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REPORT IN BRIEF

The Royal Society of Canada Expert Panel

Sustaining Canada's Marine Biodiversity: Responding to the Challenges Posed by Climate Change, Fisheries, and Aquaculture

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Report in Brief— Report by the Royal Society of Canada Expert Panel on Sustaining Canadian Marine Biodiversity

Canada's oceans both define and sustain this nation. They support a wide range of human activities, from recreation to fisheries to transport; on three sides of the country, they provide borders and protection. But our oceans have suffered as a result of human activity — including overfishing, aquaculture and all the things we do that drive climate change. The Arctic Ocean is being affected by reductions in the quality and quantity of sea ice caused by global warming. The Atlantic Ocean has been deeply affected by overfishing and associated changes in marine food webs. Climate change, fishing and aquaculture are affecting biodiversity on Canada's Pacific coast.

Paradoxically, the oceans suffer from a lack of human action when it comes to making the changes and reforms we need to protect our marine heritage. The physical and biological shifts climate change brings, along with more direct human impact, are modifying marine biological life. That has serious implications for food security and for the social and economic well-being of coastal communities.

Our job as a panel was to identify new approaches, measures, and research initiatives to promote the sustainability of Canadian marine biodiversity. To do that, we needed to prepare expert assessments of past and projected trends in Canada's ocean environments and marine biodiversity, and the causes and projected consequences of those trends. As well, since Canada has a range of national and international obligations on aspects of marine biodiversity, we were also asked to assess whether Canada has done enough to sustain healthy, safe and prosperous oceans for the benefit of Canadians today and in the future.

> Biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems. *United Nations, Convention on Biological Diversity, 1992*

What Damage is Being Done?

Biodiversity, broadly interpreted, is the variety, quantity, and distribution of life. Together, they influence the function of ecosystems and the benefits (called ecosystem services) that people derive from them, from regulating climate to producing food to providing recreation. Biodiversity is found at every level of life, from differences in genes to entire species. The United Nations' 1992 Convention on Biological Diversity gave several markers for measuring biodiversity, including distribution of species and their genetic diversity, but for this report, we focused on population numbers, because the survival of any species depends on the resilience of its populations to human and environmental challenges.

People often ask whether it really matters if one species goes extinct, or is wiped out in one area? Our analogy is an airplane: it might lose one or two or even ten rivets without problem; but at some point, if one more rivet pops, catastrophe follows. At some point cumulative loss of biodiversity will lead to catastrophic ecosystem change. We don't know when that tipping point is for marine biodiversity. The oceans are flexible and dynamic. But we can see some clear signs of trouble.

We'll start this discussion with a look at climate change and its impact on our oceans. But before we begin, two notes. What you are reading is a highly condensed version of a far-reaching, complex report. You can see the original, full-length version, with all its references and appendices, on line at http://rsc-src.ca/expertpanels_reports.php

Also, a small style note: Fisheries and Oceans Canada is the name of the federal ministry most closely connected with this material. We have continued to use its well-known initials, DFO, in this report.

Climate Change: Observed and Projected Stressors

The immediate consequences of climate change are likely to include ocean warming, altered sea levels, and acidification of the ocean. All of these are already changing marine biodiversity. Water and air temperature are both pivotal in determining distribution of ocean plants and animals. Altered temperature patterns affect marine biodiversity, and potential yields from fisheries, by changing where different species live. Increased precipitation and warmer temperatures can change salt content and the density of water, or wash more nutrients from land into rivers and then into the sea; those kinds of changes reach right down to "primary production", the development of the most basic organisms in the food chain. Changes there could reduce the transfer of food value from organic matter. Inevitably, every organism is affected.

Climate change can also cause disconnects between the needs species have for survival and their access to vital resources. An earlier bloom of plankton, for example, may mean that fish larvae or newly hatched seabirds don't get the food that they need. The consequences of these resource 'mismatches' can be transferred up the food chain. At the species level, effects can be seen in Chinook salmon, where climate change is making some streams too warm or too shallow for young fish to survive and grow properly. That's projected to reduce population abundance and significantly increase the chance of extinction for affected populations.

Temperature change also affects where species live. Empirical and theoretical studies suggest marine fish and invertebrates respond to ocean warming by shifting between 30-130 km per decade pole-wards and 3.5 m per decade deeper. That could lead to local extinction of some species, while others invade new areas.

We think this will inevitably lead to significant changes in fisheries. In the northern hemisphere, that could mean declines in fishing in temperate regions (25^{o}N-50^{o}N), but increases at higher latitudes, particularly in the sub-Arctic. However, benefits further north might be countered by the loss of species at lower latitudes in Canadian waters.

Climate change also plays a role in depleting oxygen in water. When surface water gets warmer, the water may not produce and exchange oxygen well. Heavier precipitation that increases freshwater discharge and the flux of nutrients adds to the problem. Along the Oregon coast, low-oxygen events have caused fish and crab kills during the last several years, events that were not observed in the previous century.

The world's oceans absorb some 84 per cent of the carbon dioxide generated by burning fossil fuels. As the concentration of CO_2 in the oceans increases, more carbonic acid (H_2CO_3) is formed, which partially dissociates into bicarbonate (HCO_3) and hydrogen (H+) ions. The combination of increased acidity and decreased carbonate means many marine organisms that use calcium carbonate to construct their shells or skeletons—including corals, some phytoplankton, lobsters, mussels, snails and sea urchins—are at risk from acidification. Analyses of corals on the Great Barrier Reef show that calcification rates declined 21% between 1988 and 2003. By the middle of this century, coral reefs may be eroding faster than they are growing.

Fisheries and Marine Biodiversity

Fishing's greatest impact on biodiversity is that it reduces abundance, sometimes significantly. It is not just the fish we want to eat that are affected; other fish are taken by accident ('bycatch') and other species, such as corals and sponges, often have their habitat destroyed. Changes in abundance also alter interactions among species, such as those between predator and prey, resulting in biological changes to marine ecosystems and food webs.

Sustained exploitation does more than just reduce the population; it also reduces the total weight of all individuals, or population biomass. Changes in Canadian species have been among the greatest recorded for fish worldwide, particularly in the Atlantic, where total biomass of species such as Atlantic cod, American plaice, Acadian redfish, roundnose grenadier and winter skate have declined by more than 90% since the 1960s.

Over-exploitation also affects marine mammals. At least one species, the grey whale, is no longer found in Canadian waters as a result. However, populations of many of these species have grown when hunting stops, or declines considerably. Although it was subject to commercial whaling from 1500 until 1910, the Arctic's bowhead whale is on the rebound since being subjected only sporadically to hunting by Inuit during the past century.

Almost any fishing gear will disturb marine habitat to some degree. How habitats respond depends on their sensitivity and the type and intensity of fishing. In general, towed fishing gear such as trawls and dredges is responsible for most fishing-related destruction of habitat. But the first pass of a piece of fishing gear on previously unfished habitat has a greater impact than subsequent passes. This is important, since it means that maintaining a relatively constant footprint of fishing will have less impact than continuous movement and redistribution of fisheries over time.

Most fisheries are managed based on how harvesting is predicted to affect the population growth rate of the targeted species, with little consideration of how changing the abundance of the targeted species will affect those it interacts with. The target species' place in the community structure and the food web is not the issue. If the consequences of altered ecosystems were taken into account, fishing targets would likely be very different.

How overfishing can affect ecosystems can be seen in species that were once heavily preyed upon by Atlantic cod and other bottom-dwelling fish predators. Since the collapse of cod in the early 1990s, there have been dramatic increases in the abundance of shrimp and snow crab.

The Impact of Aquaculture

Canadian aquaculture is growing in size and value; but its success as an industry masks real and potential environmental costs and is stirring controversy. Its potential impact on the environment and biodiversity includes ecological interactions, genetic consequences, diseases and parasites and altered habitats. All of these effects are known to occur in the

open-net sea pens that are typical of Canadian aquaculture. However, most or all of them could be mitigated if fish were reared in closed-containment facilities, particularly on land.

The extent of the impact of aquaculture varies depending on the species involved, siting, the scale and type of the activity and the local environment. Localized consequences of finfish and shellfish aquaculture include damage to wild bottom-dwelling organisms and their habitat by organic wastes and chemicals such as antibiotics, anti-foulants and pesticides.

Much of the public controversy associated with salmon aquaculture in British Columbia stems from uncertainty about the extent to which infectious diseases and parasites from fish farms might affect native salmon. Nowhere else in the world where open-net pen salmon farming is done is there so much natural salmon diversity that is potentially at risk.

Atlantic Canada salmon farms raise a native species, but there are still concerns. Escaped farmed salmon have been reported in 54 rivers and bays, which constitute 87% of the watersheds that have been investigated since the inception of the salmon aquaculture industry. That matters because differences between farmed and wild salmon affect behaviour, competitive ability, and breeding success. The outcomes of interactions between farmed and wild salmon depend on context but they are usually bad for wild salmon. Interbreeding between farmed and wild salmon may threaten the persistence of wild populations.

The potential environmental consequences of shellfish aquaculture are similar to those associated with finfish. Natural populations may be affected by the farming of non-native species, the diversity of native populations may decrease and other species that live in the area and are part of the food chain, such as fish and birds, can be affected.

BC's shellfish aquaculture industry dates back to the 1930s and has probably had relatively limited effects on marine biodiversity, especially when considered on a coast-wide scale. Some individuals have even suggested that positive benefits accrue to natural ecosystems in the guise of improved water quality and the increased productivity of some native species. In contrast to the Pacific, shellfish aquaculture in the Atlantic involves predominantly native species, but many of the other concerns about shellfish culture apply on the east coast.

***Is Canada Delivering on Commitments to Marine Biodiversity*?**

This report's descriptions of the impact of climate change, the fisheries and aquaculture on biodiversity, and our projections of their future impact, do not present a positive vision of the future. Climate change and its consequences will take hundreds of years, possibly much longer, to reverse. We believe, on the other hand, that the consequences of mistakes in the fisheries and in aquaculture can be fixed more readily — if the effort is made.

After examining the evidence, we conclude Canada has made little substantive progress in meeting its commitments to sustain marine biodiversity. Although Canada has developed and signed on to sound policies and agreements, and heralded good ideas with strong rhetoric, comparatively little has actually been done, leaving many of our national and international obligations unfulfilled.

That can — and must — be changed, starting with the *Oceans Act*. This 1996 law was a landmark in the move toward managing the oceans from an ecosystem perspective, after decades of focusing on one species or habitat at a time, without regard to the intricacies of biodiversity. Unlike the *Fisheries Act*, it provided a clearly articulated legislative foundation for marine conservation (an objective no one would even have considered in 1868, when the *Fisheries Act* was written). It was followed by the *Species at Risk Act* (2002), which included a commitment to develop legislation for the protection of threatened species. But neither has lived up to its promise.

Two of the *Oceans Act's* most important ideas have yet to be broadly put into practice, although both could significantly enhance Canada's ability to sustain marine biodiversity. One is the development and implementation of integrated management plans for Canada's oceans and coastal areas. The other is the development of a national network of marine protected areas.

Very little has been accomplished so far in integrated management planning. The federal government has focused on five of what they call "large ocean management areas," Placentia Bay and the Grand Banks, the Eastern Scotian Shelf, the Gulf of St. Lawrence, the Beaufort Sea, and the Pacific North Coast. Only one plan, for the Beaufort Sea, is complete and has ministerial approval. At the same time, the Federal government recently withdrew funding that would have ensured an integrated plan for the North Pacific Coast by December 2012. Major offshore areas including the Bay of Fundy, the Gulf of Maine, and the central and eastern Arctic are not part of integrated planning.

Canada's federated political structure is also a bar to proper management planning. The *Oceans Act* does not provide incentives to encourage provincial participation in planning and provincial governments, including Newfoundland and Labrador, Nova Scotia, New Brunswick, and BC, have developed their own strategies and policies for coastal and ocean management.

Ensuring adequate funding for integrating planning is also a challenge. Planned spending by DFO for 2010-11 gave oceans management $15.9 million out of the $154.7 million envelope to be spent on healthy and productive aquatic ecosystems. The recent demand all departments cut spending by 2014 will take a further $57 million from the DFO budget, which does not bode well for improved planning.

Policy reflects the values of those who create it. We have done far more to protect land than oceans in this country. As of May 2009, 9.4% or 941,418 square kilometres of Canada's terrestrial environment was protected. A far smaller proportion, less than 1% of Canada's marine environment is protected. In the past 50 years, terrestrial areas have

been protected at a rate of approximately 14,000 square kilometres per annum, 20 times the rate of 700 square kilometres in marine environments. In total, there are 797 marine protected areas, accounting for less than 1% of Canada's oceans. That's nowhere close to meeting our international commitments to establish a network of marine protected areas by 2012.

As the steward of a high proportion of the world's coastlines and marine waters, Canada should adopt more ambitious targets for marine protection areas and make them more meaningful by expanding fisheries closures in them (160 of 161 Pacific coast protected areas are reportedly open to some commercial harvesting within their bounds).

Putting Principled Governance into Fisheries Management Practice

Fisheries and Oceans Canada has a Sustainable Fisheries Framework (which we refer to as 'the framework'). Although both scientific advice and management decisions in large-scale commercial fisheries around the world have historically been dominated by single-species focus, the framework is a welcome Canadian approach to ecosystem-based fisheries management, which is the only way fisheries will be sustainable in the long run.

In ecosystem-based management, decisions must take into account the sustainability of ecosystem components and attributes. In several jurisdictions, policies and regulations now use this more comprehensive viewpoint. Effective ecosystem-based management usually involves the "precautionary approach", which stresses that the absence of full scientific certainty should not be used as a reason for postponing decisions where there is a chance of serious or irreversible harm. They also set "reference" targets to warn when stocks are getting low and include plans for promoting recovery if a population drops too far.

In contrast to other developed fishing countries, Canada has not adopted the use of reference points. For example, 20 years after the collapse of Newfoundland's northern cod (once one of the largest fish stocks in the world,) there is still no recovery target, let alone a timeline for rebuilding. We think that is unacceptable.

One consequence of this lack of initiative is that, among industrialized fishing nations, the status of Canada's marine fish stocks is among the worst in the world. In fact, compared to other major fishing nations such as Australia and New Zealand, Canada is moving very slowly on incorporating ecosystem indicators into scientific guidance. Our policies for conservation of wild Pacific and Atlantic salmon, for example, recognize the need for consideration of ecosystem-level. But they have yet to be implemented.

Modernizing the Fisheries Act

How can we bridge the gaps between international best practice, Canadian knowledge and commitment and what we actually do in this country? We think modernization of Canada's *Fisheries Act* (1868) is essential. It must be rewritten to include the principles that guide marine biodiversity and sustainability worldwide — using an ecosystem approach and being guided by the precautionary approach.

Driving reform of the *Fisheries Act* will not be easy. There is no indication the health of the ocean is a great concern for the present government. In the Speech From the Throne that opened Canada's 41st Parliament on June 3, 2011, there was no reference to climate change, species recovery, fisheries rebuilding, or marine biodiversity. Neither the word 'ocean' nor 'Arctic' was mentioned in the throne speech. The 'sea' was mentioned in the context of a government commitment to complete the Dempster Highway to connect Canada "by road from sea to sea to sea". 'Fishing' was used only in the context of a government pledge to support it and other industries "as they innovate and grow".

As well, the *Fisheries Act* delegates absolute discretion to the minister of Fisheries and Oceans to make decisions, with no formalized scientific guidelines or environmental framework for them. That leaves important biodiversity issues open to dictates of passing political concerns and is completely at odds with the best practices of fisheries legislation that supports sustainability, such as in the US, Norway, and Australia.

Many possible changes to support sustainable fisheries and coastal communities can be found in fisheries bills introduced over the years in other countries. From a biodiversity

perspective, key modernizations to Canadian legislation would include:

- Making sustainable development of Canada's fisheries an overarching objective;
- Insisting that key sustainability principles, such as the precautionary approach, public participation and the ecosystem approach, be followed in fisheries management; and
- Establishing a Canada Fisheries Tribunal to decide sanctions for violations of the principles and regulations of the Act.

Further legislative measures that should be considered to adequately protect marine biodiversity include:

- Ending the inherent conflict within DFO to promote industry and economic activity on one hand and the conservation of fish and aquatic ecosystems on the other;
- Requiring full ecological impact assessments for proposed fisheries;
- Encouraging the use of environmentally responsible fishing gear and fishing methods;
- Setting out clear, participatory procedures for integrated fisheries management planning;
- Mandating the following of scientific advice;
- Formalizing the explicit use of limit/target reference points and harvest control rules in fisheries conservation and management;
- Providing explicit and quantitative definitions of overfishing and recovery;
- Requiring recovery plans and rebuilding timelines for over-fished or depleted stocks; and
- Increasing political accountability and transparency in fisheries governance.

Undertaking to modernize Canada's ocean and fishery legislation to conserve marine biodiversity can be done. Both Australia and Norway have. Australia's *Environment And Biodiversity Conservation Act 1999* requires ministerial approvals for activities that will, or are likely to have, a significant impact on the Commonwealth's marine environment, environmental assessments for Commonwealth-managed fisheries, and provides a sound

legal foundation for bioregional planning.

In June 2009, Norway adopted an *Act Relating to the Management of Biological, Geological and Landscape Diversity (Nature Diversity Act),* which sets overall management objectives for ecosystems and species. The species conservation objective is "to maintain species and their genetic diversity for the long term, and to ensure that species occur in viable populations in their natural ranges".

Finally, the Canadian government must expand its horizons when it comes to biodiversity management. As former prime minister Pierre Trudeau once famously said in defence of federal jurisdiction, "fish swim." This raises additional biodiversity challenges. To ensure a sustainable future for those shared populations, Canada should place a high priority on working more closely with other maritime nations to enhance marine biodiversity around the world.

Conclusions and Recommendations

The preamble to the *Oceans Act* says Parliament wished "to reaffirm Canada's role as a world leader in oceans and marine resources management." This was a remarkable statement, given the Act was passed in 1996, a short four years after the collapse of the northern cod fishery. That one example of resource mismanagement was not only the greatest numerical loss of a vertebrate in Canadian history, it resulted in the greatest single layoff in Canada when between 30-40,000 people lost their jobs. It also cost $2-3 billion in social and economic financial aid.

But rhetoric over substance too often characterizes the Government of Canada's handling of its oceans and their marine biodiversity. In contrast to Canada's self-proclaimed ocean leadership, analyses of Canada's marine conservation and management initiatives are less than complimentary. Researchers at Yale and Columbia Universities constructed an Environmental Performance Index and used it to rank 163 countries on 25 performance indicators, for environmental public health and ecosystem vitality. In this analysis, Canada was ranked 125th of 127 countries in terms of fisheries conservation. In another

analysis, Canada was ranked 70th of 228 countries in the establishment of marine protected areas.

Canada has consistently failed to meet targets and obligations to conserve biodiversity and promote sustainability. The government has the knowledge, expertise and even the policy and legislation it needs to correct that; but multiple factors have combined to slow the pace of statutory and policy implementation almost to a standstill. Those factors, we believe, include the inherent conflict at Fisheries and Oceans Canada, which has mandates both to promote industrial and economic activity and to conserve marine life and ocean health. The minister of Fisheries and Oceans has excessive discretionary power to dictate activities that should be directed by science and shaped by transparent social and political values.

Canada's progress has been unduly slow in both an absolute sense (some commitments have still not been met almost two decades after they were agreed on) and comparatively — other western industrialized nations have made substantive progress in meeting, and often exceeding, their national and international commitments to sustain marine biodiversity.

Canada faces significant challenges in its efforts to conserve and sustain marine biodiversity in light of climate change, fisheries, and aquaculture. Among these three factors, human-induced climate change represents the greatest challenge primarily because its effects on marine biodiversity will not be readily reversed. Some might argue for complacency on the basis that little can be done to mitigate the effects of climate change. Based on the information presented in this report, we assert otherwise.

The simplest and best strategy to deal with climate change is to protect existing diversity and to rebuild depleted populations and species to restore natural diversity. The challenge then is to sustain them at levels at which Canada's marine biodiversity is able to optimize the ecosystem services that the oceans provide in support of Canadian society and in support of the welfare of the global community. By improving and protecting the health

of Canada's oceans, such a strategy will restore the natural resilience of Canada's ocean ecosystems to adapt in response to the challenges posed by climate change and other human activities.

In light of these needs, we offer seven recommendations for action that will take Canada from negligence to effectiveness in managing its fisheries and preserving marine biodiversity, for the benefit of Canadians and all the world's people.

RECOMMENDATION 1:

The Government of Canada should identify international leadership in oceans stewardship and biodiversity conservation as a top government priority.

Canada has not kept pace with international efforts to sustain marine biodiversity compared to successful initiatives and precautionary management approaches exercised by many other jurisdictions, such as Australia, New Zealand, the US and Norway. Canada's lack of strong institutional leadership has been exacerbated by ambivalence on the part of society and minimal incentives to move from rhetoric to action. The responsibility for fulfilling Recommendation 1 rests with the Prime Minister who should lead this initiative. The Minister of Fisheries and Oceans can also play an important role, by kick-starting action on this panel's recommendations. Support from all sectors of society, including industry, will increase the chance the government will act.

Key Actions

- The Government of Canada should fully implement all its statutory and policy commitments to sustain marine biodiversity.
- The Government of Canada should take a broad approach to marine biodiversity by extending integrated management planning efforts across national and international maritime boundaries.
- The Government of Canada should increase Canada's formal membership in international agreements that pertain to sustaining marine biodiversity.
- The Government of Canada should support research to strengthen scientific advice and ensure renewal of scientific and managerial staff expertise.

- The Government of Canada should put in place a framework to maximize the number of fisheries certified sustainable by independent third-party organizations.
- The Auditor General of Canada should undertake a full audit of Canada's progress in meeting its international marine biodiversity obligations.

RECOMMENDATION 2:

The Government of Canada should resolve regulatory conflicts of interest affecting Canada's progress in fulfilling obligations to sustain marine biodiversity.

There is an inherent conflict between the Government of Canada's responsibility to conserve and protect biodiversity and its responsibility to encourage its exploitation (through both commercial fisheries and aquaculture). As noted by the Auditor General of Canada, the risk that fishing activity will endanger the long-term ecological sustainability of fish stocks can be reduced with an effective framework of clear roles and responsibilities built on accountability and transparency. Until we have a mechanism that ensures all parts of Government are accountable for supporting conservation of biodiversity, we will not progress on meeting Canada's national and international obligations. Our primary concern is that regulatory conflict compromises the integrity of regulatory science and decision making, as well as undermining public faith. The more Fisheries and Oceans Canada promotes, or is thought to promote, exploitation of marine biodiversity and ocean life, the more it undermines public trust in its ability to conserve and protect the oceans in the public interest.

Key Actions

- The Government of Canada should amend institutional structures and develop processes to limit or eliminate real and perceived conflicts of interest in the management of Canada's oceans.
- The Government of Canada should amend institutional structures and develop processes to ensure ministers are fully and transparently accountable for policy commitments on the use and conservation of marine biodiversity.

RECOMMENDATION 3:

The Government of Canada should reduce the discretionary power in fisheries management decisions exercised by the minister of Fisheries and Oceans.

Canada's progress in meeting its obligations to sustain marine biodiversity has been impeded by the absolute discretion afforded to the minister of Fisheries and Oceans. The *Fisheries Act* (1868) dates from a time in Canadian history when ministers had czar-like powers to approve, deny and change proposals affecting their mandates. In the US, in contrast, the *Magnuson-Stevens Fishery Conservation and Management Act*, first introduced in 1976 and revised numerous times, has increased accountability and strengthened links between policy and science in fisheries management. US regional fishery management councils are required to adhere to binding scientific advice (from their scientific and statistical committees) on catch limits, overfishing prevention, and rebuilding of overfished stocks. Unlike the *Fisheries Act* and the *Oceans Act*, the *Magnuson-Stevens Act* specifies actions the Secretary of Commerce must take if certain circumstances arise. The Auditor General of Canada has identified leadership and well-defined accountability as key elements for sustainable fisheries.

Key Actions

- The Government of Canada should enact prescriptive legislation to: (i) prevent over-fishing; (ii) rebuild depleted fish stocks; (iii) formalize the explicit use of reference points and harvest control rules; and (iv) ensure transparency and accountability in fisheries and aquaculture management plans.
- The Government of Canada should establish independent, arms-length advisory or decision-making bodies on matters pertaining to the use and conservation of marine biodiversity, including catch allocations, licensing and environmental impact assessments.
- The Prime Minister should use a mandate letter (publicly available) outlining expectations and policy goals, to increase ministerial accountability at Fisheries and Oceans Canada. The letter could include a mandate to respond to this panel's recommendations.

RECOMMENDATION 4:

Fisheries and Oceans Canada should rapidly increase its rate of statutory and policy implementation.

Fisheries and Oceans Canada is moving too slowly on fulfilling national and international obligations to sustain marine biodiversity. That deficiency is magnified by the pressing need to adapt to and mitigate climate change. DFO's slowness has prevented Canada from adopting the precautionary approach for managing most of its commercial fisheries and from making good progress towards targets for the establishment of marine protected areas. (We still do not have quantitative recovery targets for Canada's depleted cod stocks, 20 years after their collapse). The Auditor General of Canada said recently that "Canadians have the right to know how well fisheries are being managed," something which is not possible in the absence of fishery reference points, recovery targets and timelines for rebuilding.

Key Actions

- Fisheries and Oceans Canada should fully implement the *Oceans Act* to: (i) identify biodiversity hotspots and vulnerable biological habitats; (ii) establish a comprehensive and biologically meaningful network of marine protected areas; and (iii) develop marine spatial planning with clear geographical priorities, explicit timelines and transparent measures for public reporting.
- Fisheries and Oceans Canada should fully implement the *Species at Risk Act* for marine fishes by including endangered and threatened species on the national legal list and by affording them the full benefits of recovery strategies, including setting recovery targets, rebuilding timelines, and (when possible) limited directed harvests.
- Fisheries and Oceans Canada should fully implement existing policies on marine biodiversity use and conservation, such as those in the Sustainable Fisheries Framework.

RECOMMENDATION 5:

Canada should implement statutory renewal to fulfil national and international commitments to sustain marine biodiversity.

Canada has not kept pace with the successful international initiatives and precautionary management approaches other countries are using to sustain marine biodiversity. At a minimum, Canadian statutes and regulations must be revised to remove impediments to action on policy and legislation for sustaining marine biodiversity. Revising the 144-year-old *Fisheries Act* has proven to be complex and difficult; it may be necessary to replace it with more prescriptive legislation, such as we describe in Recommendation 3. Key actions associated with this recommendation could be initiated by the Government of Canada, DFO, or individual members of Parliament (e.g., through the introduction of a private members' bill).

Key Actions

- Enact a modernized *Fisheries Act* or new statute that: (i) makes full implementation of the precautionary approach an over-arching objective; (ii) provides legislative requirements and guidance on fully implementing the sustainable fisheries framework; and (iii) identifies conservation of biodiversity as a core consideration in the development of fisheries management plans.
- Draft and enact federal legislation on national objectives and procedures for all aquaculture operations, requiring a principled approach to aquaculture to ensure the protection of biodiversity.
- Consider enacting comprehensive legislation (similar to that in Australia and Norway) to set legally binding requirements for biodiversity protection.
- Consider amending the *Oceans Act* to clarify integrated management procedures and responsibilities and to provide a firm legal foundation for implementing completed management plans.
- Strengthen the *Species at Risk Act* through key amendments that would: (i) establish a transparent evaluation and consultation process when species are not listed, including external review of supporting analyses; (ii) clarify the procedure and process for developing recovery strategies and action plans; and (iii) restrict

discretion to exempt activities from the Act's prohibitions and incidental permitting requirements.

RECOMMENDATION 6:

the Government of Canada should establish national operational objectives, indicators, and targets for marine biodiversity.

Many of Canada's policy commitments to sustain marine biodiversity have yet to be translated into operational objectives at the appropriate levels and management actions. Ideally, policies would establish a framework of required outcomes consistent with national and international biodiversity commitments. Indicators and targets would be used to track progress in relation to these objectives and to support reporting. Progress would be strengthened by the issuance of annual reports that compare performance to the objectives. Although the Government of Canada should lead this effort, reporting on biodiversity trends, targets and changes should be supported and contributed to by groups including non-governmental organizations and academic scientists.

Key Actions

- The Government of Canada should establish operational objectives for its commitments to biodiversity conservation and formally integrate them in oceans and fisheries management. Objectives for the most serious threats to biodiversity should have top priority.
- Fisheries and Oceans Canada should establish biodiversity indicators and targets to assess progress towards meeting operational objectives, and report annually on them, and trends in marine biodiversity, as well as on national progress toward policy objectives.

RECOMMENDATION 7:

Canada should establish strategic research initiatives to strengthen scientific advice on sustaining marine biodiversity.

Canada's failure to meet many of its marine biodiversity commitments cannot be attributed to inadequate scientific knowledge or advice. However, there are new research

initiatives that will better support future scientific advice on the biodiversity consequences of climate change, fisheries and aquaculture. These initiatives will allow managers and decision-makers to achieve their objectives more efficiently and effectively and across greater geographical areas. New research is required to forecast the effects of climate change on regional spatial scales.

Key Actions

- Federal government departments (including DFO, Natural Resources Canada, Environment Canada) should maintain, improve, and/or develop new long-term environmental monitoring programmes, especially for the Arctic, to track key biodiversity sites and functional changes at all levels of the marine food web.
- DFO should establish a national programme for mapping ocean habitat and its use to inform decisions on integrated spatial management plans, identification of critical habitat, location of marine protected areas and environmental risk assessments of human activities, including aquaculture.
- The Government of Canada should promote and strengthen basic, discovery-oriented research on physical and biological oceanographic patterns, process, and function.
- The Government of Canada should develop a comprehensive research programme to forecast changes in Canadian marine biodiversity resulting from ongoing and projected climate-related changes to Canada's oceans.