Brief to the Expert Panel Committee, Royal Society of Canada:

Identifying Gaps In Scientific Knowledge

Submitted by Sierra Club of Canada, BC Chapter
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Sierra Club of/du Canada
BC CHAPTER

Introduction

The Sierra Club of Canada is a membership-based national environmental group with members from coast to coast working nationally and through four regional chapters, and the Sierra Youth Coalition, Canada's largest environmental group for youth. We have offices in Vancouver, Victoria, Edmonton, Toronto, Ottawa, Halifax, Sydney and Corner Brook. The British Columbia Chapter has been in existence since 1968, working to protect ancient forests, wilderness areas and promote sustainable fisheries.

The national programme of activities and projects includes marine issues, and conflicts about fisheries, environmental issues and expanding oil and gas exploration and development activities are playing an increasing role in both the Atlantic Canada and the British Columbia Chapter.

We appreciate this opportunity to provide written comments. We will separate our brief into comments on the process of this review, followed by our concerns about gaps in the knowledge base.

Process

As you will know from our previous correspondence with Dr. Hall, the Sierra Club of Canada believed the process was unworkable from its outset. We wrote on September 26, 2003:

> "The process of a science review on an issue as complex as off-shore exploration and development cannot, in our view, be addressed in two weeks."
> (letter from Executive Director Elizabeth May to Dr. Jeremy Hall)

But our concerns are far deeper than the rushed time frame. In establishing the Expert Panel Committee, the Honourable Herb Dhaliwal, Minister of Natural Resources, stated that the purpose of the Science Review was to "allow stakeholders to identify gaps in scientific knowledge….The approach will be comprehensive, balanced and cooperative so that decisions can be based on information that *reflects the views of all stakeholders.*" (*emphasis added*)(Natural Resources Canada -- 2003/31, press release May 15, 2003)

On July 30, 2003 Minister Dhaliwal described the panel review as "a series of workshops to identify the gaps in scientific knowledge. Scientists from governments, industry, universities and First Nations, *as well as other stakeholders*, will be invited to provide input in this review." (*emphasis added*) (Natural Resources Canada, 2003/55)

In fact, other stakeholders were *not* given an opportunity to present scientific information or to participate in the review process except as commentators. Every one of the issues reviewed in the workshops has a range of scientific opinion. Yet the process heard from only one or two scientists on each issue, and the range of views and concerns was not included. The process met none of Minister Dhaliwal's commitments to "allow stakeholders to identify gaps" nor to being "comprehensive, balanced and cooperative...reflect(ing) the views of all stakeholders."

As we understand the purpose of this process, it is to identify gaps in scientific understanding and knowledge. The panel was selected to facilitate this process. In order to assess gaps adequately, it is our view that a wide range of scientific opinion should have been engaged. Not all scientists agree as to the extent of our knowledge base when examining the complex and wide ranging issues. The Sierra Club of Canada believes it is unacceptable that scientists with different views have not been included in the official agenda.

By way of example, the issue of the impacts of seismic testing is controversial. Many scientists would agree that the area is characterized by more gaps than by knowledge. Yet, the panel only heard from one expert in the field. Dr. Rolph Davis is well known to Sierra Club of Canada as the consultant for Corridor Resources in Nova Scotia, and a leading proponent of the widely disputed view that seismic testing is acceptable in the southern Gulf of St. Lawrence. He is a respected scientist, but his views are not

universally sharedby his peers. To properly consider the state of information about impacts of seismic testing, the panel should have heard from others.

The Canada Nova Scotia Off-Shore Petroleum Board convened a scientific review group. Dr. Davis was one of the participants. The group concluded that:

> "…the most critical issues are uncertainties regarding impacts to snow crab, risks to finfish, and ecosystem effects, such as the additional effect of seismic on the existing natural and human induced factors impacting cod populations." (p.27)
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> "Concerns over the effects of the proposed seismic activities are heightened because of the concentration of stocks, the location of the migration routes and overwintering grounds, and the commercial and conservation value of the stocks." (p. 27)
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> "Knowledge and studies predicting the knowledge of the effects of seismic on these resources and the environment is generally weak. When combining the knowledge of our resources with our knowledge of the effects of seismic we end up with patchy scientific evidence."(p.28)

(Report of the Science Review Group to CNSOPB, November, 2002) The reality is that our knowledge of the impacts of seismic testing is extremely weak. Pro-industry presumptions of lowimpact are no substitute for honestly identifying gaps in knowledge.

Previous reviews suggest that the minimum number of questions that would have to be reviewed defy even passing consideration in a two-week period. A short list would include:

- impacts of seismic testing on the spawning, juvenile life stages,feeding, migration of every species present of ground fish, fin fish, crustaceans, whales, dolphins, seals, and sea turtles (with each species requiring a different analysis);
- the impacts of exploratory drilling on benthic organisms;
- the impacts of pollution from oil-based and water-based drilling muds, including direct smothering of marine life and toxic contamination with bio-accumulating heavy metals;
- the disposal of drilling muds;
- the handling and disposal and contamination of cuttings;
- the risk of blow-outs in exploratory drilling;
- development stages increasing the risks of oil spills, blow-outs, and accidents;
- the risk of earthquakes and other catastrophic events;
- the increased level of tanker traffic, and the reliability of tanker structure;
- risks to sea birds from flaring and bright lights;
- risks from operations to sea birds, ground fish, fin fish, crustaceans, whales, dolphins, seals, sea turtles, and protected areas;
- risks of climate change increasing the severity and frequency of storms, storm surges and the unpredictability of severe weather events.

The distinguished chair of the panel, Dr. Jeremy Hall has informed us, that the panel can rely on previous work. The two documents on which we are told you will rely are "The British Columbia Offshore Hydrocarbon Development – Report of the Scientific Panel"(Jan.15, 2002) and the "British Columbia Offshore Oil and Gas Technology Update" (Jacques Whitford, Oct. 19, 2001).

These documents fail to adequately consider the gaps in our knowledge. On the contrary, the documents display a tendency to gloss over uncertainties and trust that problems can be sorted out later. The document prepared by the consulting firm Jacques Whitford dismisses the issue of the impacts of seismic surveys with a single sentence, "Guidelines have emerged as a result of these research to minimize the effect of seismic survey on marine fauna." (sic, at p. 80)

In fact, new information is emerging about the impact of seismic surveys on marine mammals. The guidelines to minimize the impacts are no more than a steady increase in seismic blasting (ramping up) and the placement of marine mammal observers on board the vessel to spot whales within one kilometre. The reality is that seismic testing continues in bad weather and at night with little or no visibility. This so-called mitigation measure looks more like a public relations effort.

Similarly, the Whitford document dismisses concerns about the impact of light on sea birds by concluding that the birds do not suffer direct mortality by flying into the flares. The impact on many important and endangered species of sea birds in the region of the Queen Charlotte Islands, (marbled murrelets, ancient murrelets, and tufted puffins) would be significant without directly flying into the flares (p.99), even though historical accounts exist of ancient murrelets flying into bonfires at night. Loss of orientation could lead to mortality.

The Whitford review does not even mention the risk of contamination of the area around exploratory drilling operations with mercury and cadmium, nor does it mention the risk of uptake of these toxic materials into the food chain. The more recent Science Review (January 2002) at least mentions the risk of "heavy metal contamination," without mentioning specifically the reports of cadmium and mercury accumulating in the fish in the Gulf of Mexico and in the people who eat those fish.

The documents cited do not inspire confidence that the "fast-tracking" of this process can possibly do more than scratch the surface or repeat the mistakes of previous inadequate reviews. The process undertaken to date cannot be said to have met the stated goals of the federal government in convening this process.

Substance

The following written summary of our concerns about the gaps in scientific knowledge is not an adequate replacement for the process we believe should have been followed. Had we been given the opportunity, we would have invited independent scientists to participate in the workshops. The opportunity for a written brief is appreciated, but is clearly not a satisfactory replacement for meaningful participation in an adequate process.

Issue 1: Impacts of seismic testing on the various life cycle stages of every species present of plankton, fish and marine mammals.

As noted above, there is a significant lack of scientific information about the impacts of seismic testing on ecosystems around the world.

The nature of the technology to identify sub-surface resources has changed over the years. The industry used to use, and defend the use of, dynamite. They have shifted to the use of powerful air guns, dragged below the surface, at depths of about six metres, about 100 metres apart, running up to 7.5 kilometres behind the seismic vessel. The air guns emit loud percussive sound waves (by electrical discharges or compressed gas) at regular intervals (every ten seconds) over many days. This amounts to millions of explosions in a typical survey. Each explosion from a single air gun creates a sound pulse of approximately 226 dB. For the entire air gun array, the decibel level is between 242-252 dB. Behind the airguns, hydrophones pick up the received sound, reflected from the structures below the sea bed.

Seismic is not a uniform operation. There are varying degrees of intensity of seismic testing. The first cut is often 2D seismic, but if results suggest a petroleum resource is present, then additional seismic testing is likely, utilizing progressively more intense seismic – 3D and 4D. Each step involves progressively greater levels of noise and disruption to the marine world. 4D involves shooting 3D seismic repeatedly at intervals of months or years.

Sound propagation is a very complex scientific question. Each area will have different impacts. Factors to be considered include water depth, water temperature, climatic conditions during the survey (wind, wave action) and ocean bottom characteristics (sandy, craggy, etc.) In fact, during hearings on the issue of

possible seismic in the southern Gulf of St. Lawrence, evidence was contradictory and inconclusive as to whether the fact that the proposed seismic was in shallow water would enhance the impact (DFO) or reduce the impact (Davis). The Commissioner concluded in her report that the question of sound propagation in the southern Gulf of St. Lawrence was one of scientific uncertainty.

Considering how long seismic testing has been used, there is surprisingly little science on the impacts of seismic on marine life. As noted in the Report of the 2002 Scientific Review Panel in British Columbia: "Little information exists…on the impacts of fish eggs and larvae or on salmon migration and behaviour from seismic surveying." (p. 33)

The limited studies conducted on the impacts of seismic testing suggest that marine life forms capable of moving away from the testing, will do so. Fish catch rates fall and remain low for a week or more following seismic survey events. Whales attempt to escape the noise. These effects are hardly surprising given that the decibel level of the seismic pulse is roughly equivqalent what you get standing beside an airplane jet engine running at full throttle, albeit delivered in a series of single pulses.

Those creatures that cannot move away, crustaceans for example, may also be impacted. Recent work in Atlantic Canada suggests that egg survival falls 34% in those snow crab exposed to seismic testing. The study mentioned by Dr. Rolph Davis has not been accepted by the Department of Fisheries and Oceans and has not yet cleared its peer review process (critiques of this study are attached). There is a significant lack of scientific research on the impacts of seismic testing on all life stages of crustaceans. There is even less information on the impacts of seismic on jelly fish and other no-commercial species that are significant food sources for sea birds, sea turtles and fish.

While we have relatively little information on the impact of seismic on adult commercial fish, even less well understood is the impact on juvenile fish, eggs and larvae, as well as the long term damage to the hearing of whales. Of special concern is the impact of a 226 db sonic pulse on the fragile tissues and membranes of free floating fish eggs and zooplankton.Some mortality occurs in the immediate area around the air gun. This occurs not just below the guns but on either side as well. Dr. Robert Abbott, a respected expert in bio-acoustics who has conducted extensive research in the San Francisco Bay area, has compiled studies that suggest the lethal mortality zone around a seismic air gun is up to 50 meters in all directions for various organisms. It is frankly difficult to believe that controlled scientific experiments have not been conducted to clarify such impacts, given its significance to ocean productivity and fisheries.

The Fisheries Resource Conservation Council (2000) in a report to the federal Minister of Fisheries noted that: "Several scientific works have described the detrimental effect of seismic blasting on every life stage of fish."

It is clear that seismic testing impacts fish behaviour and can result in direct mortality. Less clear is the impact on fish communication capacity and potential impacts on reproductive success. Dr. Jeff Hutchings of Dalhousie University has been investigating the role of sound in cod reproduction. Given the lack of a scientific explanation for the failure of stocks of Atlantic Cod to recover following ten years under moratorium and the simultaneous arrival of massive oil and gas activity off Newfoundland, the potential for a causal connection should be carefully examined. It remains a very significant gap in scientific knowledge.

The impact on whales is better understood. Cetaceans clearly rely on sound to communicate, but also to experience their whole world. Whales and dolphins rely on an acoustic map of the world for finding fish, for navigation and for all activities.

The impacts of seismic testing are particularly worrying for cetaceans. The Queen Charlotte Basin has resident populations of gray, sei, humpback, minke, finn, sperm and orca whales, as well as many species of dolphins. A number of these are threatened or endangered under COSEWIC designations. These animals rely on sound for virtually their whole comprehension of the world around them and each other. Dr. Davis's research shows for the most part that whales will move away from the enormous assault that seismic blasting is on their senses. But his work also has shown that necessity (hunger) can over-ride their

desire to avoid the dangerous levels of noise, and whales will stay in feeding grounds and receive a potentially damaging exposure to noise if driven by necessity. Dr. Christopher Clarke of Cornell University and Dr. Hal Whitehead of Dalhousie University should have been included in this forum to have a balanced discussion of the threat to whales from seismic testing.

Dr. Clarke, who has studied whales extensively, has said that it is the scale of seismic testing that can inflict damage on whales. "This is not some trivial little sparker or someone tapping on the side of the boat. These are explosions that are happening at regular intervals, every ten seconds, every thirteen seconds, for hours and hours and hours, and days and days and days….I would not be surprised if one looked at the ears of animals living in these areas of high seismic activity that you could actually find notches in their ears where they had lost the ability to hear in certain frequency ranges because of just physiological damage." (Crude Costs)

We are clearly learning more about the impact of seismic on whales all the time. The use by the military of Low Frequency Sonar has only recently been linked to the strandings and deaths of whales. While LFS is not the same as seismic, it is important to consider that it is the effort to escape unbearable sounds that is now being linked to whale deaths, somewhat similar to the debilitating effects experienced by human divers in "the bends" (rising too fast for metabolic health).

Sea Turtles may also be harmed by seismic testing. There is much less information on turtles and their ability to withstand sonic assault than there is for understanding the risk to whales and fish.

Lastly, although the impacts of seismic have traditionally been associated with the noise generated, and not actual pollution, in fact, seismic testing is not without the risk of pollution. The six kilometre streamers behind the seismic vessel have been shown in Atlantic Canada to spring leaks. This summer, on nine separate occasions between mid-June and August, 2003, quantities of mineral oil and kerosene were spilled in this way. Some spills were on the order of 500 litres.

The pollution risk of seismic testing is mentioned nowhere in the background documentation referred to in Dr. Hall's letter to Sierra Club of Canada ("The British Columbia Offshore Hydrocarbon Development – Report of the Scientific Panel"(Jan.15, 2002) and the "British Columbia Offshore Oil and Gas Technology Update" (Jacques Whitford, Oct. 19, 2001).

Given the sensitivity of marine life in the Queen Charlotte Basin, this risk requires further research to reduce the gaps in science.

Issue 2: the impacts of exploratory drilling on benthic organisms and fish, the impacts of pollution from oil-based and water-based drilling muds, including direct smothering of marine life and toxic contamination with bio-accumulative heavy metals:

Exploratory drilling has a wide number of impacts on benthic organisms, from direct physical damage, to physical smothering from the use of commercial drilling muds, to contamination with heavy metals and toxic chemicals to the food chain.

An astonishingly large amount of drilling muds are generated as waste for each well drilled. Typically as much as a million pounds of mud is dumped at each exploratory well. The drilling muds can physically smother benthic organisms in the vicinity of the well. The oil based muds have largely been replaced with water-based products, but these too are contaminated with heavy metals such as cadmium and mercury. (note discussion in "Process" section of this brief.) The issue of contamination through the food chain from muds is little understood, highly contentious and requires more research.

Exposure to drilling muds can reduce the survival of young cod. (Wills 2000).

The use of these commercially produced muds requires far greater testing and understanding. The chemical composition of the drilling muds are currently proprietary, secret, industry information. The muds may contain as many as 1000 ingredients.

Issue 3: the risk of blow-outs in exploratory drilling:

The worst case scenario for exploratory drilling is a major gas blow-out. These blow-outs can last for weeks or months. There have been at least three major gas blow-outs on the Scotian shelf in recent years, and a multitude of smaller leaks and spills.

The environmental impacts of these events will differ depending on the hydrocarbon involved.

Issue 4: development of industry increasing risks of oil spills, blow-outs, and accidents;

Obviously, if the industry moves forward, the impacts and risks increase. The original reason for the B.C. moratorium was related to the risk of oil spills. We do think the workshops did a good job of hearing a more balanced view on these risks. We think the Expert Panel will have heard ample information to conclude that oil spills in the Queen Charlotte Basin will create relatively more environmental damage than a similar event off Hibernia. The currents and weather systems in the Queen Charlotte Basin are more likely to bring the hydrocarbons into highly productive and vulnerable ecological zones than would be the case off shore in Newfoundland.

Issue 5: risks of climate change impacts in increasing the severity and frequency of storms, increasing storm surges and enhancing unpredictability of severe weather events:

Although the panel heard strong evidence that scientists believe the Queen Charlotte Basin within the territory of Haida Gwaii is among the world's most volatile areas for storms. You also heard that it was one of the most difficult areas for which to receive accurate forecasts. However, one of the largest areas of uncertainty was not thoroughly reviewed. The impacts of climate change on severe weather events represent a large area of scientific uncertainty.

We simply do not have detailed information on specific regional impacts to be anticipated from the acknowledged increase in global average temperature due to increases in concentrations of greenhouse gases in the atmosphere. We do know that ocean temperature is intimately linked to major systems resulting in more sever El Nino events, for example. We know from the global climate circulation models that, while waters east of Newfoundland are likely to become colder, waters of the Pacific are likely to be much warmer.

Relevant work is that dealing with projections and observations of intensity of severe storms (mainly winter). The most recent reference is McCabe, G.J., Clark, M.P., and Sereze, M.C. 2001, "Trends in Northern Hemisphere Cyclone Frequency and Intensity", J. of Climate 14(12) 2765-2768. They say that over the past 3 to 5 decades more frequent and intense storms have occurred North of 60ºN, and more intense but not more frequent events South of 60ºN.

From the Canadian climate model Lambert reported that winter and early spring storms would increase in intensity with continuing greenhouse forcing. (Lambert,S.J. 1995. "The effect of enhanced greenhouse warming on winter cyclones frequency and intensity", J. of Climate 8, 1447-1452).

The observed changes in storms have been consistent with the model projections. It is unacceptable to decide that the gaps in our knowledge of climate change impacts should simply be ignored. It is not a valid scientific approach.

Issue 6: Cumulative Effects:

The scientific uncertainty related to cumulative impacts is perhaps the largest area of scientific uncertainty. Any oil and gas development will not occur in a vacuum, but in an environment which is already stressed by over-fishing, land-based sources of marine pollution, climate change and ozone depletion. Particularly significant in any review of cumulative effects is the impact of sub-lethal effects. Russian biologist Stanislav Patin, in his encyclopedic review of oil and gas industry in the offshore, wrote:

"The available data suggests that primary sub-lethal responses of marine biota (including commercial species) in the form of biochemical changes, histological anomalies, diseases and some other effects of chronic stress have become global phenomena in the marine coastal zone. An early diagnosis of these responses is presently an important and challenging task, especially in areas directly affected by anthropogenic impact. These areas undoubtedly include places of offshore oil and gas developments."

Conclusion

With all due respect to the panel, Sierra Club of Canada and the SCC-British Columbia Chapter must conclude that the process did not meet the public commitments made by the federal Minister of Natural Resources. The approach taken, (invitation-only presentations with very few experts per topic) was not capable of identifying areas of scientific uncertainty.

We urge the Royal Society to report back to government that a further process is necessary. A process designed to meet Minister Dhaliwal's commitments should allow all interested parties to submit expert scientific information through expert testimony to the panel. There should be adequate funding available to ensure that all stakeholders are able to secure highly qualified experts from around the world. The search for gaps in knowledge is not difficult; there are more gaps than knowledge. Nevertheless, given the stakes of lifting the thirty-two year moratorium on off-shore oil and gas development, the governments and the Royal Society owe the people of Canada a thorough review. The two workshops held this fall are far short of the mark.

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