Statement by Dr. Christopher W. Clark

My name is Christopher W. Clark. I have been asked, on behalf of the Margaree Environmental Association & the Save Our Seas Coalition, to provide expert commentary on the potential effects of oil and gas exploration and drilling activities on the marine environment with particular attention to the Southern Gulf of St. Lawrence and Sydney Bight regions, but including the Scotian Shelf region.

My background: I have formal training and experience in both engineering and biology with a masters degree in electrical engineering and a Ph.D. in Biology. In 1972 Roger and Katy Payne introduced me to the world of whales and in particular the issues relating to the potential impacts of human-made underwater sounds on marine mammals. My Ph.D. research was on acoustic communication in an endangered population of southern right whales. Since completing my Ph.D. I have focused my research on acoustic communication in marine mammals with particular attention to large whales including bowheads in the Arctic, blue, fin and humpback whales throughout the world's oceans, and right whales in the western North Atlantic. A significant amount of that research has included studies on the impacts of human-made underwater sounds on marine mammals. Presently I am the I. P. Johnson Director of the Bioacoustics Research Program at Cornell University in NY, USA.

I consider myself extremely fortunate to be a biological engineer studying whales for a living. It is a rather specialized job. When you work in the ocean on endangered species, you cannot help but observe the tension that exists between the basic needs of the animals living in the ocean and human society's demands for resources that occur in and beneath that ocean. In every case throughout my 25 years of working with whales and observing other marine organisms - off the North Slope of Alaska, off the California coast, off Florida, in the Gulf of Mexico, off the Shetland Islands, in the Mediterranean Sea - in every case there has been a conflict between the basic needs of the natural world and human demands to exploit deposits of hydrocarbons that lie beneath the sea. As a result of these conflicts, I have conducted research on the potential impacts of oil and gas development and production on blue, fin, gray and humpback whales. I have served on numerous scientific review boards related to the potential impact of oil and gas development and production on marine life. Over the past 10 years I have also conducted research on the potential impacts of other human underwater sound sources on marine mammals. All these sound sources are intense and low in frequency or pitch. All are specifically designed to probe the ocean or seafloor. In an interesting perspective, humans in the latter part of the 20th century began to learn to use sounds to investigate the ocean - to communicate, to navigate, to avoid enemies, to find food, to find resources -- in much the same way as marine animals have adapted their voices, ears and brains over the past 30 million years to communicate, navigate, avoid enemies, and find food. Fundamentally, this is the conflict. Humans are using increasing numbers of intense acoustic probes in the ocean without much, if any, regard for the environmental consequences. In the case of shallow coastal waters and shelf edges which support the vast majority of marine productivity, the potential harm is enormous. In highly productive environments such as the coastal plains around Nova Scotia and Cape Breton, the consequences can not yet be determined with any

reasonable certainty yet the potential harm is immeasurable, and irreversible.

In this statement I want to address two important topics. These topics are at two different levels of concern. One is immediate to the Scotian Shelf and Cape Breton areas and relates to the issue of harvesting hydrocarbons within these highly productive and ecologically complex shallow coastal habitats. The second topic is more general and relates to issues of ocean resource exploitation and habitat degradation. I would precede this by saying that the decisions made in this particular case will have profound and far reaching impacts, not only on the lives of the people living in these coastal communities today, but on these communities in generations to come. However, by far the greatest impact will be on the communities of animal populations living in the waters surrounding those landfast communities. As the ocean goes, so goes the land. Destroy the sea, and the land goes with it.

What are my greatest concerns regarding the impact of oil and gas development and production on marine life? First, oil and gas is not a renewable resource. You extract it, you convert it to energy, carbon dioxide, water and byproducts, and you move on to exploit another source. Second, the process of exploration is by its very nature dirty work. It requires exploring for hydrocarbons. To discover where they are, very short bursts of very high energy noise are exploded within the ocean and injected into the earth. Those acoustic explosions are repeated over and over again, 24 hours a day, for days on end. They are the modern form of exploratory dynamite, controlled explosions going off every 9-12 seconds. They represent the most severe acoustic insult to the marine environment I can imagine short of naval warfare. Lastly, we simply do not know enough about the impacts of exploration, development and production on such biologically rich areas as the habitats surrounding Nova Scotia and Cape Breton. We don't know enough about the short-term impacts, and we certainly do not know enough about the long-term and cumulative impacts to accurately determine the effects on fish populations, lobster populations, crabs, scallops, and other populations of critical species. You folks here have far greater knowledge and experience than I do with the cultural and economic value of the coastal regions around Nova Scotia and Cape Breton. Here there is a choice based on the costs and benefits. What is the potential cost with the loss of this highly productive habitat? What amount of loss is tolerable and what is intolerable? What are the benefits from the exploration, development and exploitation? Do these offset the costs? Do these offset the costs in the short-term? In the long-term?

I don't have answers to all these questions, but I do have some direct experience with potential short-term impacts, and I have real concerns about the uncertainties related to long-term and cumulative impacts.

Marine animals, whales, dolphins, seals, turtles, and fish, are at risk from these proposed oil and gas exploration and production activities. Yes, it is true that the evidence on the negative impacts is not black and white, but there is enough for me to conclude that the development of the Scotian shelf and other coastal areas of the region is a risky and potentially damaging undertaking. These animals' reactions are not always consistent and often depend on context - that is, a feeding or breeding animal will tolerate much

higher levels of acoustic noise exposure than resting or traveling animals. Reactions vary between species. Predictions of total avoidance have not been demonstrated except in a few cases. Predictions of no-impact have usually proven false, or if applicable, only so over the short-term. From experimental research conducted almost 20 years ago on gray whales off California, we know that migrating whales show obvious and dramatic avoidance responses when exposed to explosions from seismic airgun arrays (Malme et al. 1983, 1984). Mothers and calves move rapidly into the breaking surf close to the coastline, adults hide in acoustic shadows behind large rocks, and groups of animals split apart and appear disoriented. From more recent research off Alaska, bowhead whales almost totally avoid coming within 20 km (12 miles) of seismic airgun activity (Richardson et al. 1997). The bowhead situation is interesting because it involves a case where claims by native Alaskans that industrial activities were changing whale behavior were ignored or not given much credence, but later proven correct after several years of field research. Sometimes, it seems, local intuition is correct and the more direct passage to a reasonable solution.

Persistent or high levels of noise are characteristic of both exploration and production activities associated with oil and gas. I have been monitoring coastal habitats with and without oil and gas industrial activity and the comparative contrast is profound. In areas, such as off the west coast of Africa or around the British Isles, it is not an exaggeration to describe the environments as urbanized. In cases where there is seismic exploration activity, the noise is so loud that it drowns out whale songs and contact calls. It is so loud that it drowns out the mating choruses of fish. It is important to remember that there are no vertebrate animals that are deaf. They all hear. Such high noise levels drastically shrink the distances over which marine animals can communicate. Animals normally in contact are no longer able to hear each other. In cases where the sounds are critical for breeding or defense against predators, the results can be disastrous. For whales, which are long lived and breed once every few years, the impact would take years to accumulate and be less immediate. For most fish, the impact could be immediate and lethal.

One very important aspect of high levels of noise and any resultant acoustic impact are the spatial and time scales over which impacts can occur. When it comes to spatial scale, I'm not talking about a few square miles. I'm talking about tens of thousands of square miles, areas the size of the Norwegian Sea and certainly the size of the Scotian shelf! When it comes to time scale, I'm not talking about a few hours every now and then. I'm talking about significant portions of the year - May through October.

A common misconception regarding acoustic impacts is the that just because everything looks peaceful at the surface this is not representative of what it is like below the surface. Sound travels very effectively in water and in the earth's crust. Over the past two years as I and others have been acoustically monitoring the western North Atlantic, we easily hear the seismic activities occurring along the Scotian shelf. The airgun explosions occurring along the Scotian shelf are consistently detected off Cape Cod 100 miles away. These same explosions are also detected on instruments located over a thousand miles away on the mid-Atlantic ridge. These are not trivial

acoustic events. They are intentionally designed to be intense and repetitive. During seismic surveys and other industrial activities entire ecosystems over extensive regions will be exposed to high levels of noise for extended periods of time.

The fact that the proposed exploration will occur in shallow water could lead to even greater impact than in deeper water because the animals at the bottom (lobster, flounder, crabs, scallops, larvae and spat of many species) will be that much closer to the airguns. The benefits from decreased airgun source levels will be offset by the increased proximity of animals in the water column or on the bottom. Large portions of animal populations will be immersed in intense, persistent curtains of sound from which they can not escape.

Air breathing mammals, such as whales and seals, are large and obvious enough that we can follow and observe them reacting to such acoustic exposures. We know they avoid places where seismic activity occurs. Smaller, non air breathing species, such as fish, are not easily observed responding to such sounds. But the sounds are audible to the fish, and most fish species have air bladders making them susceptible to physiological effects. We simply don't know how all these fish or their larvae will respond to high density, high intensity seismic surveys in the rich, productive coastal waters around Nova Scotia and Cape Breton.

What does this mean in the short-term? Maybe all it means is that animals that live in the waters around Nova Scotia and Cape Breton will have a hard time making a living over the next few years while exploration is happening. Is that acceptable? What are the impacts of such a decision? I would predict that some animals will tolerate the poor conditions while others will leave and not return. Which species can tolerate the habitat loss? Whales can move out of the area and probably find other feeding areas. What about the fish? The DFO (2001) has clearly stated that the west coast of Cape Breton and Sydney Bight habitats are dynamic, that certain fish populations are fragile, and "impacts from oil and gas exploration activities will be amplified."

What does it mean in the long-term? Basically it means the loss of a large piece of critical habitat around Nova Scotia, a habitat that supports a large complex ecosystem that is linked to the larger system of the western North Atlantic. That habitat, once lost can probably never be recovered. It reminds me of what has happened to major portions of the US coastline and coastal marine habitat. Little by little it gets converted from a natural, vibrant, productive state into a synthetic, one-dimensional, stagnant state, a salt march gets converted into a parking lot, an inlet serves as the receptacle for storm water run off and the shellfish die, another herring run gets polluted. No one particular incident is the cause of the demise of the habitat. It is the slow, insidious removal of each little piece; the slow, degradation of portions of the larger environment over time that eventually leads to its loss.

The immediate benefits of healthy marine ecosystems go unnoticed by those who do not directly rely on it or live with it. Yet it is the health of those systems that supports the roots of our existence.

I am an outsider speaking to you from a distance. I have no

investment in this particular argument, but I do, as we all do, have a stake in the larger outcome. My advice is simple enough, be as careful and wise with the habitat that supports and surrounds you as you would be with those you love and hold most dear. We know that oil and gas are presently essential components of our immediate energy needs. They come at a price which many will not be aware of until it is too late. If this is the choice, then noise, development, and the industrialized urbanization of your coastal plain will be your legacy. It will be the demise of your most productive asset, the sea. You can never go back. There is only one Scotian shelf, one Sydney Bight, one Cape Breton seascape. It is unique, highly productive. Parts of it are fragile and could be seriously impacted by shallow water development. Protect these places and let them continue as vibrant, living, renewable resource for the future.

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