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| This section answers the questions: How does climate change threaten the stability and / or effectiveness of international treaties guiding sharing of marine biological resources? What non-climate forces are equally or more important? How equipped are we to understand, articulate and protect Canadian interests in these and emerging treaties as climate change intensifies? |

# Climate change and transboundary marine resource management

**Key messages**

1. Fisheries are important to Canada’s economy and society, with a number of valuable stocks being shared with one or more countries (transboundary stocks).
2. Current and projected increases in ocean temperatures and changes in ocean chemistry are expected to alter the distribution and relative abundance of many marine species, with most projected to migrate poleward.
3. Existing fisheries management and governance structures are largely predicated on past dynamics and the assumption that marine resources remain broadly static through time. Current treaties are therefore ill-equipped to address fisheries governance issues and conflicts resulting from climate-related shifts and associated altered catch potential in transboundary marine resources.
4. Uncertainty is pervasive across future ecological projections, social dynamics arising out of climate-related shifting stocks and the development of governance mechanisms to meaningfully and equitably address these.
5. Future (or renegotiated) transboundary fisheries management frameworks will need to plan for variability and uncertainty, by building greater more flexibility and adaptive capacity in the governance system, including mechanisms such as capacity adjustment, dynamic catch limits, and the facilitation of gear switching or the provision of alternative livelihoods for fishers.
6. Fish and shellfish have vital nutritional, economic, cultural and spiritual value for First Nations. Their communities are therefore highly vulnerable to projected cumulative effects of climate change and will need to be considered fairly in future negotiations. First Nations have traditional knowledge that can effectively support adaptation to climate-induced changes.
7. Tradeoffs. It is likely that managers’/policy makers will be faced with decisions that will come with tradeoffs. Clear objectives (e.g. food security, profits, jobs) would help make better decisions.

Main text (to be subsetted under each key message in the final text version)

* Canada is bordered by three oceans that differ in terms of environmental, as well as sociocultural, economic, and governance characteristics.
* Importance of **fisheries** to Canada (DFO 2016):
  + In 2016 commercial seafisheries landed 848,165 tonnes valued at CAD3.3 billion.
    - Over 78% (89% by value) of total catch was landed in the Atlantic.
    - Shellfish accounted for 48% of total catch, pelagics 26% and groundfish 24%.
  + Approximately 76,400 Canadians make their living directly from fishing and fishing-related activities.
  + Transboundary fisheries are an important subsector. Just for British Columbia, in 2016 exports of hake ($70.5), salmon (chinook, $47.5) and, pacific halibut ($43.6) accounted for CA$ 161.6 million.
* Unfortunately, fisheries are impacted by a number of threats including overharvesting, and other pressures on the marine/coastal environment such as pollution and habitat degradation.
  + Of the 170 major stocks assessed in 2016:
    - 76 stocks (45%) were classified as Healthy
    - 31 stocks (18%) were classified as Cautious
    - 21 stocks (12%) were classified as Critical
    - 42 stocks (25%) could not be classified with current information
    - Groundfish stocks (e.g., cod, halibut and haddock), have the highest proportion of stocks in the Critical zone
* Transboundary fish[[1]](#footnote-1) resources involve stocks that occur within the Economic Exclusive Zones (EEZs) of two or more coastal States and which show clear, as a result of seasonal or developmental migration, or no clear pattern of movement (Gulland 1980). Discussion in this section will focus on international transboundary stocks only – i.e., provincial transboundary stocks and international straddling, those that also occur in the high seas, stocks are not considered.
* How is **climate change** affecting marine resources?
  + The primary consequences of increased atmospheric CO2 that are of concern for marine resources are increased ocean temperatures (Bindoff et al. 2007) and higher acidity (Doney et al. 2009).
  + Climate change increases uncertainty about fish stock productivity, migratory patterns, trophic interactions and adds vulnerability of fish stocks to the pressure of exploitation.
  + Of interest here: Warming oceans are resulting in the shift of fish poleward or into deeper water to stay within their preferred temperature range. Globally, fish and other animals have already shifted at a rate averaging 70km per decade (Poloczanska et al. 2013) and these shifts are projected to continue or accelerate (Cheung et al. 2016).
  + Depending on current stock distribution and range, climate may result in different shifts across boundaries, with potentially different implications for governance mechanisms (*see Link et al. 2010 – possibly include summary as textbox*)
  + Specific examples from Canada:
    - Poleward range shifts for the 98 exploited marine fishes and invertebrates of commercial and cultural importance to First Nations in coastal British Columbia were projected to occur at a median rate of 10.3 to 18.0 km decade-1 by 2050 relative to 2000 (Weatherdon et al. 2016) resulting in a cumulative decline in catch potential coastwide.
    - Cheung et al. Model projections suggest that the distribution of 28 North Pacific pelagic fish species are expected to shift poleward at an average rate of 30.1 ± 2.34 (S.E.) km decade􏰁 by 2055. This result suggests a high rate of range expansion into the Gulf of Alaska and the Bering Sea while a contraction is expected at the Aleutian Islands, and in the California Current Large Marine Ecosystem.
* **External forces**: Pollution, extensive development, overfishing all contribute to the general state of Canada’s ocean ecosystems and fisheries being of concern (Hutchings et al. 2012a,b; Baum and Fuller 2016).
  + Projected socioeconomic trends also form important components of future marine ecosystem and fisheries conditions, since Canada’s level of demand, and hence exploitation level, for fish in the future is likely influenced by the projected trajectory of population growth, economic development and income levels, as well as Canadian trade policies (Sinclair 2013).
  + While these external forces are of considerable concern, with impacts likely to be exacerbated by climate change they are unlikely to threaten the stability/effectiveness of existing international treaties the way shifting marine resources are. As such, given the scope and remit of this section, they are not considered further here.
* While the focus of many of climate change’s impacts have been ecological in nature, marine ecosystems do not exist in isolation. Changes are very much social-ecological – i.e., social and ecological systems are interconnected, and these two systems typically co-evolve across spatial and temporal scales (Berkes et al. 1998).
* Fisheries governance addresses the complex decisions to be made in that space to promote benefit-driven, cooperative, and ecosystem-based approaches to marine resource utilization.
* **Governance of transboundary marine resources** in Canada is regulated by means of agreements or multilateral environmental agreements. These regulatory policies provide an operational framework for addressing cooperation, compliance, and the appropriate use of international transboundary resources. To this end they integrate economic, social, legal, political and ecological considerations.
* Globally, the United Nations Convention on the Law of the Sea (UNCLOS) and the United Nations Fish Stocks Agreement (UNFSA) dictate states to cooperate to manage shared stocks sustainably and to apply a precautionary approach to fisheries.
* Canada-specific governance institutions that deal with transboundary stocks currently are (*to be summarized as a table that would include ‘name of the agreement’ | ‘geographic coverage’ | ‘objective’ | ‘No. of species considered’ | ‘No. of countries involved’*):
  + Northwest Atlantic Fisheries Organization (NAFO)
  + Inter-American Tropical Tuna Commission (IATTC)
  + International Commission for the Conservation of Atlantic Tunas (ICCAT)
  + North Atlantic Salmon Conservation Organization (NASCO)
  + International Pacific Halibut Commission
  + Pacific Salmon Commission
  + Whitening Treaty

Parties to the organization are: Canada, Denmark (for the Faroe Islands and Greenland), the European Union, Norway, the Russian Federation and the United States.

There are currently no commercial fisheries for wild Atlantic salmon in Canada, but limited recreational and Food, Social and Ceremonial Aboriginal fisheries in certain areas closely monitored to ensure conservation of the resource.

* + North Pacific Anadromous Fish Commission (NPAFC)

The anadromous fish stocks covered under the Convention are: chum salmon, coho salmon, pink salmon, sockeye salmon, chinook salmon, cherry salmon and steelhead trout. Five Contracting Parties: Canada, Japan, the Russian Federation, the Republic of Korea and the United States.

The Commission does not have the mandate to set or manage stock-specific catch allocations.

Currently, no direct targeting of stocks since Convention came into force in 1993.

* + Western and Central Pacific Fisheries Commission (WCPFC)
* Important considerations for the renegotiations of treaties to address issues of governance and conflict over allocations of marine resources under climate change:
  + The negotiations that led to existing treaties were conducted under a prescribed set of circumstances that are essentially relatively static in nature (e.g., stock boundaries, stock status) (Pinsky et al. 2018). Such approaches are unsustainable in variable environments (Hanna 2008).
  + **By redistributing fishing stocks, climate change is essentially modifying the terms under which rights and responsibilities were agreed to, challenging existing cooperative governance structures and requiring the establishment of new management precedents.**

(*Potentially include game theory box to highlight issues of concern in supporting future governance frameworks*)

* + Perceived fairness, or equity, of a given conservation and management scheme
  + Rights, responsibilities and justice are critical elements of defining equity.
  + Treaties are often the results of negotiations of contractual and reciprocal rights and responsibilities between stakeholders:
    - Responsibility plays a critical role in assigning accountability and apportioning blame for action or inaction in resource conservation and management (Ringius et al. 2002). Responsibility includes a ‘duty to cooperate’ (e.g., such as through ‘good neighbourliness’ principles), a duty to avoid causing harm (e.g., such as through the precautionary principle) or to remediate harms (e.g., such as the polluter pays principle), and a duty to fulfil agreed-upon commitments ‘in good faith’ (United Nations 1970).
    - Rights represent a guarantee of freedoms and entitlements as well as of permissible actions (Wenar 2011).
  + Social justice, which in this case would be supportive of fair sharing (Rawls 1999)
  + Fair sharing to achieve equity may mean to treat stakeholders ‘un-equally’, i.e., to allocate costs and benefits differentially according to criteria such as capacity, need, and entitlement. For example, the need of some parties may warrant prioritization to achieve an overall more ‘just’ attribution or opportunity among stakeholders.
  + Equitable international policy approaches should consider specific vulnerable groups. For example, the United Nations “Fish Stocks Agreement” Art. 24 (1,2) (UNFSA 1995) requires parties to consider food security as well as dependent and indigenous communities when adopting conservation and management measures.
  + Note: While earlier studies argued that cooperative fisheries management arrangements may not be required or desirable for stationary, non-migratory resources. Given that climate change will redistribute such stocks, this assertion may have to be revisited and the cost-benefit of developing a possible cooperation arrangement evaluated.
* **Future governance**: Restrictive governance policies in general have impeded efforts to address the pressures that have contributed to biodiversity loss and declines in Canadian marine resources (Favaro et al. 2012; Bailey et al. 2016).
  + More flexible and responsive fishery management regimes to address increased variability in ways that maintain the sustainable utilization of fishery resources.
    - These need to be negotiated by identifying the relevant parties and conservation goals explicitly assessing trade-offs, while acknowledging and discussing the role of equity. Doing so could substantially improve the transparency, accountability, and acceptance of resource policy processes and conservation outcomes (Franck 1995).
  + Schemes for capacity adjustment (e.g., license buy-back or tradable quota shares, limit license by area)
  + Regular (in season) monitoring of fishery independent stock status and catches and inclusion of climate data into management
  + Responsive catch limits (shorter openings)
  + Strong cooperation among fishers as well as across fishers, the government, research centers, and the wider industry.
  + Facilitate entry into different fisheries for fishers (e.g., gear switching) or provide opportunities for alternative livelihoods (e.g., aquaculture, ecotourism), giving special consideration to First Nations communities who do not have the same capacity as industrial fisheries, but are strongly dependent on fish resources as source of food, nutrition, livelihood and cultural identity.
* (possibly include autonomous adaptation)
* Whilst the science is clear on the types of climate-related impacts faced by future stocks and associated governance mechanisms, **uncertainty** pervades the magnitude and timing of these changes.
  + Small changes in temperature may result in large changes in the productivity and range of the targeted stocks; with changes likely to be sudden and the fluctuations large.
  + Future fisheries management will need to acknowledge and address the additional uncertainty introduced by climate change around marine systems’ states and processes and the coupled governance system. Governance structures will need to be structured in such a way that they can operate effectively even with uncertainty (Miller et al. 2007).
  + Stock assessments and governance mechanisms built around their outputs assume stable environmental conditions with a degree of inter-annual variability, but become unrealistic when attempting to address larger-scale change.
  + Environmental uncertainty therefore leads to scientific uncertainty, which in combination with socio-ecological and political factors creates governance uncertainty.
  + Governance uncertainty makes it difficult to decide on steps required to effectively and equitably address climate-related changes, in turn complicating the development of incentives to promote those actions (Miller et al. 2010, Polasky et al. 2011).
  + While the predictions available address gradual changes in temperature. Both the north Pacific and Atlantic oceans have suffered extreme events in recent years with different impacts on local biodiversity. These events are poorly understood and could be an additional source of pressure to the socio-ecological system
* Adaptation measures (evidence of action and effectiveness) will be highlighted through the use of a case study (TBD).

(Most examples of current effective renegotiated management arrangements have occurred in response to *temporary* increases in variability and shifts in stocks – not permanent)

* Success in adaptation measures will be measured by the implemented activities’ ability to achieve objectives while minimizing risks, maximize benefits, while striving for equity and legitimacy.

# References

Bailey M, Favaro B, Otto SP, Charles A, Devillers R, Metaxas A, Tyedmers P, Ban NC, Mason T, Hoover C, Duck TJ, Fanning L, Milley C, Cisneros-Montemayor AM, Pauly D, Cheung WWL, Cullus-Suzuki S, Teh L, Sumaila UR (2016) Canada at a crossroad: the imperative for realigning ocean policy with ocean science. Mar Policy 63:53–60.

Baum JK, Fuller SD (2016) Canada’s marine fisheries: status, recovery potential and pathways to success. Oceana Canada, pp 150

Berkes F, Folke C, Colding J (1998) Linking social and ecological systems: management practices and social mechanisms for building resilience. Cambridge University Press, Cambridge

Campbell, B., and Q. Hanich. 2015. Principles and practice for the equitable governance of transboundary natural resources: cross-cutting lessons for marine fisheries management. Maritime Studies 14:8.

Cheung, W. W. L., G. Reygondeau, and T. L. Frölicher (2016) Large benefits to marine fisheries of meeting the 1.5°C global warming target. Science 354:1591-1594

DFO (2016) Statistics Canada, Canadian International Merchandise Trade Database.

Favaro B, Reynolds J, Cote IM (2012) Canada’s weakening aquatic protection. Science 337(6091):154–154. doi: 10.1126/science.1225523

Franck T (1995) Fairness in international law and institutions. Oxford: Clarendon.

Hanna, S. S. (2008) Institutions for Managing Resilient Salmon (*Oncorhynchus* Spp.) Ecosystems: the Role of Incentives and Transaction Costs. Ecology and Society 13:35.

Hutchings JA, Côté IM, Dodson JJ, Fleming IA, Jennings S, Mantua NJ, Peterman RM, Riddell BE, Weaver AJ, VanderZwaag DL (2012a) Is Canada fulfilling its obligations to sustain marine biodiversity? A summary review, conclusions, and recommendations. Environ Rev 20:353–361. doi: 10.1139/er-2012-0049

Hutchings JA, Côté IM, Dodson JJ, Fleming IA, Jennings S, Mantua NJ, Peterman RM, Riddell BE, Weaver AJ (2012b) Climate change, fisheries, and aquaculture: trends and consequences for Canadian marine biodiversity. Environ Rev 20:220–311. doi: 10.1139/a2012-011

Miller, K., A. Charles, M. Barange, K. Brander, V. F. Gallucci, M. A. Gasalla, A. Khan, G. Munro, R. Murtugudde, R. E. Ommer, and R. I. Perry. 2010. Climate change, uncertainty, and resilient fisheries: Institutional responses through integrative science. Progress In Oceanography 87:338-346.

McIlgorm, A., S. Hanna, G. Knapp, P. Le Floc’H, F. Millerd, and M. Pan (2010) How will climate change alter fishery governanceʔ Insights from seven international case studies. Marine Policy 34:170-177.

Miller, K. A. 2007. Climate variability and tropical tuna: Management challenges for highly migratory fish stocks. Marine Policy 31:56-70.

Pinsky, M. L., G. Reygondeau, R. Caddell, J. Palacios-Abrantes, J. Spijkers, and W. W. L. Cheung (2018) Preparing ocean governance for species on the move. Science 360:1189-1191.

Polasky, S., S. R. Carpenter, C. Folke, and B. Keeler (2011) Decision-making under great uncertainty: environmental management in an era of global change. Trends in Ecology & Evolution 26:398-404.

Poloczanska, E. S., C. J. Brown, W. J. Sydeman, W. Kiessling, D. S. Schoeman, P. J. Moore, K. Brander, J. F. Bruno, L. B. Buckley, M. T. Burrows, C. M. Duarte, B. S. Halpern, J. Holding, C. V. Kappel, M. I. O'Connor, J. M. Pandolfi, C. Parmesan, F. Schwing, S. A. Thompson, and A. J. Richardson (2013) Global imprint of climate change on marine life. Nature Climate Change 3:919-925.

Rawls J (1999) A theory of justice. Revised edition. Cambridge: Harvard University Press.

Ringius L, Toravanger A, Underdal A (2002) Burden sharing and fairness principles in international climate policy. International Environmental Agreements: Politics, Law and Economics 2: 1–22.

Sinclair S (2013) Globalization, trade treaties and the future of the Atlantic Canadian fisheries. Canadian Centre for Policy Alternatives. [www.policyalternatives.ca](http://www.policyalternatives.ca)

United Nations (1970) Declaration on principles of international law concerning friendly relations and co-operation among states in accordance with the charter of the United Nations (UN Declaration of Principles). Resolution 2625 adopted by the general assembly, 25th Session. New York, USA; United Nations. 24 October 1970.

UNFSA (1995) Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA). [www.un.org/depts/los/convention\_agreements/convention\_overview\_fish\_stocks.htm](http://www.un.org/depts/los/convention_agreements/convention_overview_fish_stocks.htm).

Wenar L (2011) “Rights”, In the Stanford Encyclopedia of philosophy, ed. EN Zalta. Fall 2011 edition.

1. Thought here to refer to finfish as well as shellfish [↑](#footnote-ref-1)