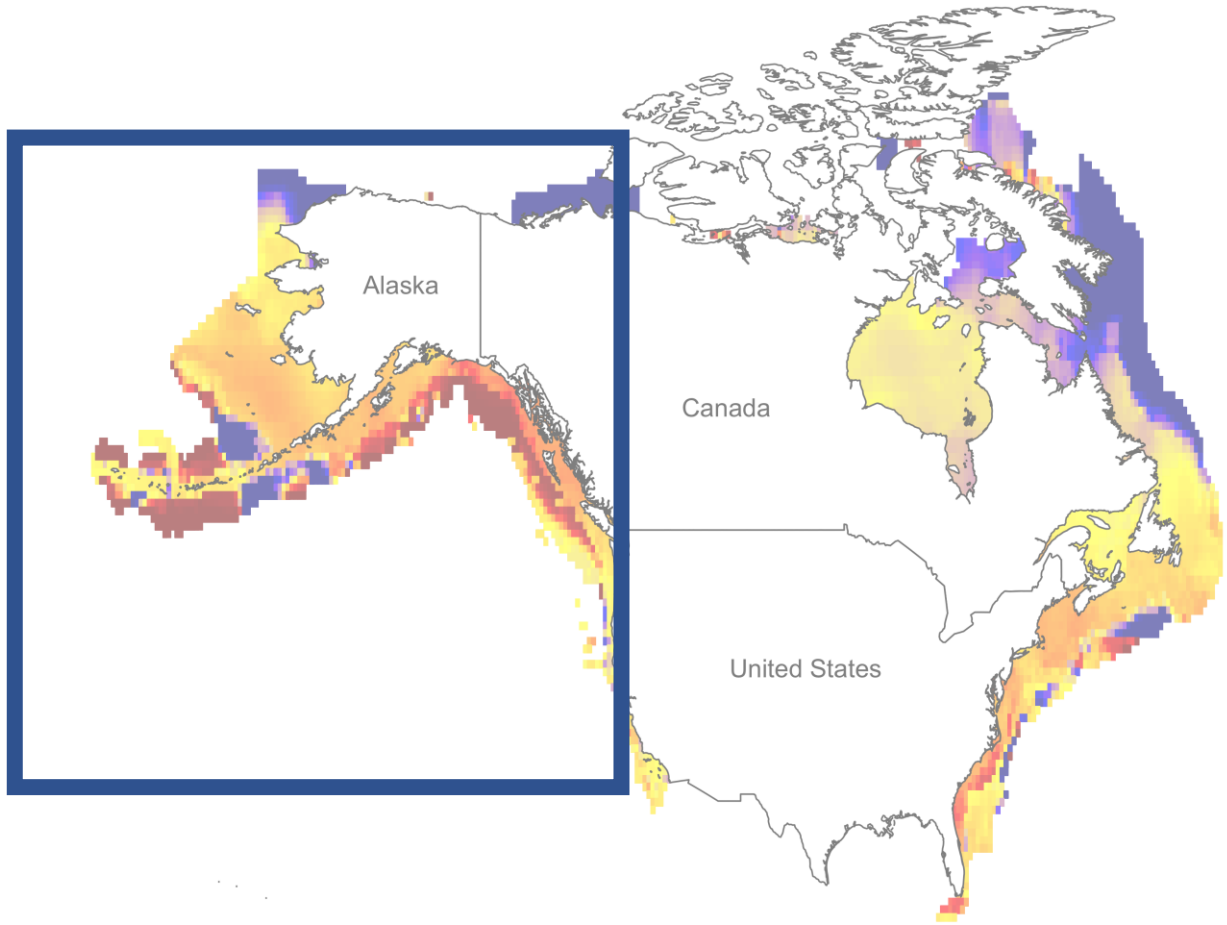
- What will be the effects of shifting species to the co-management of transboundary fisheries?

OCEAN CANADA

INTERNATIONAL PACIFIC HALIBUT COMMISSION

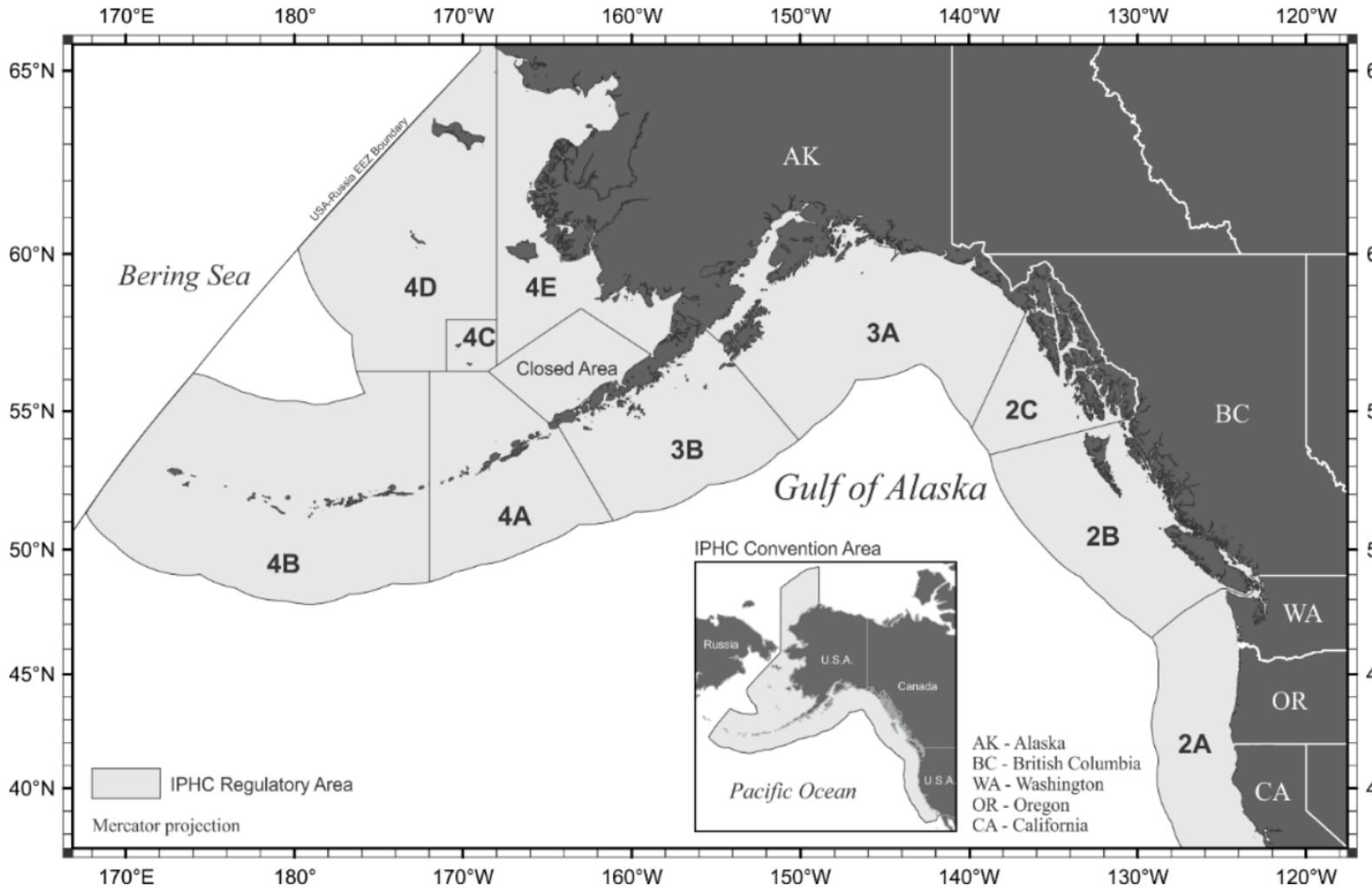
Pacific halibut (*Hippoglossus stenolepis)*

Sablefish (*Anoplopoma fimbria)*



IPHC | Management rules

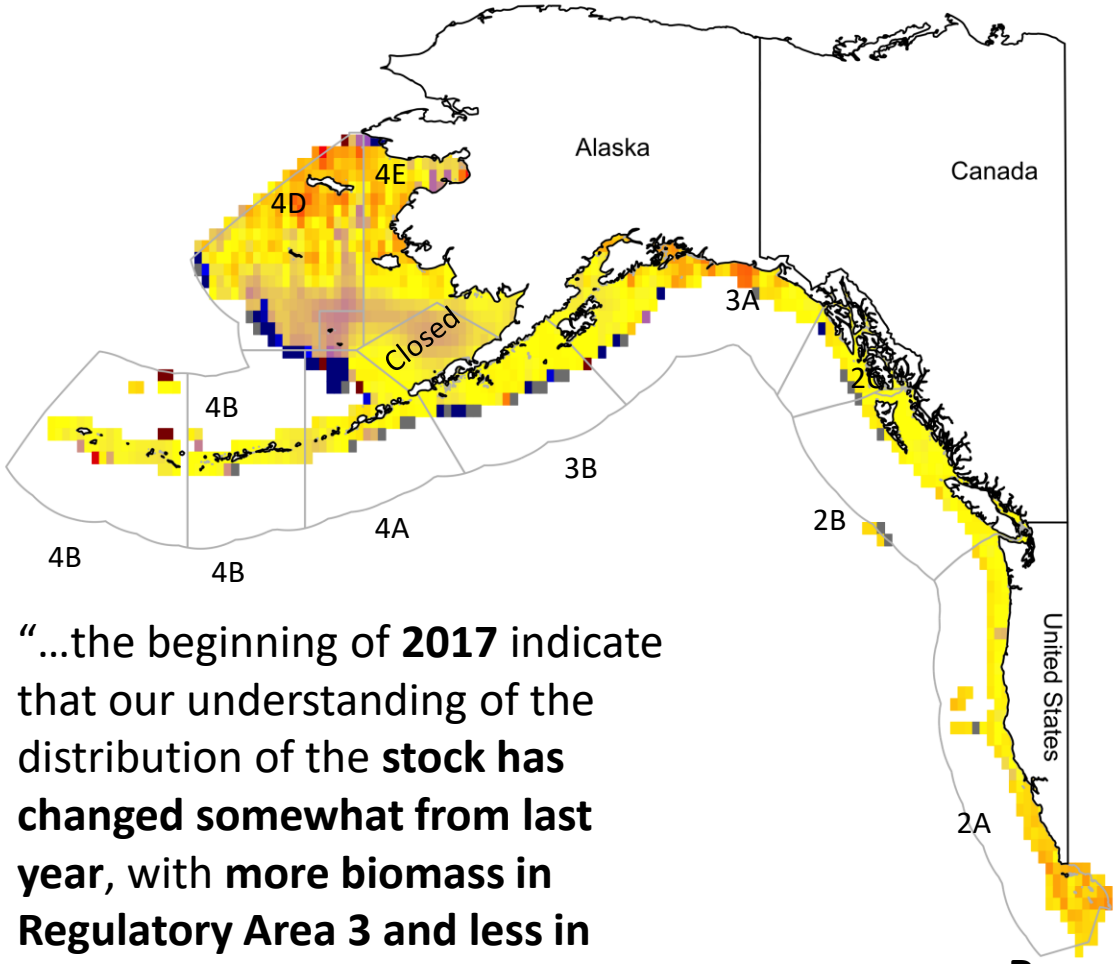
- **Management:**
  - US = NOAA Fisheries
  - Canada = DFO
- **Harvest Control:**
  - ✓Total Allowable Catch (TAC)
  - ✓Longline with “J” hook
  - ✓Minimum catch size
  - ✓Bycatch quota
  - ✓Season (Mar. ~ Nov.)
  - ✓Effort (time)



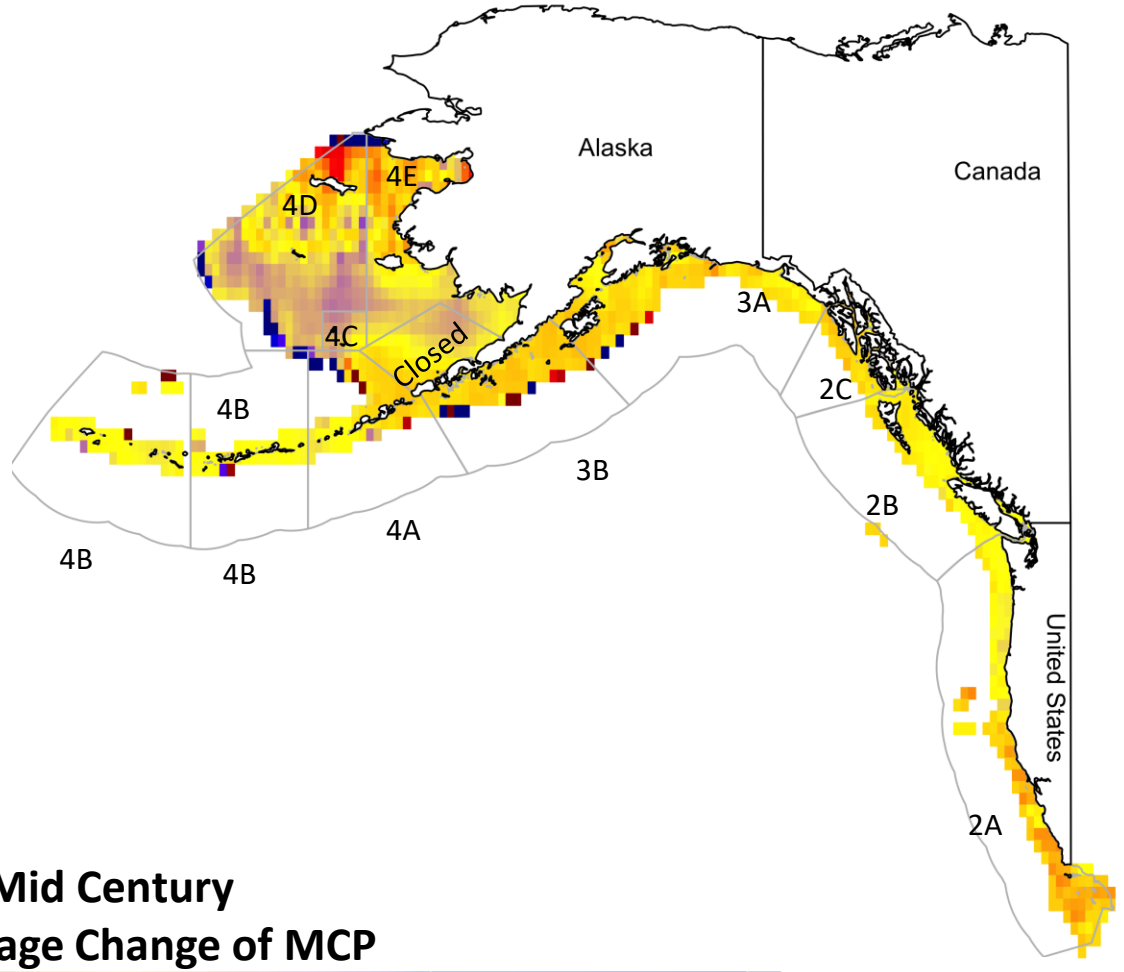
 IPHC, 2017

IPHC | Differences in catch potential (Mid 21st Century)

RCP 2.6



RCP 8.5

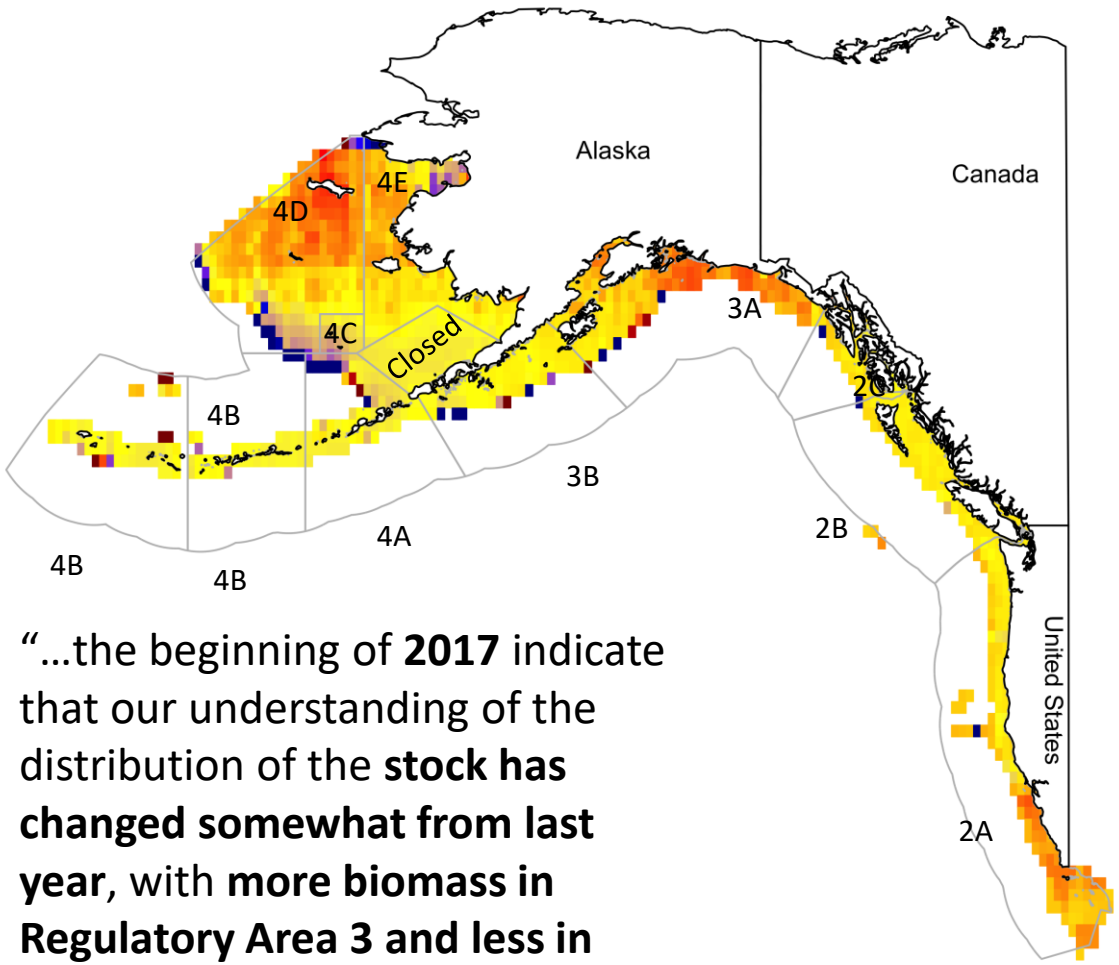


"…the beginning of **2017** indicate that our understanding of the distribution of the **stock has changed somewhat from last year**, with **more biomass in Regulatory Area 3 and less in Area 2.**" IPHC, 2017

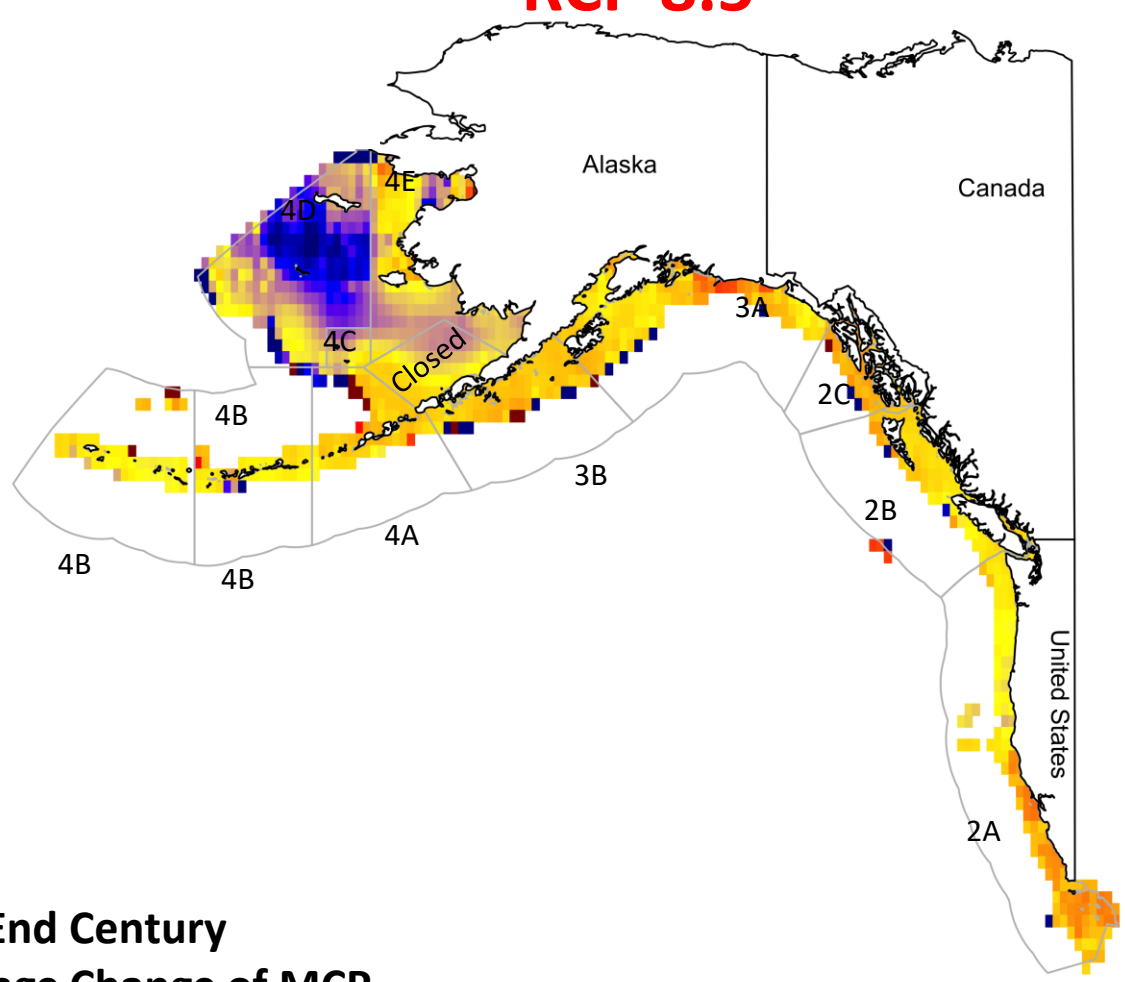
Mid Century
Percentage Change of MCP

IPHC | Differences in catch potential (End of 21st Century)

RCP 2.6



RCP 8.5

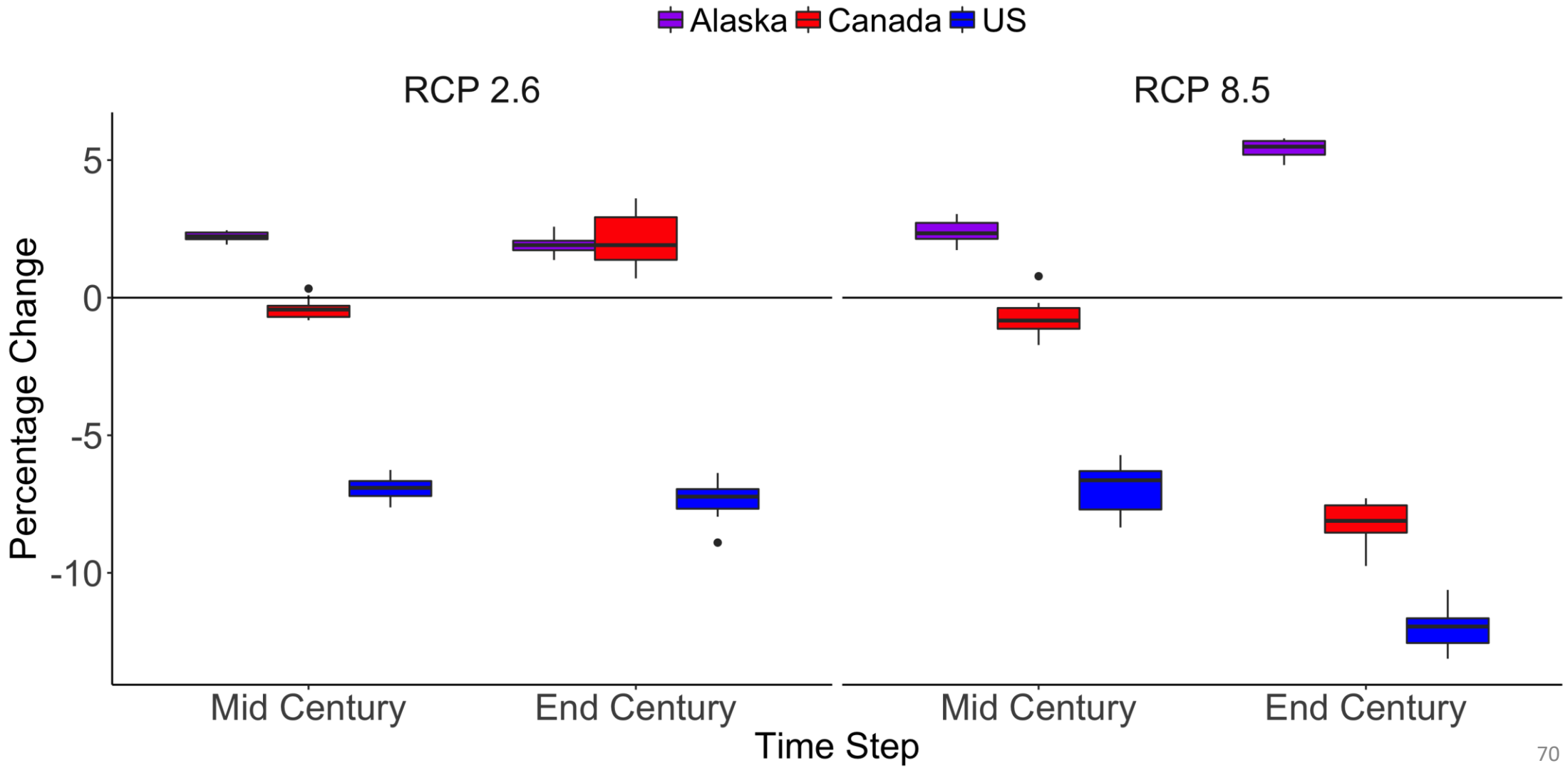


"…the beginning of **2017** indicate that our understanding of the distribution of the **stock has changed somewhat from last year**, with **more biomass in Regulatory Area 3 and less in Area 2.**" IPHC, 2017

End Century
Percentage Change of MCP

OCEAN CANADA

IPHC | Change in catch

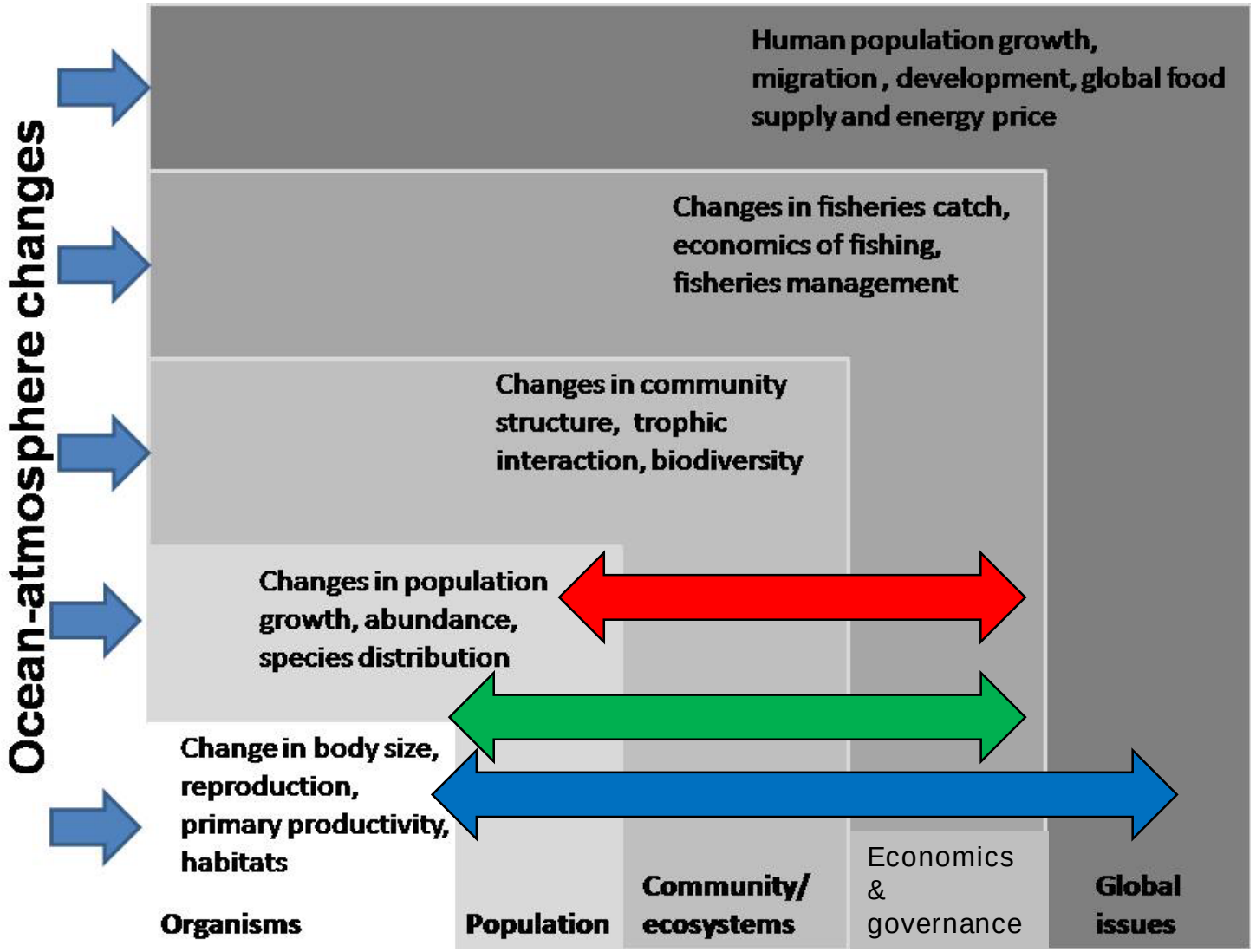


Management implications

- Dynamic TAC estimation ✓
- Flexible quota ✓
- Regime shifts ✓
- Countrywide trade-offs
  - Landings might equilibrate under 2.6
  - Larger landings difference under 8.5
- Regional trade-offs
  - Conservation (Closed area)
  - Social consequences
  - Bycatch quota

The crew of the *F/V Seymour* pull a large Pacific halibut over the rail. Photo by Chris Noren.

Outlook



Inform Canada and coastal communities about impacts and vulnerability of changing oceans and the responses needed

Transboundary fisheries (NDIS + Law & Policy)

Arctic Ocean Acidification (NDIS & Law & Policy)

OceanCanada book (all WGs and CCTs)