CHAPTER 5 ARCTIC REGION

Introduction

The Canadian Arctic, for the purposes of the National Programme of Action for the Protection of the Marine Environment from Land-based Activities (NPA), includes that portion of Canada north of 60 degrees and all of Hudson Bay and James Bay. This area encompasses 24% of Canada, and its coastline stretches 179 950 km. The Arctic coast features diverse habitats including tidal flats, saltmarshes, cliff shorelines, river deltas and the ice edge**.**

While it is vast, it is also the most sparsely populated part of the country, with only 76 communities and a total population of approximately 69 000. The majority of these communities (approximately 50) are located either directly on the coast or in the Mackenzie River watershed, a major riverine input to the Arctic Ocean. The other major riverine input to the Arctic is the Hudson Bay drainage system, extending southward more than 2000 km. Scheduled for the future in the NPA workplan are the assessment of land-based sources of marine pollution in northern

Figure 5-1 The Canadian Arctic

Quebec and the Hudson Bay and James Bay drainages.

Canada's Arctic differs from the rest of the country in many ways. Although its climate is harsh, its ecosystems are fragile. The assessment of impacts on Arctic marine habitat from land-based activities includes an element not found in other oceans — the ice platform. Much of the Canadian Arctic also has a unique administrative structure that involves co-management by Aboriginal land claimants, communities and government. A prominent feature of the co-management bodies is their application of traditional ecological knowledge to regulatory processes (see box). Compared with the rest of the world, Canada's Arctic is relatively pristine and unpolluted. However, land-based sources of marine pollution do exist within the Canadian Arctic. It is also highly susceptible, through long-range transport of contaminants, to land-based activities outside Canada.

Arctic concerns are addressed in the Arctic chapter of Canada's NPA, and in the Arctic Council's Regional Programme of Action for the Protection of the Arctic Marine Environment from Land-based Activities (RPA). The RPA was developed under the Arctic Council by the Working Group on the Protection of the Arctic Marine Environment (PAME) and adopted at the first Ministerial Meeting of the Arctic Council in September 1998. Thus, Arctic concerns are dealt with in a Canadian context in the NPA and in a circumpolar regional context in the RPA.

Land-based activities in the Arctic are associated with both communities and remote industrial sites and facilities. Communities in the Arctic are relatively small. Mining and oil and gas exploration/development are the predominant industrial land-based activities with potential marine impacts; others include hydroelectric development and a growing tourist industry. Government facilities such as weather stations and Distant Early Warning (DEW) Line sites are also points of past and ongoing land-based activity.

Traditional Ecological Knowledge

An important feature of environmental impact assessments in the North is the use of traditional knowledge. It is always costly to monitor environmental issues in the Arctic. Furthermore, it is extremely difficult to document environmental changes that result from the transitory effects of environmental noise and human disturbance. Local knowledge of habitats and wildlife behaviour is often extremely detailed and accurate, and should be used wherever possible to assess, interpret and monitor environmental impacts such as these. Similarly, conservation management plans that integrate wildlife protection with development activities require detailed knowledge of species, their life cycle, and their habitat requirements. In these instances, traditional ecological knowledge can provide much of this detail.

5.1 Identification and Assessment of Problems

5.1A Contaminants

Sewage

Disposal of liquid and solid wastes is a concern in all coastal communities because of the harsh climate and the presence of permafrost. Conventional sewage treatment systems do not work well in these communities.

Geological formations and the presence of permafrost forces some communities to dispose of solid wastes in open sites. Sewage concerns are often closely tied to problems related to solid waste dumps.

About 50 communities, with an average population of about 740, are situated on the Arctic coast. Although overall volumes of municipal waste are not large, wastewater is more concentrated than in the south (UMA Engineering, Ltd., 1993). On the other hand, northern sewage does not contain significant volumes of industrial or institutional wastes, so the total release of metals and other inorganic wastes into the marine environment is low. Some communities, such as Resolute, discharge raw or primary-treated sewage directly into the ocean. Others have sewage lagoons (e.g., Iqaluit and Tuktoyaktuk), but these frequently do not operate properly or overflow. Raw or primary treated sewage may enter the marine environment directly (during fall decant), by percolation through lagoon substrates, or by leaching into surface drainage waters. Finally, some communities dispose of sewage in plastic bags that are placed in solid waste disposal sites. These wastes take years to degrade because of the slow rate of decomposition in the Arctic environment. They also present the potential for leaching into the marine environment. The effects of sewage are very localized, and there is currently no direct evidence of cumulative effects in coastal waters.

Persistent Organic Pollutants

Over the last 30 to 40 years, the Arctic has been subjected to point source contamination from local activities, such as DEW Line sites, and to pollutants transported over long distances from the industrialized regions of the world. The long-range transport of persistent organic pollutants (POPs) to the Arctic is viewed as one of the most significant threats to environmental quality. Studies of their composition and geographic distribution indicate that they are transported to the Arctic primarily by air currents (Jensen et al., 1997). However, ocean currents and north-flowing rivers also contribute. Contamination with toxicants is already evident in some wildlife populations, and concerns about the safety of traditional foods have been raised in several areas of the Arctic. Health advisories have been issued recommending limits on the consumption of some traditional foods (Jensen et al., 1997).

Abandoned waste sites have been identified throughout the Arctic, some of which are known to contain toxic chemicals, including polychlorinated biphenyls (PCBs). While about 500 sites have already been cleaned up, much more remains to be done to address problems from the past. The contaminants at the DEW Line sites have been identified, and steps are being taken to clean up these sites. Studies at Cambridge Bay, Iqaluit and other sites in the Arctic have not identified any significant sources of contamination resulting from ocean dumping (Bright et al, 1994, 1995); however, the potential impacts of past ocean disposal practices remain a major public concern.

Radionuclides

There are no land-based activities in Canada that contribute radionuclides to the Arctic marine environment. The majority of radionuclides that have entered the Arctic originate from atmospheric fallout of nuclear weapons testing that took place between 1952 and 1978, and the accident at the Chernobyl nuclear power plant in 1986 (Nilsson, 1997). The current levels of radioactive contamination in the Arctic seas (water and sediment) and biota are relatively low, and cause no concern for human health or the environment (Nilsson, 1997). Potential radioactive threats include accidents connected with the operation of nuclear-powered vessels, and the long-range transport of radionuclides from reprocessing plants and radioactive waste

storage sites outside the Canadian Arctic. Although present radionuclide levels are low, long-range transport presents the potential for significant impacts on the Arctic marine environment from accidental releases in other parts of the world.

Heavy Metals

Anthropogenic sources of metal pollution in the Arctic marine environment include oil and gas drilling and related shore-based facilities, mines, DEW Line sites, dumps, hydroelectric developments and atmospheric inputs. Concerns related to hydroelectric development will be addressed in the future work programme of the NPA, with the inclusion of Hudson Bay and James Bay.

The major concern related to land-based oil and gas drilling is the accumulation of metals (and other contaminants) from drill wastes in soils and plants around sumps. Drilling has declined over the last few years in areas where impacts from heavy metals could reach the marine environment. While environmental management practices of ongoing drilling activities have improved, many abandoned sumps are potential sources of environmental contaminants. Studies indicate that accumulation of contaminants in soils and plants around sumps is usually confined to the area within 100 m (Hardy and BBT Ltd., 1988). In flood plains and coastal areas, erosion of sumps can also result in the release of heavy metals to the marine environment.

The operation of shorebases to support offshore oil and gas drilling also has the potential to affect the marine environment. Chronic spills and runoff from workyards appear to be the primary sources of contamination. Measurements indicated elevated levels of chromium, copper, mercury, nickel and lead (Wells and Rolston, 1991).

Two lead-zinc mines operate near the Arctic coast: Polaris Mine on Little Cornwallis Island in the High Arctic and Nanisivik Mine near Arctic Bay on the north coast of Baffin Island. Both mines discharge effluents containing heavy metals to the marine environment pursuant to Northwest Territories water licence conditions. Although these discharges cause local elevations of metal concentrations in sediments and biota, they are not a major ecological concern. Assessment of mining impacts in the Hudson Bay and James Bay drainage will be part of the NPA's future work programme.

At DEW Line sites, the most common inorganic contaminants detected were copper and zinc from plumbing and paints, and lead from fuels and discarded batteries. Contaminated soils from these sites may release heavy metals to the marine environment. DEW Line contamination issues are being addressed in ongoing clean-up activities.

In summary, metal discharges from land-based sources within the Arctic seem to have, at most, localized biological effects. Some metals may be present in sewage and solid waste, but these occur only in small quantities because there is limited industrial activity and relatively low volumes of waste are produced. Abandoned sumps and mine sites may be a source of metals, but impacts have not been documented. Hydroelectric developments are known to be a source of mercury when lands are flooded. Several hydroelectric projects have been constructed on the Hudson Bay and James Bay drainage basins, and will be addressed in the NPA's future work programme.

Metals that are transported to the Arctic by way of long-range transport (in particular, mercury, cadmium and lead) create a more significant concern because of their apparent presence throughout the Arctic marine environment (Jensen et al., 1997; Nilsson, 1997). As with

POPs, these metals originate in industrialized regions of Europe, Asia and North America. Elevated levels of mercury have been found in polar bears, and high levels of cadmium have been found in the kidneys and livers of other marine mammals. This remains a major health concern for all northerners, particularly Aboriginal groups who have a high reliance on marine and land animals for food and for social and ceremonial purposes.

Oils/Hydrocarbons

There is little or no exploratory drilling currently under way in or near the marine environment. During the last 30 years, however, numerous oil and gas exploratory wells have been drilled in the Mackenzie Delta-Beaufort Sea region. The major concern related to land-based drilling is the accumulation of contaminants in soils and plants around sumps (see Heavy Metals). The major land-based source of hydrocarbon release into the Arctic marine environment is spillage from fuel storage and transfer facilities at coastal communities, and from former oil and gas drilling, production and associated staging operations (Dobrocky Seatech Ltd., 1985). Natural sources may also contribute significant amounts, particularly from seeps along the Mackenzie River.

Nutrients

The addition of nutrients to the marine environment is not a problem in the Arctic, except where input of sewage may lead to localized over-productivity and eutrophication.

Contaminated Sediments

Relatively little is known about the distribution and kinetics of sediments in the Arctic marine environment. Dredging activity is limited, so sediment inputs result mainly from natural sediment transport. Any contaminants associated with these sediments are dealt with in preceding sections.

Litter

During the early 1980s, shoreline litter surveys conducted on the southern Beaufort Sea indicated that over 90% of the wastes sighted along the Beaufort Sea shoreline had originated from oil and gas exploration activities. The studies concluded that the wastes had minimal biological impact but did have a negative aesthetic effect. In 1990, additional surveys showed that the most commonly found items were polystyrene foam and polypropylene rope. With the decline in oil and gas activities, the largest source of debris now seems to be domestic waste, presumably from solid waste sites of coastal communities.

5.1B Physical Alteration and Destruction of Habitat

Physical habitat alterations result in changes to the biological structure and function of the estuarine, coastal and ice environments. There is the potential for impacts on the social systems of humans living in these environments. Some of the biological impacts on these environments include lowered spring primary productivity, lowered benthic invertebrate productivity, changes in ice characteristics and the timing of break-up, and changes in the distribution and survival of fish (larval, juvenile and adult stages), marine mammals, coastal waterfowl and seabirds. All of these changes can impact negatively upon people who rely on the aquatic environment for subsistence.

The assessment of impacts on Arctic marine habitat from land-based activities includes an element not found in other oceans — the ice platform. The ice platform provides habitat for the pupping of seals and the denning of polar bears, and is an important winter transportation route for local people and caribou. Open cracks (leads) in the ice are breathing habitat for marine mammals. Seabirds are totally dependent for food on open water in leads and polynyas (areas

where open water can be found year-round) within a 150-km radius of the breeding colonies. The undersurface of the ice is also an important habitat for the epontic community, which consists of ice algae and other micro-organisms, amphipods that graze on these algae, and a fish community that feeds on the amphipods. This is thought to be an important habitat for Arctic cod, a key ecological species in the Arctic eaten by many bird, fish and mammal species. Underwater noise must also be considered an important habitat element because of its potential to interfere with marine mammal vocalizations and behaviour.

Shoreline Construction/Alteration

The construction of port facilities and structures to stabilize shorelines can affect local nearshore current patterns and marine physical features. This may alter fish habitat or prevent fish from following their normal migration routes, where they are traditionally harvested. The disturbance of shoreline granular material for port construction, in certain areas where the granular material has a high ice content, is likely to result in significant shoreline erosion. Removal of the insulating overburden exposes the shoreline to modification by wave action and the longshore current transport of granular material.

Impacts from current construction activities tend to be very localized, and good management practices are in place for ice road construction and harbour development, minimizing sediment-related problems.

Inter-tidal and Sub-tidal Alteration

Ice-breaking activities are required for sea transportation in the Arctic, but pose three major problems: interference with transportation over ice, the potential harm to animals hunted for subsistence, and the disturbance of animals in traditional hunting areas.

Transportation over ice among Inuit communities and camps is essential for social interaction and subsistence hunting. The passage of an ice-breaking ship leaves a rough track that interferes with and endangers sea-ice transportation. Ice-breaking activities may also accelerate the separation of large ice pans at the ice edge during spring break-up, endangering hunters who may be positioned there. Ice breaking may also harm animals hunted by the Inuit. Seals raise their young on the ice, and narwhal may be attracted by the temporary open water created by ice breaking. When the open leads close again, narwhal may become trapped without access to air. The migration of caribou over ice may also be affected.

The underwater noise generated by ice-breaking activities may disturb animals and drive them from traditional hunting areas. Concerns have been raised in both the western and eastern Arctic about the effects of underwater noise and ice breaking on the migration patterns of whales, particularly in the vicinity of polynyas, such as those in Amundsen Gulf and eastern Lancaster Sound.[1] Polynyas are critical habitats because they provide feeding areas for many overwintering marine mammals and seabirds. Other concerns arise where the ship passage through inlets is likely to bring ships close to communities and hunting areas.

Mineral and Sediment Extraction/Alteration

Dredging in the Arctic is primarily associated with the maintenance of navigation channels and harbours in the shallow bays and estuaries of the Mackenzie Delta. Dredging is also associated with the extraction of granular deposits, such as sand and gravel for the

[1] Beluga whales react to ship noise at a distance of 40 km, and their response to being startled is rapid flight, herd formation, loss of pod integrity, asynchronous, shallow dives and "alarm" calls usually associated with fear of killer whales. They may return to the site while ship noise is still present, but "belugas in the high Arctic are extraordinarily sensitive to shipping activity in the spring" (Finley et al., 1986).

construction of artificial islands, and with the laying of undersea pipelines.

Several concerns arise in connection with dredging activities. There is the potential impact on whales if underwater noise and increased suspended sediments disturb feeding or migrating activities. Another concern is the impact on plankton and fish populations in nearshore environments, where particularly productive coastal embayments support large populations of fish. More severe impacts can be expected on benthic communities because of the direct mortality of infauna and some epifauna in areas of dredge spoil removal and deposition. In other areas, ocean disposal of dredge spoils from harbour maintenance may have an impact on seaducks and shellfish beds that have commercial potential, or are important feeding grounds for bearded seals.

Wetland and Saltmarsh Alteration

Large areas of the Mackenzie Delta consist of wetlands that are important habitat for waterbirds and fish. The inshore zone is an important nursery, feeding and overwintering site for both nearshore and offshore organisms. It is especially important to those anadromous species forming the basis of the domestic and commercial fishery in the Delta: broad whitefish, Arctic char, Arctic cisco and inconnu. Standing stocks of fish are greatest nearshore, since the anadromous species tend to frequent shallow coastal waters during the summer months rather than move offshore.

Areas of significant hydrocarbon potential exist within these habitats, ranging from the outer Beaufort Sea coast to the upper Arctic Red River, and the potential still exists for the laying of an oil and gas pipeline. Impacts on fish could result from changes in the smaller food organisms and the exclusion of fish from important habitats. There may also be changes in the habitats themselves, such as oxygen depletion and sedimentation of spawning and overwintering areas.

As industrial development proceeds, fuel and other toxic substances may be spilled. There will also be more people in the area along with an expected increase in sport, domestic and commercial fishing. In years when the north slope of the Yukon is snow-covered at the time Snow Geese arrive, up to 325 000 birds use the Mackenzie Delta as a staging area. The birds are extremely vulnerable to aircraft overflights and to the kinds of disturbance associated with construction on land and sea. Large areas of tidal flat and coastal marshland are also found in the lower Hudson Bay and James Bay. These areas are used extensively by migrating shorebirds in fall, by geese in spring, and by both waterfowl and shorebirds for nesting in summer. They are also important for the subsistence harvesting of wildlife and waterfowl. Communities in these areas have expressed concern about the impact of hydroelectric development on changes in the pattern of freshwater runoff, which in turn may cause significant changes in wetland vegetation and wildlife use.

Marine Waters and Coastal Watershed Alteration

Water storage for power production and inter-basin water diversion produces changes in the natural hydrologic cycle. Unless some effort is made to operate upstream facilities in a way that mimics natural hydrologic flows, these upstream changes can extend thousands of kilometres downstream and last a very long time. The possible physical impacts on habitat brought about by altering seasonal freshwater flow include:

- desiccation of wetlands, increased offshore salinity, and upstream saltwater intrusion because of reduced flows;
- collapse of natural deltaic levees and

subsidence of coastal deltaic areas because of reduced sediment inputs;
- overall reduction of spring nutrient inputs to estuaries; and
- changes to the characteristics of sea ice and the timing of ice break-up near estuaries.

Significant hydroelectric development and water diversion projects have taken place in the North, notably the large-scale damming and diversion of drainage systems flowing into James Bay and Hudson Bay. An assessment of hydroelectric developments will be included in future NPA work. At present, problems associated with the input of sediment are not a major concern in the Arctic.

Biological Alteration

The introduction of pathogens to the marine environment by aquaculture operations is not a significant factor in Arctic waters, and there has been little study of the introduction of exotic marine species into Arctic waters via the discharge of ballast water from vessels originating in southern ports. Recently, the disposal at sea of offal from a commercial muskox harvest raised the issue of pathogen/parasite introduction to the marine environment. This issue also may require further examination.

5.2 Establishment of Priorities for Action

Sources of contaminants and physical alteration of habitat were evaluated in terms of their potential or actual impacts on environmental quality, human health and traditional food sources. The adequacy of existing controls was also considered in the setting of priorities. A source that has severe potential impacts but is well regulated is thus given a lower priority than one that has fewer known impacts but is not adequately controlled.

5.2A Contaminants

In the Arctic, sewage/solid wastes and POPs are considered to be **high priorities**, while heavy metals and oils/hydrocarbons are **medium priorities**. At present, radionuclides, nutrients, sediment and litter are **low priorities**.

Sewage

The effects of sewage on the marine environment are very localized; however, a public health concern may exist in communities that harvest shellfish from contaminated waters or process fish and marine mammals on contaminated shorelines. Overall, the relationships among sewage disposal practices, consumption of contaminated meats, and the incidence of enteric diseases in northern residents are largely unknown. Municipal effluents are a **high priority** because of:

- the potential for impacts on traditional food sources; and
- the potential for improving existing control measures.

Persistent Organic Pollutants

In the Arctic, POPs are viewed as a **high priority** from both local and international perspectives. POPs have the potential to affect human health and traditional food sources in the Arctic. The international sources are the greatest concern because they cannot be controlled domestically, and long-range inputs could potentially increase. Moreover, there is evidence of bioaccumulation at levels that raise human health concerns. Locally, all DEW Line sites have been assessed and targeted for clean-up by the responsible departments (Department of Indian Affairs and Northern Development [DIAND] and Department of National Defence [DND]). Clean-up is ongoing or complete at four stations and will continue at the remaining sites as resources permit. There is public opposition to the amendment of PCB legislation

to permit on-site burial of PCB-contaminated paint, and further discussions will be required to resolve this issue.

Historical ocean dumping practices and the identification of land-based sources of contaminants have raised concerns about potential effects on the nearshore fisheries. Measurements of PCBs, metals, polycyclic aromatic hydrocarbons, and pesticides in biota at historical dumpsites, however, have not been found to exceed the levels requiring restrictions on consumption of fish (Bright et al., 1994, 1995).

Radionuclides

Radionuclides are a **low priority** concern as there are no substantial local sources from land-based activities in the Arctic. However, long-range inputs of radionuclides into the Arctic remain an ongoing concern.

Heavy Metals

Metal discharges from land-based sources within the Arctic seem to have only localized biological effects. Some metals may be present in sewage and solid waste, but these occur only in small quantities because of the relatively low volumes of waste produced. Impacts from abandoned sumps and mine sites have not been documented. Local sources of heavy metals are therefore a **medium priority**.

Metals that are transported to the Arctic by way of long-range transport create a more significant concern because of their apparent presence throughout the Arctic marine environment. Long-range transport of heavy metals is viewed as a **high priority**, because industrial sources outside the Arctic could affect human health and traditional food sources.

Health advisories have been issued recommending limited consumption of some traditional foods. Furthermore, some knowledge gaps remain. Most studies have investigated bioaccumulation of metals in marine mammals and fish; however, little is known about lower trophic levels. More information on potential chronic physiological effects (as opposed to acute effects) is needed in order to determine acceptable limits of contamination. In this respect, it will be necessary to conduct individual studies on various metals (especially mercury, cadmium and lead). Knowledge gaps have been identified and included in the work programmes of the Arctic Monitoring and Assessment Programme (AMAP) and the Northern Contaminants Programme (NCP).

Oils/Hydrocarbons

Hydrocarbons and oil handling facilities are considered to be a **medium priority** in the Arctic. Except for the immediate area around a spill, hydrocarbons in the Arctic marine environment are generally found in such low concentrations that they do not pose a threat to marine life. However, where hydrocarbon levels are elevated, some species have shown hydrocarbon uptake, which may lead to health effects. Long-term concerns centre on the threat of large oil spills posed by oil drilling and production activities, and how such spills could affect marine wildlife.

Nutrients

The input of nutrients into the marine environment is a **low priority** concern in the Arctic. Any concerns associated with nutrients can be addressed through improvements in the way sewage is treated.

Contaminated Sediments

The input of contaminated sediments into the marine environment is a **low priority** concern in the Arctic because sediment inputs result mainly from natural and uncontaminated sediment transport.

Litter

Litter is primarily a solid waste-related issue in the Arctic. Although it is not likely to have significant effects on human health or traditional food sources, litter does have an adverse effect on the growing tourism industry in the Arctic, and is therefore included as a **low priority**.

5.2B Physical Alteration and Destruction of Habitat

Certain marine habitats are more important than others for particular animal and plant species. Cliff shorelines that host seabird breeding colonies are critical habitats, as are the polynyas in which seabirds feed early in the breeding season. Tidal flats and estuarine areas are critical feeding habitats for shorebirds and some waterfowl. Saltmarshes form critical breeding areas for Brant geese. Ice edges, polynyas and areas that are free of ice early in the season are of paramount importance to a variety of marine wildlife.

Canada's Arctic marine environment is home to six species of endangered, threatened or vulnerable wildlife species (World Wildlife Fund, 1996). Human activities and degradation of habitat are present or potential threats to these species. To minimize future declines in endangered species populations, their habitats must be identified and then protected from abuse.

Shoreline Construction/Alteration

The impact of harbour works on fisheries also affects food security, but is considered a **medium priority** because it is highly localized. The erosion of coastlines caused by removing granular overburden from gravel shores is an issue mainly associated with possible future port developments on the Yukon north slope, related to hydrocarbon extraction in the Beaufort Sea.

Inter-tidal and Sub-tidal Alteration

Environmental noise and ice-breaking impacts on marine mammals and hunting activities, as well as wildlife disturbance, are considered to be a **high priority** concern because these impacts are ongoing, and they are perceived to threaten food security and public safety.

Mineral and Sediment Extraction/Alteration

Mineral and sediment extraction and alteration are relatively **low priority** concerns in the Arctic marine environment. Gravel removal is currently dormant, and the smothering of benthic communities by dredging activity is localized with short-term impact.

Wetland and Saltmarsh Alteration

Wetland and saltmarsh alteration is a **medium priority** concern in the Arctic marine environment. The two main industrial developments affecting wetlands are hydrocarbon exploration and extraction (mostly in the Mackenzie Delta) and hydroelectric development (mostly in Hudson Bay and James Bay). These industries can have significant effects on coastal wetlands, and although both are currently dormant, there is strong potential for further development.

Marine Waters and Coastal Watershed Alteration

No substantial sediment-related problems have been identified, and good management practices are in place to prevent future problems. Impacts associated with hydrocarbon and hydroelectric industries, such as the alteration of river delta habitat resulting in changes to drainage patterns, are **medium priority** because these industries are not in an expansion phase at the present time. (A more detailed assessment of hydroelectric development will be included in future NPA work.)

Biological Alteration

Biological alteration is a relatively **low priority** concern in the Arctic marine environment. The introduction of pathogens into the sea via slaughter wastes is an issue that needs more study. However, the disposal at sea of such wastes is infrequent and very localized.

5.3 Setting Goals and Management Objectives

Under the NPA, Canada's goals are to:

- protect human health;
- reduce the degradation of the marine environment;
- remediate damaged areas;
- promote the conservation and sustainable use of marine resources; and
- maintain the productive capacity and biodiversity of the marine environment.

The following are specific management objectives for each source category.

5.3A Contaminants

The general management objective for most of the contaminants is to reduce their presence in the marine environment, primarily through pollution prevention. Where contaminants are released to or occur in the marine environment, the management objective is to apply life-cycle management or remediation to address the problems.

Specific management objectives for each of the contaminants of concern at the national level are as follows.

Sewage — reduce contamination from sewage; maintain and improve estuaries, coastal water and marine ecosystem quality for all users; maintain and restore shellfish growing areas.

Persistent Organic Pollutants — reduce/ virtually eliminate anthropogenic inputs; apply life-cycle management to remaining inputs.

Radionuclides — reduce inputs where they are likely to cause pollution; apply radiological protection.

Heavy Metals — reduce inputs where they are likely to cause pollution; apply life-cycle management.

Oils/Hydrocarbons — prevent spills and establish contingency plans; apply life-cycle management.

Nutrients — reduce inputs where they are likely to cause pollution.

Contaminated Sediments — reduce sediment contamination at source.

Litter — reduce the incidence of litter/debris found in the marine environment.

5.3B Physical Alteration and Destruction of Habitat

The primary management objectives are to mitigate or avoid harmful alteration and destruction of habitats, and to restore those habitats already degraded. For some categories of harmful alteration (e.g., mineral and sediment extraction or alteration; alteration of marine waters and coastal watersheds), it is also necessary to identify critical habitats to ensure such activities take place in areas of lesser environmental sensitivity or significance. Finally, there are some specific management objectives that apply to unique problems. For instance, the objective is to eliminate the accidental or deliberate introduction of exotic species to the marine environment from land-based activities.

Specific management objectives for each of the habitat categories of concern at the national level are as follows.

Shoreline Construction/Alteration — minimize habitat loss and balance these losses by restoring or creating equivalent replacement habitat.

Inter-tidal and Sub-tidal Alteration — identify critical habitats and prevent loss or degradation of these areas while restoring those already degraded.

Mineral and Sediment Extraction/Alteration — identify and protect sensitive habitats and marine resources.

Wetland and Saltmarsh Alteration — prevent any further loss or destruction of critical habitats and, where feasible, restore valuable areas previously drained or altered.

Marine Waters and Coastal Watershed Alteration — protect key habitats for all life stages of marine resources.

Biological Alteration — prevent all inadvertent or inappropriate introductions of alien species and pathogens and protect sensitive coastal ecosystems.

5.4 Strategies and Actions

In addition to the national strategies and actions identified in Chapter 3 (National Issues), the NPA management objectives will be addressed in the Arctic with the following regional strategies and actions.

5.4A Contaminants

Sewage

In partnership with Health Canada, the Government of the Northwest Territories' Municipal and Community Affairs (MACA), and the Government of Nunavut's Department of Community Government, Housing and Transportation:

- use a community-based approach to identify and assess sewage-related problems and treatment requirements;
- improve the operation of sewage facilities by increasing training;
- consult and provide expertise to communities to assist in focusing on priorities and monitor progress in sewage treatment;
- report on assessments of required improvements;
- promote investment in the implementation of these improvements;
- provide training and public education; and
- work toward complete community licensing and compliance.

Persistent Organic Pollutants

- Promote continued monitoring of POP levels in the Arctic environment.
- Monitor the progress of current clean-up activities.
- Keep local source issues under continuing review.
- Assess the need for further investigations based on anecdotal information on a case-by-case basis.
- Participate in international initiatives to control POPs (e.g., Arctic Council).
- Monitor progress in other initiatives for the control of foreign sources of POPs.

Radionuclides

- Promote and report on the circumpolar initiative of the Arctic Council.

Heavy Metals

- Promote monitoring at abandoned sumps and assist in assessing the need for

remediation at abandoned sumps by identifying and consulting key stakeholders.
- Identify, review and report on ongoing studies.
- Monitor regulated mine effluents.
- Assess extent and effects of long-range transport.
- Determine acceptable limits of contamination.

Oils/Hydrocarbons

- Encourage all northern fuel handling facilities to comply with the *Canada Shipping Act* and proposed amendments to the Act.
- Promote regular review and revision of spill response plans by operators.
- Promote regular training of all personnel for spill response plans.
- Promote development of guidelines for rigorous inventory management to increase early detection of fuel losses from fuel handling facilities.
- Promote the need for community-based waste oil recovery, management and disposal.
- Assist in developing appropriate regulations for prevention of hydrocarbon spills.
- Contribute to the level of preparedness in the Arctic by promoting the work of EPPR (Arctic Council Working Group on Emergency Prevention, Preparedness and Response) and AREET (Arctic Regional Environmental Emergencies Team).
- Promote increased spill reporting.
- Assist in developmenting emergency plans for oil spills.
- Assist in setting minimum standards for oil spill clean-up and test procedures.
- Encourage the development of on-ice clean-up technology.

Nutrients, Contaminated Sediments and Litter

- Existing strategies and actions are adequate to achieve management objectives.

5.4B Physical Alteration and Destruction of Habitat

Shoreline Construction/Alteration

- Establish and improve review, assessment and approval mechanisms.
- Integrate renewable resource management with regional land-use planning.
- Develop policy and regulations for coastal construction.
- Support integrated planning for coastal zone management through the provisions of the *Canada Oceans Act*.
- Establish protection of habitats for key species harvested for subsistence or commercial use.
- Support the following activities:
  - inventories of critical habitats and species;
  - mapping of development plans and resource-use areas; and
  - protection of important natural resources from negative impacts of development.

Inter-tidal and Sub-tidal Alteration

- Protect wildlife used for subsistence or commerce from disturbance, particularly during sensitive periods of the life cycle.
- Control timing and location of ice-breaking/seismic surveys.
- Encourage co-operation between the transportation industries and coastal communities to investigate the impacts of ice breaking and to devise means for mitigation.
- Improve the safety and efficiency of ice travel by Inuit.
- Facilitate the plan for a federal/territorial framework for marine protected areas.

Mineral and Sediment Extraction/Alteration

- Encourage the integration of development scenarios into development plans to minimize environmental impacts.
- Improve site selection for nearshore dumping of dredged materials.
- Rank known sources of granular material with respect to removal impact on coastal integrity.
- Develop restoration conditions for licensing of development.

Wetland and Saltmarsh Alteration

- Support the formation of integrated land-use plans that consider all impacts of developments on a watershed.
- Encourage the integration of land-use planning among jurisdictions.
- Assist in development of new guidelines for reservoir design and management.
- Use existing mechanisms to assess cumulative impacts prior to development.
- Identify drainage patterns for marshlands.
- Establish a system for evaluating cumulative impacts of overall development plans.
- Work toward monitoring and assessment of coastal wetland habitat through existing action plans such as the North American Waterfowl Management Plan (NAWMP).

Marine Waters and Coastal Watershed Alteration

- Promote integrated coastal planning.
- Develop effective inter-governmental environmental impact assessment (EIA) procedures.
- Develop guidelines for reservoir management.

Biological Alteration

- Obtain further information on introduction of pathogens from the disposal of muskox offal on ice.
- Support research to examine pathways of pathogenic or exotic species introduction.

5.4C Linkages

International

Ministers of the Arctic countries recently agreed to continue joint efforts to develop, implement and improve the Arctic Environmental Protection Strategy (AEPS) programmes under the auspices of the Arctic Council. These programmes include Conservation of Arctic Flora and Fauna (CAFF), Protection of the Arctic Marine Environment (PAME), Arctic Monitoring and Assessment Programme (AMAP), Emergency Prevention, Preparedness and Response (EPPR), and Sustainable Development (SD), all of which contribute to meeting commitments under the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) in the Canadian Arctic.

The Regional Programme of Action for the Protection of the Arctic Marine Environment from Land-based Activities (RPA) was adopted at the first Ministerial Meeting of the Arctic Council in Iqaluit, September 17-18, 1998. The RPA supports national and sub-regional efforts in the Arctic through capacity building and harmonized measures where appropriate.

The North American Waterfowl Management Plan is an agreement between Canada, the United States and Mexico to restore waterfowl populations to levels present in the 1970s. In the Arctic it includes joint ventures of research and monitoring on Snow and Arctic Geese and their habitats. This activity supports the promotion of biological diversity, which is a key component of sustainable development.

National

- *Northern Ecosystems Initiative (NEI)* — The NEI is the newest of the family of ecosystem initiatives across Canada. Covering over 40% of Canada, this initiative reaches from the Yukon in the west to Labrador in the east, and includes the three territories and northern Quebec and Ontario. The five-year initiative, which started in 1998, uses a partnership approach to bring together various levels of government, Aboriginal organizations, industry, environmental groups and others to address ecosystem issues facing the North. The four ecosystem priorities include: (1) biodiversity, (2) contaminants and toxics, (3) the impacts of major developments, and (4) atmospheric change.
- *Northern Contaminants Programme 2 (NCP2)* — The Northern Contaminants Programme was established in 1991 as part of the six-year Arctic Environmental Strategy. Funding for the NCP has been extended until 2003. The NCP is managed by a partnership of northern Aboriginal peoples and federal and territorial departments. It focuses on human health; education, communication, and community-based strategies; monitoring the health of Arctic people and ecosystems; and development of international controls.
- *Northern Sustainable Development Strategies* — Following amendments to the *Auditor General Act* in 1997, all federal departments were required to prepare a sustainable development strategy (SDS) to integrate sustainable development principles into departmental decision making. Northern consultations to obtain input for departmental SDSs were led by DIAND with co-operation from other key departments. One of the recommendations of northern stakeholders was the development of a consolidated northern SDS.

Other initiatives, strategies, policies and acts that contribute to meeting GPA commitments are identified and described elsewhere. Of central importance are the co-management bodies established pursuant to the Western Arctic Inuvialuit Final Agreement and the Nunavut Land Claims Agreement. These are:

Western Arctic Inuvialuit Final Agreement

- Wildlife Management Advisory Council
- Fisheries Joint Management Committee
- Environmental Impact Screening Committee
- Environmental Impact Review Board

Nunavut Land Claims Agreement

- Nunavut Wildlife Management Board
- Nunavut Planning Commission
- Nunavut Impact Review Board
- Nunavut Water Board
- Nunavut Marine Council

The NPA can contribute to environmental management in the Arctic by supporting co-management institutions with scientific and technical expertise, and by building human capacity in the North for improved environmental decision making.

5.5 Next Steps

An assessment of northern Quebec and the Hudson Bay and James Bay drainages is part of the NPA's future work. This examination will complete the process of identifying and assessing land-based activities that affect the Arctic marine environment.

In the Arctic, as elsewhere, the impact of land-based activities on the marine environment raises inter-jurisdictional issues. Most land in the Northwest Territories, Nunavut and Yukon

is owned by the federal government, except for lands transferred to the Government of the Northwest Territories (GNWT), to the Government of Nunavut, to the Government of Yukon (GY), or to Aboriginal peoples under specific land claims agreements. Within the federal government, DIAND has jurisdiction over most matters, except where that matter is assigned by law to another federal department or agency. Some legislative authority is delegated to the territorial governments under various administrative agreements, acts and other legislation. The land claims agreements in the North establish various classes of land ownership. Most importantly for the NPA, these agreements establish resource co-management boards with the rights to participate in land and water management. At the international level, Canada is a member of the Arctic Council. These considerations largely determine the strategic direction of the next steps that Canada should take toward implementation of the NPA objectives.

Federal Inter-agency Integration

The federal government plays a central role in land and oceans management in the North. Therefore, in all future steps designed to further the objectives of the NPA, there should be a better mechanism for integration of federal programmes relating to oceans management and to the integration of land-based activities with oceans management. This mechanism should primarily involve the agencies most closely associated with resource use and marine transportation: the departments of Indian Affairs and Northern Development, Fisheries and Oceans, Environment, Natural Resources, Canadian Heritage, and Transport, and the Canadian Environmental Assessment Agency. Some progress in interdepartmental integration has already been made in response to the *Canada Oceans Act*, and further efforts are required.

Co-management

In the future, most coastal areas in the North will be subject to land claims that have provisions for resource co-management. Land and ocean management directed toward the objectives of the NPA in the North must be pursued within the context of co-management. Therefore, the land claims boards, agencies and commissions need to be drawn more closely into the NPA process as co-management partners. Given the limited capacity of many of these boards to address the priorities of the NPA, the federal government should raise the awareness of the NPA in the North and help build capacity within the land claims organizations to address the issues defined by the NPA.

Aquatic Ecosystem Health and Monitoring

The impact of land-based activities on the Arctic marine environment comes from three major sources: local, shore-based development activities; airborne pollutants; and riverine inputs and influences. In the Canadian Arctic the main riverine influence on the marine environment at present is through the Mackenzie River watershed. The departments of Indian Affairs and Northern Development, Environment, and Fisheries and Oceans, and the Canadian Environmental Assessment Agency all provide regulatory control for most water-borne pollution. Consequently, the objectives of the NPA could be significantly advanced by encouraging a special degree of co-ordination among these agencies. The Department of Fisheries and Oceans (DFO) has the primary role for aquatic ecosystem health and monitoring, and should take the federal lead in fostering aquatic ecosystem health in the Arctic.

Ecosystem Conservation and Protection

A major component of the NPA strategy is to protect and conserve important marine ecosystems subject to negative impacts from land-based activities. A variety of tools are

available to protect marine ecosystems and the land-based ecosystems upon which they depend. The GNWT has announced a Protected Areas Strategy that primarily focuses on terrestrial ecosystems. At the same time, three federal departments have legislation to protect marine, coastal and marshland ecosystems — Environment Canada with its marine wildlife areas and migratory bird sanctuaries; Canadian Heritage with its national marine conservation areas; and DFO with its marine protected areas. The *Canada Oceans Act* gives DFO the lead in developing a national strategy for marine protected areas, and DFO can use this mandate to advance the objectives of the NPA by working co-operatively with the GNWT, the Government of Nunavut and the Government of Yukon as well as within the co-management framework established by the land claims agreements in the Arctic.

Integrated Coastal Zone Planning

Coastal activities that affect the marine environment in the Arctic fall under a wide range of jurisdictions: municipal, territorial, provincial, land claims and federal. These activities and their management also require the application of many disciplines, including those based in science, sociology, economy and traditional knowledge. At the same time, they are driven by a wide variety of coastal marine users such as subsistence hunters, coastal communities and multinational resource companies. These jurisdictions, disciplines and users have their own unique viewpoints, which must be integrated at a higher level for the type of planning that will protect marine ecosystems from land-based activities.

Circumpolar Arctic

The Arctic Ocean is the only ocean for which the riparian states have established (in 1996) a council with a mandate for sustainable development. The Arctic Council is a high-level inter-governmental forum that deals with the common concerns and challenges faced by the Arctic governments and people. In 1997, the AEPS programmes were integrated into the Arctic Council. These programmes include:

- *Protection of the Arctic Marine Environment (PAME)* — PAME addresses policy and non-emergency response measures related to protection of the marine environment from land- and sea-based activities. Its activities include implementing the RPA; promoting the application of guidelines for offshore petroleum activities; gathering information on current and future shipping activities and associated environmental effects; and maintaining an overview of the adequacy of existing international agreements.

- *Conservation of Arctic Flora and Fauna (CAFF)* — CAFF was established to address the special needs of Arctic species and their habitats in the rapidly developing Arctic Region. CAFF's main goals are to conserve Arctic flora and fauna, their diversity and their habitats; to protect the Arctic ecosystem from threats; to seek to develop improved conservation management, laws, regulations and practices for the Arctic; to collaborate for more effective research, sustainable utilization and conservation; and to integrate Arctic interests into global conservation fora. The majority of CAFF's activities are directed at species and habitat conservation, and at integrating the involvement of indigenous peoples and their knowledge into CAFF.

- *Emergency Preparedness, Prevention and Response (EPPR)* — The main goal of EPPR is to provide a framework for Arctic country co-operation in responding to environmental emergencies. The EPPR Working Group was established to evaluate the adequacy of existing arrangements and

to recommend the necessary system of co-operation.

- *Arctic Monitoring and Assessment Programme (AMAP)* — The primary objectives of AMAP are to measure the levels of anthropogenic pollutants in all compartments of the Arctic environment, and to assess ecosystem and health effects; to document trends in pollution; to examine the impact of pollution on Arctic flora and fauna, especially those used by indigenous people; to report on the state of the Arctic environment; and to give advice on priority actions needed to improve the Arctic condition.

The objectives of the NPA can be furthered by strengthening the linkages among Canada's conservation and protection programmes and those of the other Arctic countries.

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