Incorporating climate, oceanographic and ecological change considerations into population assessments in Canada: A review and recommendations

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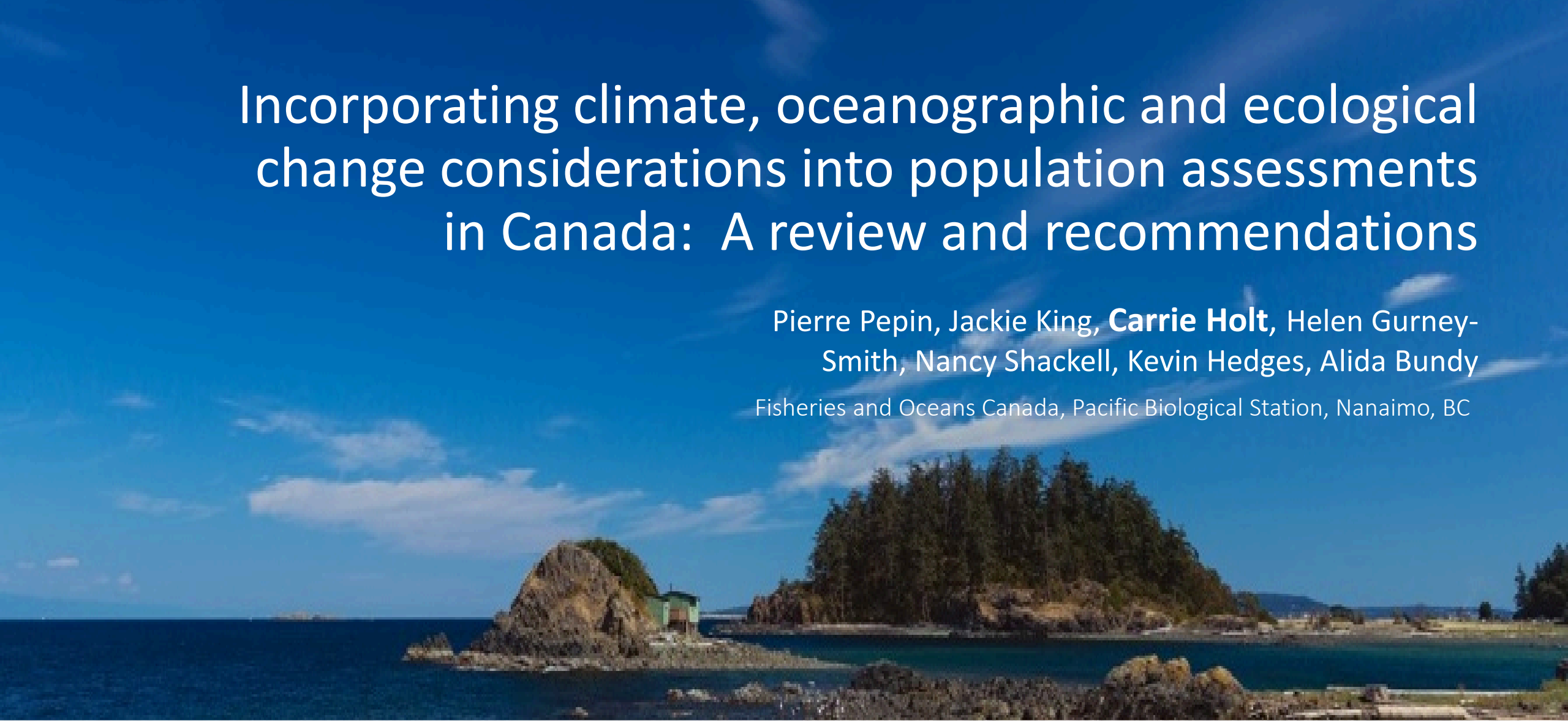
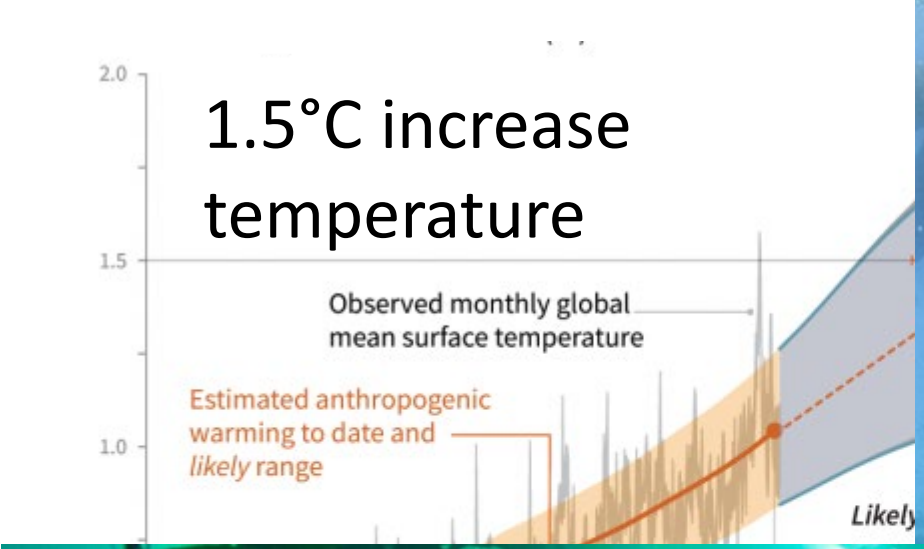


Fisheries and Oceans Canada

Key messages

1. Decrease in ecosystem consideration from conceptual hypothesis (46%) stage to management advice (27%)
2. A combination of qualitative and quantitative approaches for accounting for ecosystem considerations is required
3. Frequent re-evaluation of hypotheses and metrics is required under changing climate and ecosystem status.
4. Critical gap: Evaluation of the performance of management decisions with and without ecosystem considerations
5. Critical gap: Seasonal to decadal ocean projections at appropriate spatial scales are required

1.5°C increase temperature



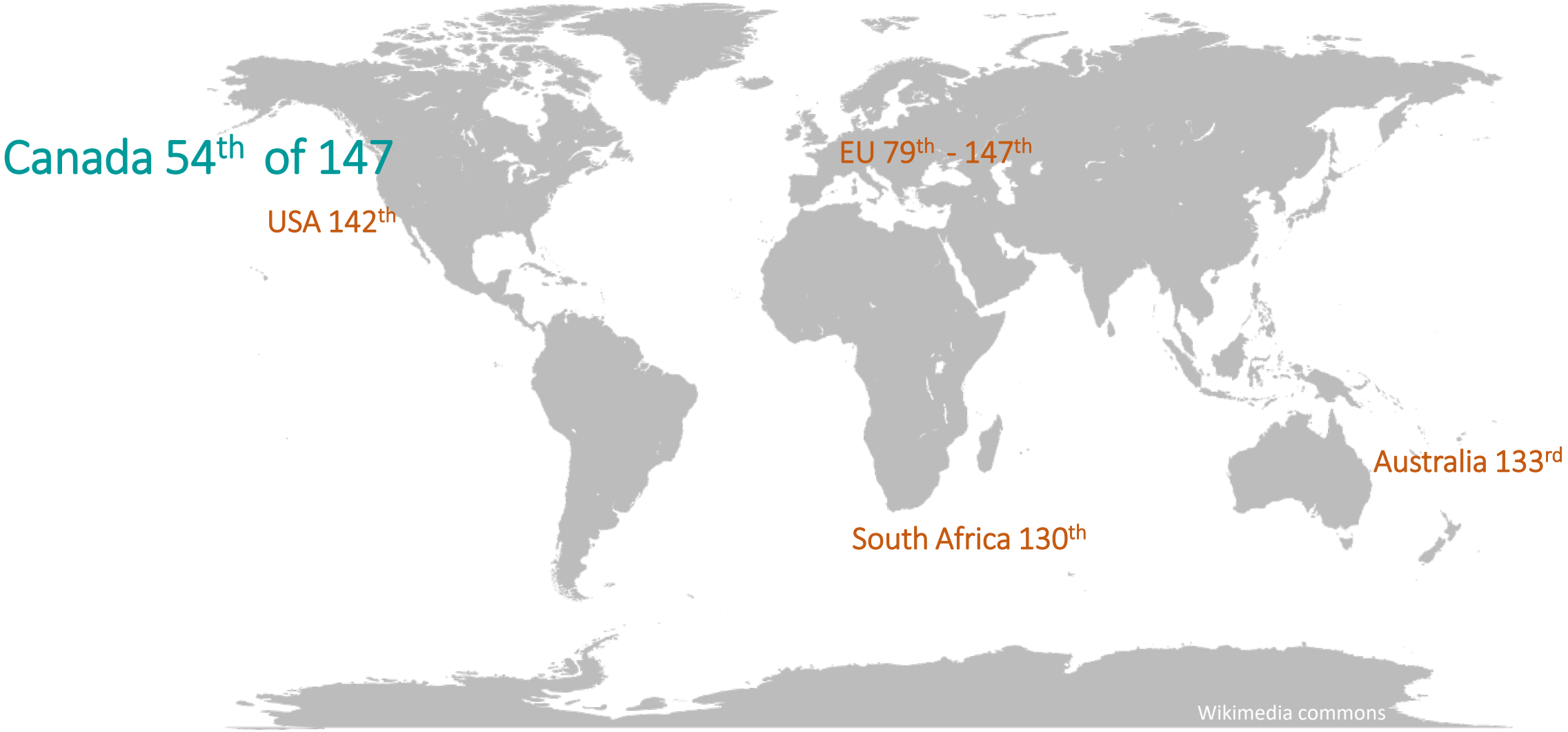
Keith Ellenbogen

Oceana

Ecosystem Approach to Fisheries Management

Fisheries and Oceans Canada

Countries with marine fisheries most vulnerable to climate change



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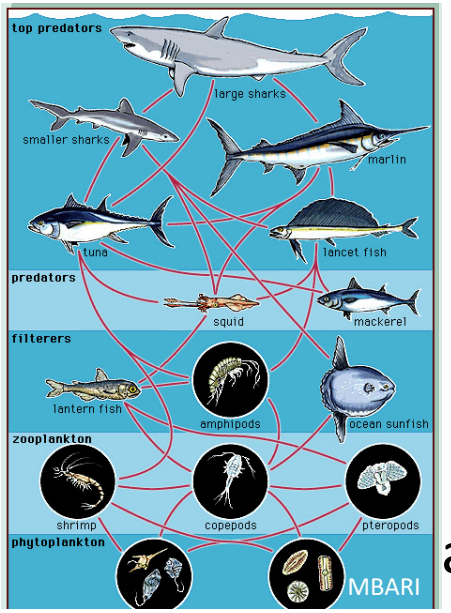
(Blasiak et al., 2017)

Climate impacts



Trophic structure and spatial distribution

atterns

CO_2 and O2: acidification

Temperature, wind, turbulence

Benthic habitat

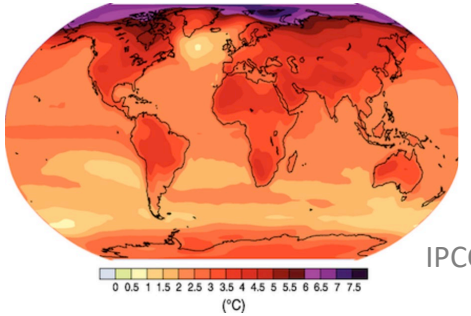
Objective

To what extent do Canadian fish stock assessments apply environmental information to models, assessments, or advice to Resource Management?

- 178 recent stock advisory documents, by taxonomic group and region
- Evaluated general conceptual knowledge, methods for consideration, and whether advice was informed by environmental variables

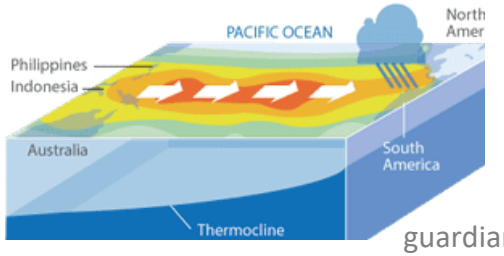
Environmental Drivers

- Climate (**C**) drivers: long-term (multi-year) variations and trends in regional or large-scale atmospheric processes
- Oceanographic (**O**) drivers: associated with climatic variability but include short-term and/or regional variability
- Ecological (**E**) drivers: broad range of ecosystem features, e.g., trophic interactions and habitat requirements



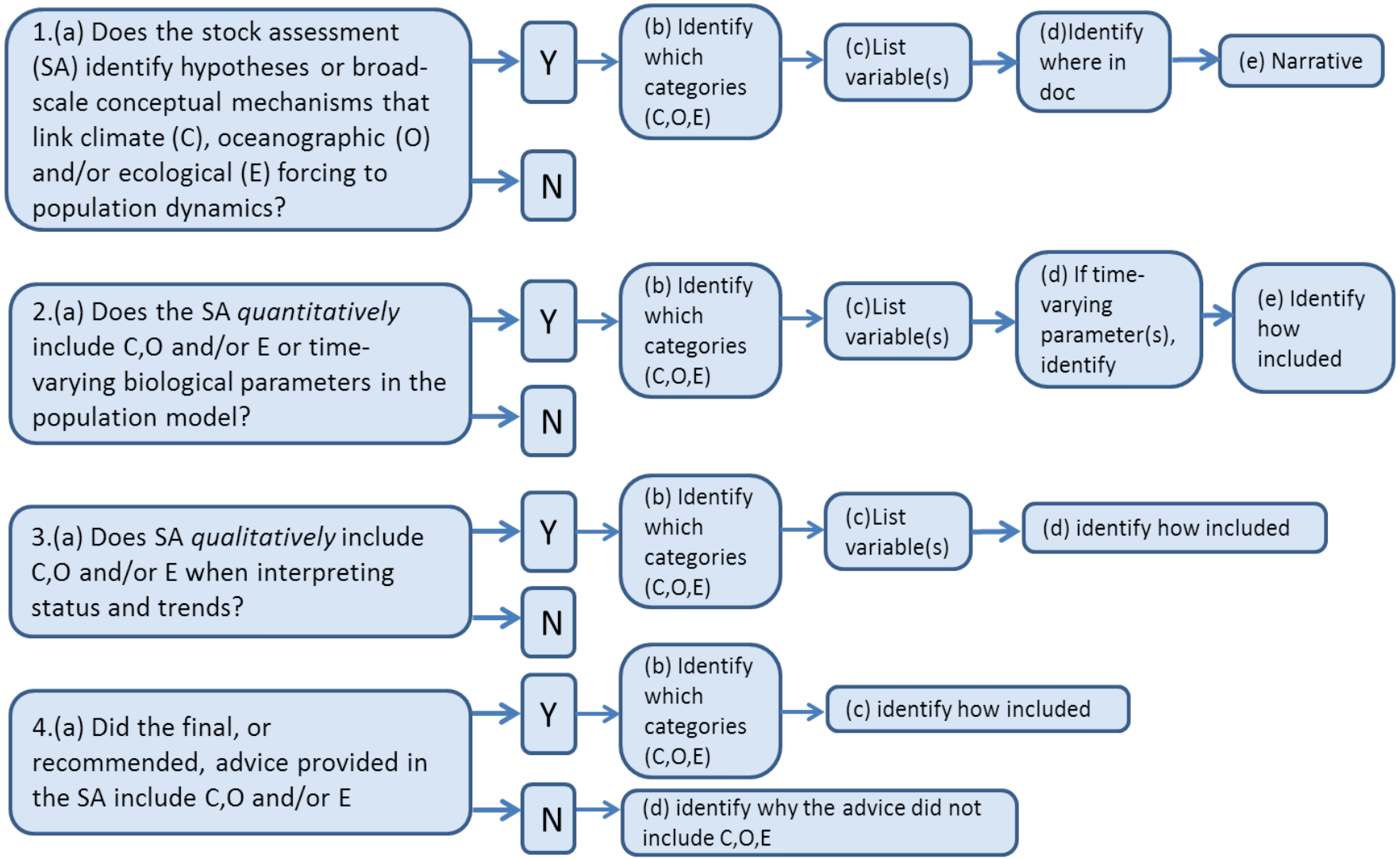
IPCC

El niño



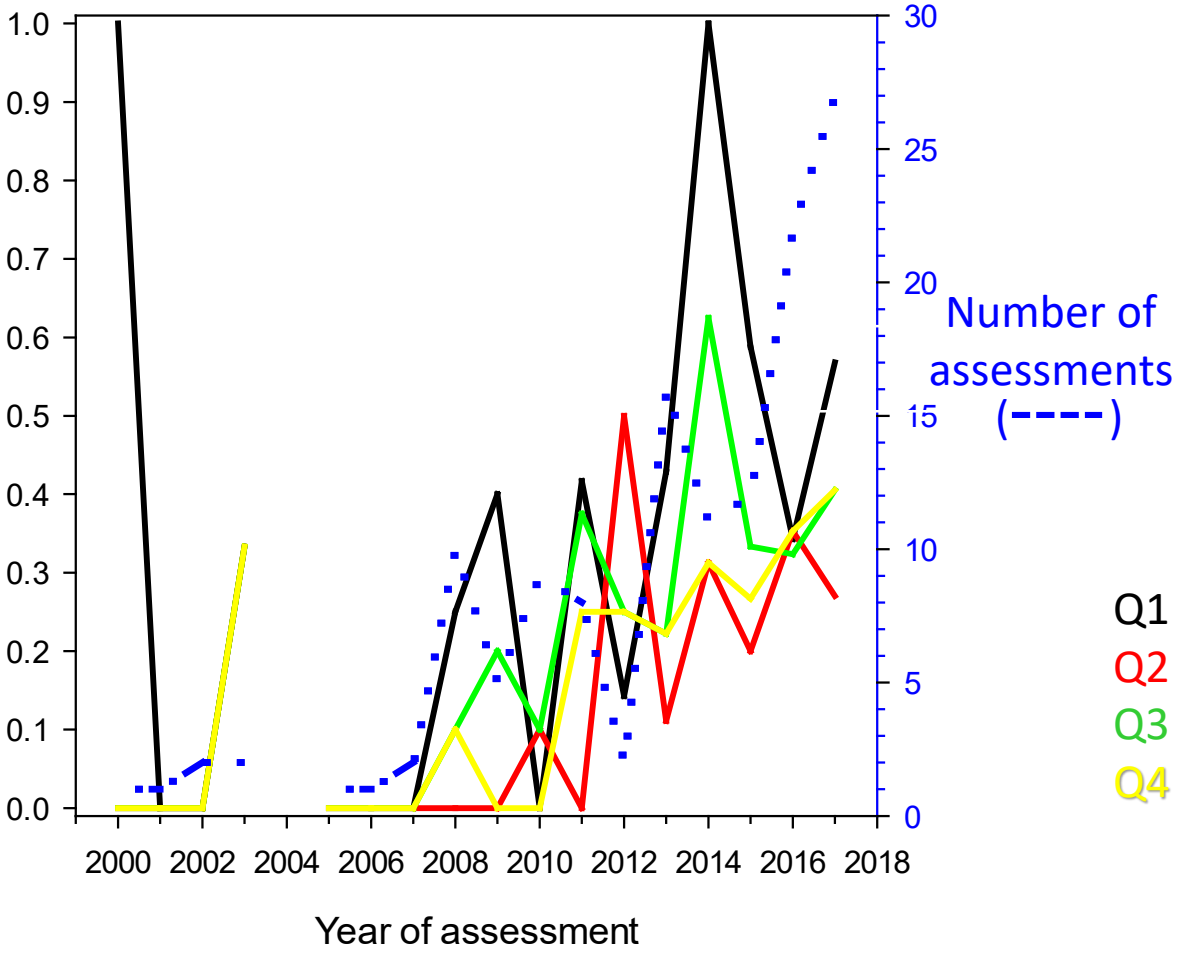
guardian

Questions used to conduct Inventory of Climate, Oceanographic, Ecological information in Canadian Stock Assessments



Results

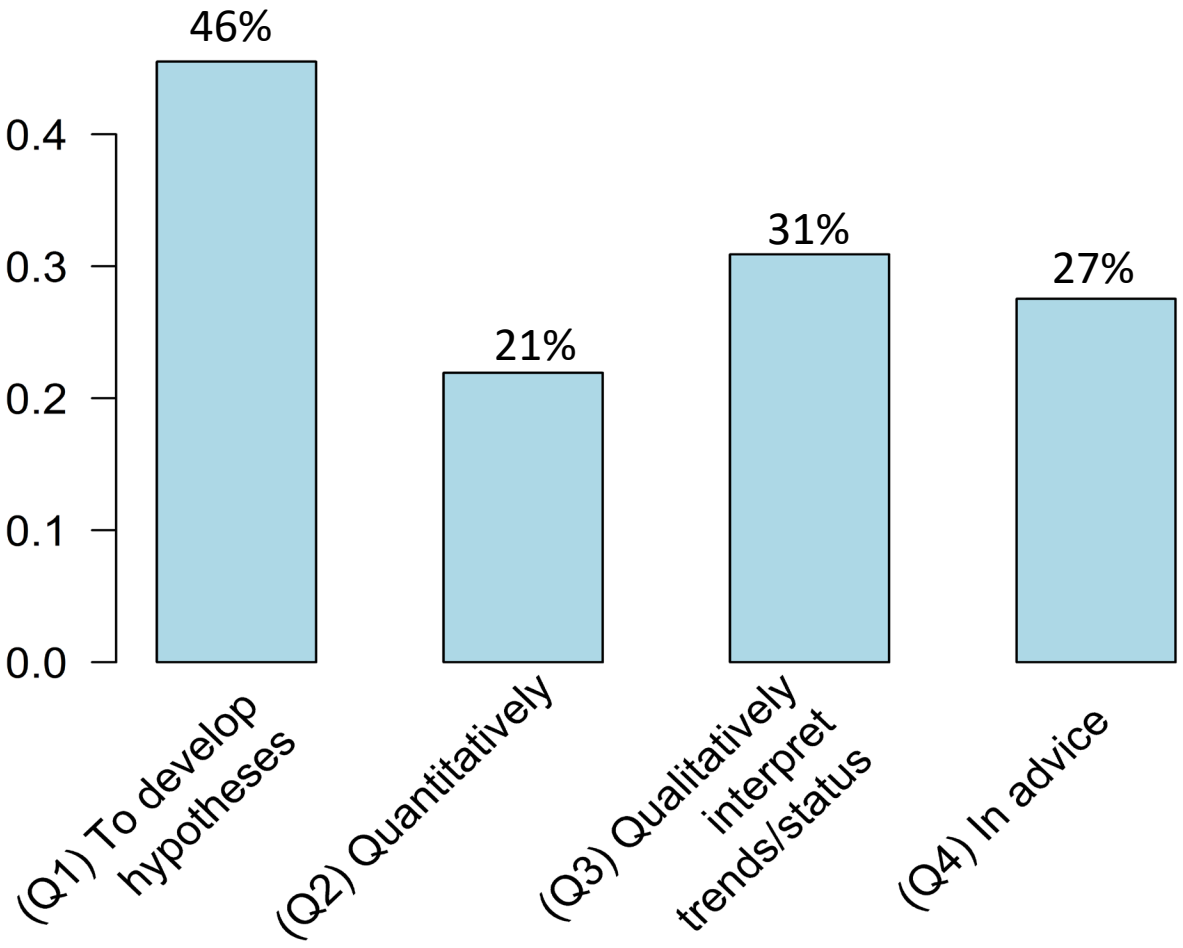
Proportion of assessments that include environmental (C,O,E) variables



Q1 Broad-scale processes or hypotheses
Q2 Quantitatively
Q3 Quality to explain trends
Q4 In advice to resource management

Results

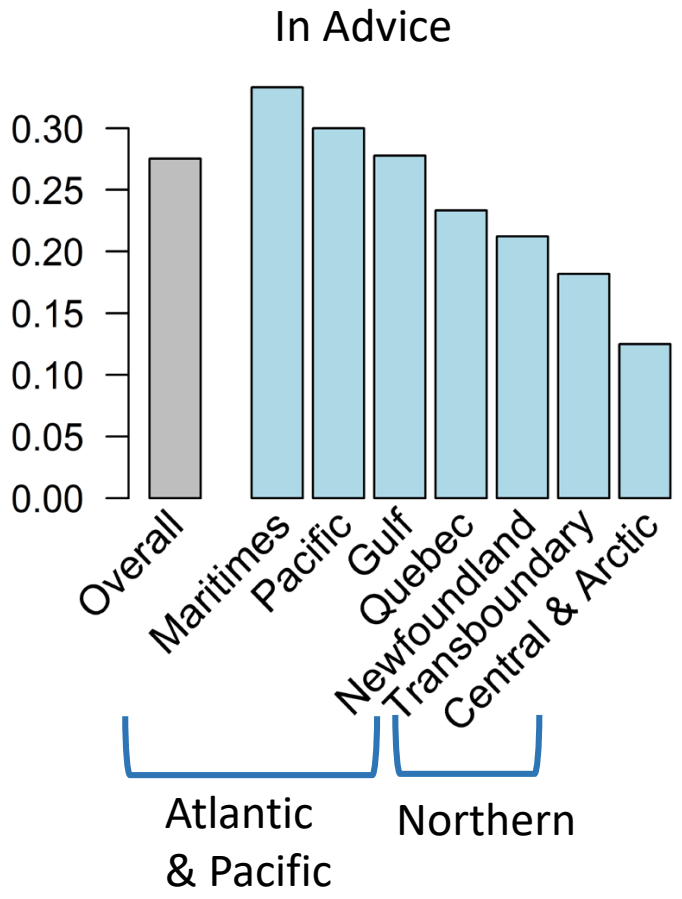
Proportion of assessments that include environmental (C,O,E) variables



Results

Taxa	Concept	Quantitative	Qualitative	Advice
Anadromous	0.58	0.65	0.46	0.58
Pelagic	0.50	0.14	0.43	0.36
Invertebrate	0.53	0.17	0.36	0.26
Groundfish	0.44	0.15	0.22	0.15
Mammal	0.21	0.11	0.21	0.26
Elasmobranch	0.14	0.00	0.14	0.00

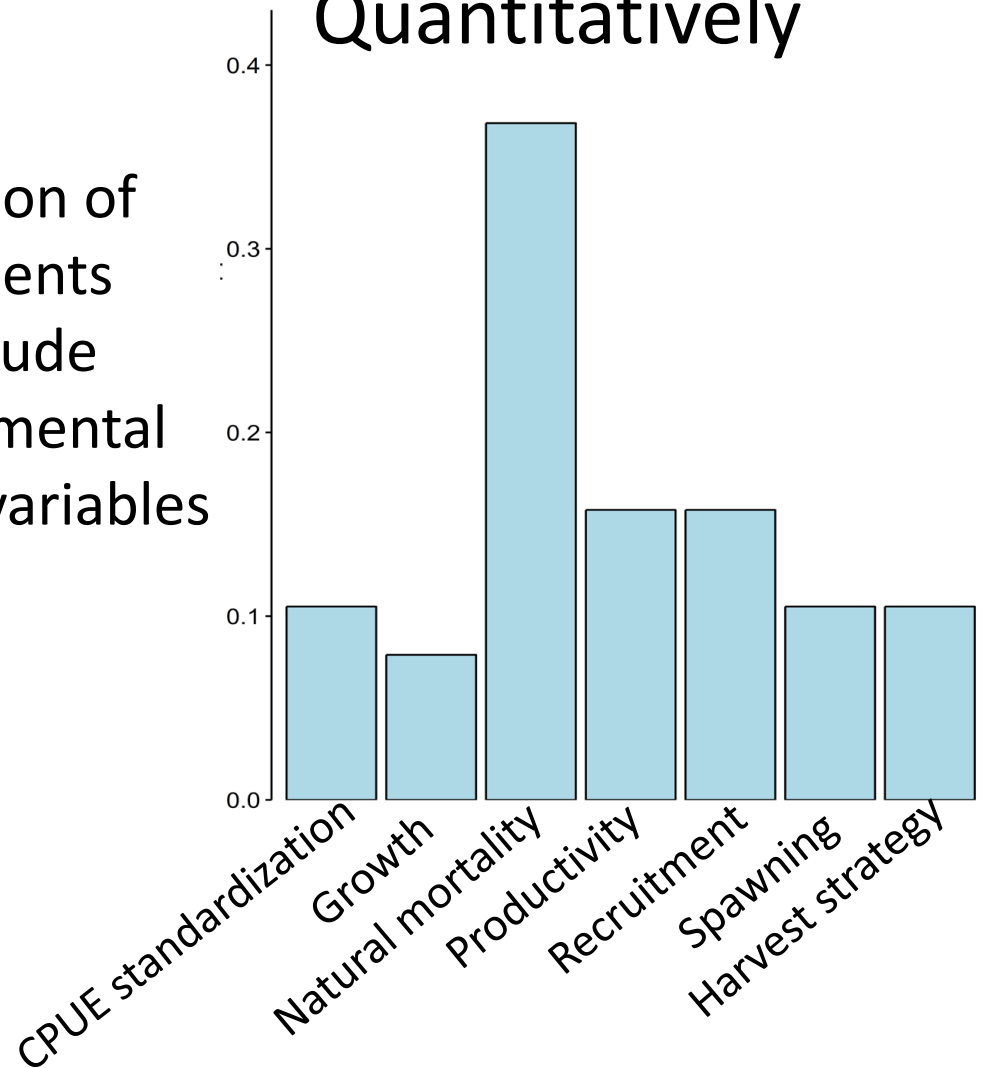
Proportion of assessments that include environmental (C,O,E) variables



Approaches for including in assessment

Proportion of assessments that include environmental (C,O,E) variables

Quantitatively



Qualitatively

- Explain trends (temporal and spatial)
- Explain anomalies
- Forecast based on categorical indices (e.g., stoplights)
- Account for uncertainties

Approaches for including in advice

- Inform implementation of harvest control rule, HCR (90% of cases)
  - via time-varying parameters in models (31%)
- Provide expectation for future potential
- Sensitivity of HCR performance to uncertainty in climate impacts
- Occasionally used qualitatively to recommend precaution in choice of TAC or exploitation rates
- Gap: ¼ of these did not include hypothesized mechanisms, being based on exploratory analyses

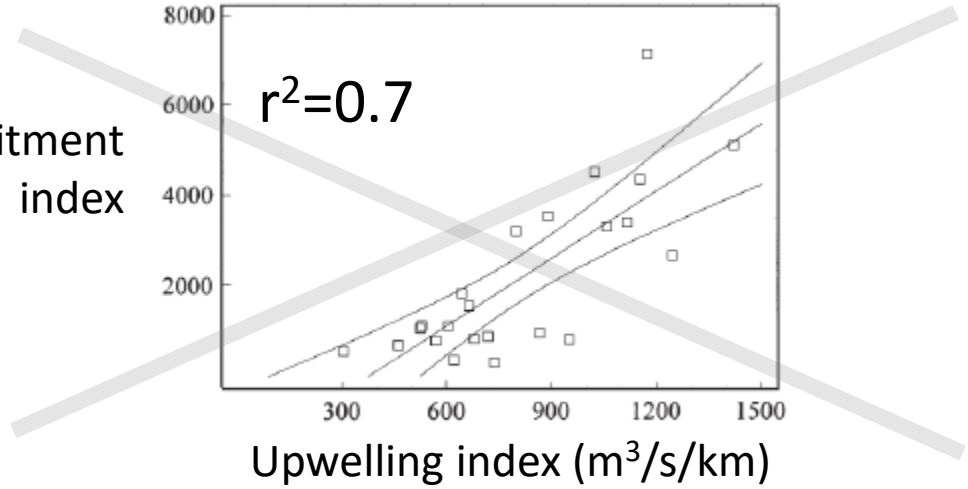
When not considered in advice, why not?

- Data limitations (45%)
- Lack of mechanisms (39%)
- Climate dwarfed by other factors (17%)

International examples

US: Pacific Sardine, Arrowtooth flounder, Pink salmon…
Australia: Rock Lobster. Bluefin Tuna…
Europe: Blue Whiting, Bay of Biscay Anchovy…

Bay of Biscay Anchovy: correlation between upwelling and recruitment included in advice to management late 1990s, until 2000/2001 when relationship broke down



(Borja et al. 1996;1998; ICES 2001; 2005)

NOAA Ecosystem Status Reports

Key points

- Decrease in ecosystem consideration from conceptual stage to advice
- A combination of qualitative and quantitative approaches is likely required
- Frequent re-evaluation of hypotheses and metrics is required under changing climate and ecosystem status.

Critical gaps

- Evaluation of the management performance with and without ecosystem considerations (Management Strategy Evaluation and retrospectively)
- Seasonal to decadal ocean projections
- Impacts on Arctic species

National Ecosystem Approach to Fisheries Management Working Group (DFO 2019-2023)

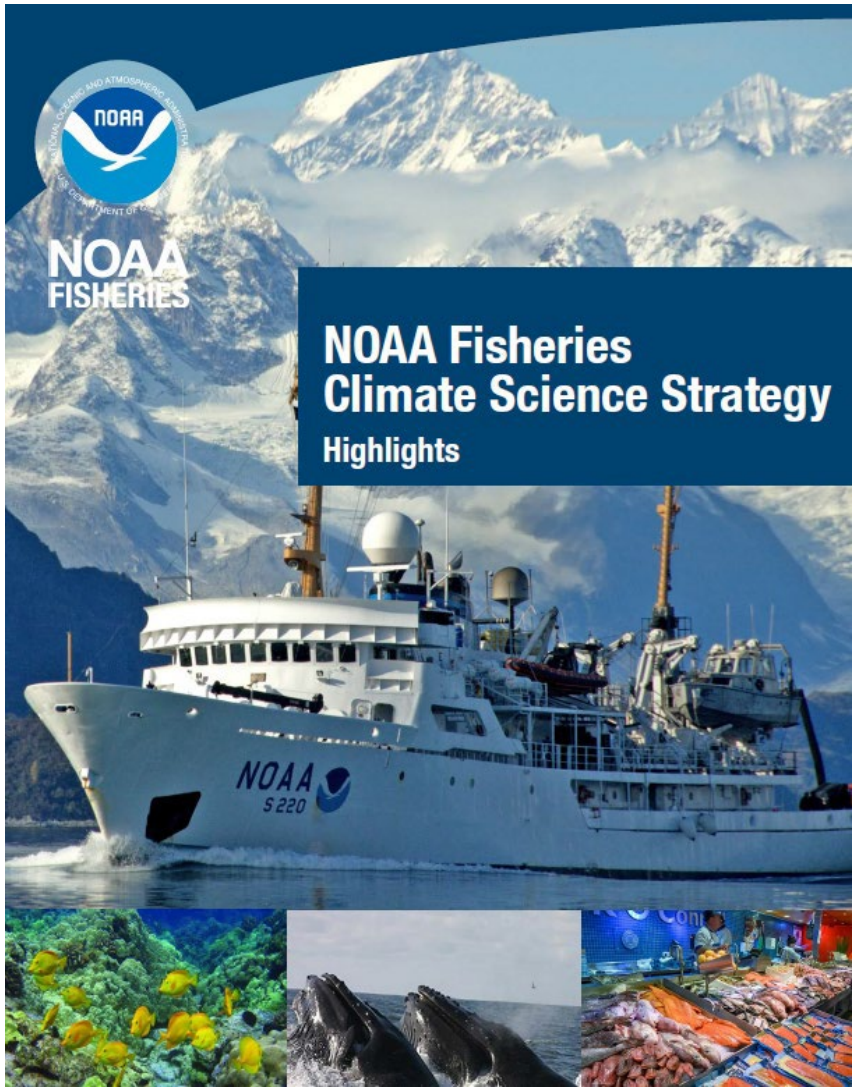
Recommendation: Climate and Fisheries Strategy

Countries already developed / are developing strategies are:

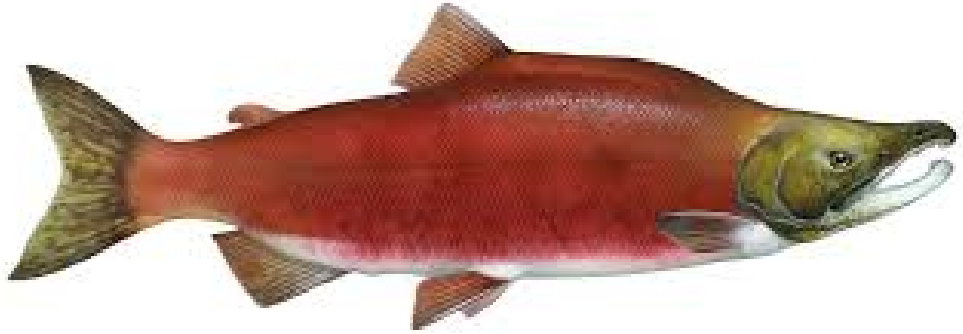
- USA
- Australia
- ICES
- South Africa
- ICCAT

Summary of common elements are:

- vulnerability risk assessments
- reviews of research impact
- considers both multiple marine industries
- development of adaptation options,
- stakeholder engagement
- management responses (e.g. EBFM)
- a need for funding and capacity



Thank you



Jason Link, Kirstin Holsman, Patrick Lynch, Brian Mackenzie, Andrew Edwards, Karen Hunter, Jake Rice, Daniel Duplisea, Marie-Julie Roux

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