

**IMPLEMENTING THE  
GLOBAL PROGRAMME OF ACTION  
IN THE GULF OF MAINE**

**STRATEGIC ACTIONS FOR THE TWENTY  
FIRST CENTURY**

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*A report of the Commission for Environmental Cooperation's project on  
Cooperation on the Protection of Marine and Coastal Area Ecosystems*

**PREPARED BY**

**THE GULF OF MAINE PILOT PROJECT**



Global Programme of Action  
Coalition for the Gulf of Maine

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# Table of Contents

CHAPTER 1	FROM SEA UNTO SEA	
	The Global Programme of Action.....	2
	Guiding Principles.....	2
	Commission for Environmental Cooperation.....	3
CHAPTER 2	THE GULF OF MAINE	
	State of the Environment.....	5
CHAPTER 3	THE GLOBAL PROGRAMME OF ACTION COALITION FOR THE GULF OF MAINE (GPAC)	
	Structure and Function.....	6
	Guiding Principles.....	7
	Progress to Date.....	7
	Challenges Faced.....	8
CHAPTER 4	GPA PRIORITY ISSUES IN THE GULF OF MAINE	
	Task Group on Sewage and Eutrophication.....	10
	Task Group on Toxics.....	12
	Task Group on Coastal Development.....	14
	Task Group on Physical Alterations to Water Flow and Salt Marshes.....	16
	Task Group on Resource Use.....	17
CHAPTER 4	GPAC PRIORITY ACTIONS	
	Information Gaps.....	18
	Sustaining Economies and Environments.....	18
	Priority Actions on Sewage and Eutrophication.....	19
	Priority Actions on Toxics.....	20
	Priority Actions on Coastal Development.....	21
	Priority Actions on Physical Alterations to Water Flow and Salt Marshes.....	22
	Priority Actions on Resource Use.....	23
APPENDIX A	DOCUMENTS	
APPENDIX B	GPAC RESERVE ISSUES	

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## From Sea unto Sea

*The oceans are the dominant feature of our planet, covering the greater share of its surface, and playing a key role in the hydrological cycle, the chemistry of the atmosphere and the shaping of climate and weather. Long a source of food, a network of shipping lanes and a playground, the seas have more recently become suppliers of energy, minerals and medicines.* Michael Beazley, *Caring for the Earth*

**T**he words 'From Sea unto Sea' from the Coat of Arms of Canada, could just as appropriately have appeared on the coats of arms of either the United States or Mexico. From sea unto sea, our three relatively young countries stretch across the great mass of North America. These are the seas that feed us, the seas that refresh our spirits, and the seas that connect us to the peoples and the commerce of the world. Unfortunately, the health of our seas, like those of other global marine and coastal ecosystems, continues to decline.



### The United Nations Environment Programme, 1995

“Most of the pollution load of the oceans, including municipal, industrial and agricultural wastes and run-off, as well as atmospheric deposition, emanates from such land-based activities and affects the most productive areas of the marine environment, including estuaries and near-shore coastal waters.”

Degradation of the marine environment too often is the result of human activities that use resources beyond replenishment, that dispose of wastes in areas unable to assimilate pollutants, and that physically alter or destroy habitats. Worldwide, the loss or destruction of these critical resources is a direct cause of the deterioration of the economic and social well being of coastal communities. These activities may also imperil human health through the contamination of seafood, and the pollution of swimming beaches and recreational waters. It is estimated that 80% of human activities that threaten the health and productivity of the oceans takes place on the land, not on the water.

## THE GLOBAL PROGRAMME OF ACTION

In 1995, 109 nations of the world adopted the United Nations Global Programme of Action for the Protection of the Marine Environment from Land Based Activities (GPA) (United Nations Environment Programme, 1995). The United Nations Environment Programme (UNEP) coordinates the GPA, which is the culmination of 13 years of efforts by the international community, in close cooperation with intergovernmental and non-governmental organizations (NGOs).

The GPA is intended to assist nations in the implementation of the recommendations of Agenda 21 and the 1992 Rio de Janeiro Earth Summit, as well as other established global conventions and regional instruments.

### GPA Related Marine Conventions and Instruments

- 1985 Montreal Guidelines for the Protection of the Marine Environment against Pollution from Land Based Sources;
- Convention on the Law of the Sea (UNCLOS);
- Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter;
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal;
- Convention on Biodiversity; and
- Convention on Prevention of Pollution from Ships (MARPOL)

## GUIDING PRINCIPLES

Under the GPA, regional and subregional cooperation is crucial, particularly when the marine area is a shared jurisdiction, such as enclosed or semi-enclosed seas. The GPA recommends identifying, sharing, and making readily available existing knowledge and experience and declares that:

“...Cooperation allows for more accurate identification and assessment of the problems in particular geographic areas and more appropriate establishment of priorities for action in these areas. Such cooperation also strengthens regional and national capacity building and offers an important avenue for harmonizing and adjusting measures to fit the particular environmental and socio-economic circumstances. It, moreover, supports a more efficient and cost-effective implementation of the programmes of action.” (United Nations Environment Programme. 1995. Chapter III).

The Global Programme of Action acts as a guideline for national and regional cooperation in the identification of problems, in priority setting, and in the development of preventive and precautionary measures to reduce and control the degradation of the marine environment.

The GPA proposed programme of action can be used by all countries; whether highly industrialized or with developing economies; and is applicable at the regional, national and local levels. There are six recommended steps.

1. Identification and assessment of problems.
2. Establishment of priorities.
3. Setting management objectives for priority problems.
4. Identification, evaluation and selection of strategies and measures, including management approaches.
5. Adoption of criteria for evaluating the effectiveness of strategies and programs.
6. Development of programme support elements such as integration with existing sustainable development objectives and programs, enforcement and financial mechanisms, education and training, research, contingency planning, and public participation.



COMMISSION DE COOPÉRATION ENVIRONNEMENTALE  
 COMISIÓN PARA LA COOPERACIÓN AMBIENTAL  
 COMMISSION FOR ENVIRONMENTAL COOPERATION

The Commission for Environmental Cooperation (CEC) is an international organization whose members comprise Canada, Mexico and the United States. The CEC was created under the North American Agreement on Environmental Cooperation (NAAEC) to address regional environmental concerns and to promote the effective enforcement of environmental law, as a complement to the environmental provisions established in the North American Free Trade Agreement (NAFTA). The CEC facilitates cooperation and public participation to foster conservation, protection and enhancement of the North American environment for the benefit of present and future generations, in the context of increasing economic, trade and social links among Canada, Mexico and the United States.

Through its Cooperation on the Protection of Marine and Coastal Area Ecosystems Project, the CEC is providing support to bi-national partnerships formed primarily to assist in the implementation of the GPA in their coastal regions. These sectoral partnerships are intended to form the basis for ongoing regional co-operation and joint actions in marine and coastal areas. Two CEC supported initiatives focussed on the implementation of the Global Programme of Action in North America are currently underway, in the Bight of the Californias between Mexico and the United States, and in the Gulf of Maine, between Canada and the United States.

# The Gulf of Maine

*The face of the sea is always changing. Crossed by colours, lights and moving shadows, sparkling in the sun, mysterious in the twilight, its aspects and its moods vary hour by hour. The surface waters move with the tides, stir to the breath of the winds, and rise and fall to the endless hurrying forms of the waves.*

*Rachel Carson, marine biologist (1951).*

**T**he Gulf of Maine is located off the northeast coast of North America and extends from Cape Sable, Nova Scotia (Canada) to the north shore of Cape Cod, Massachusetts (United States), and offshore some 200 miles to the rich underwater plateaus of the George's and Browns Banks. The Gulf encompasses six major bays, but is perhaps best known for the huge expanse of the Bay of Fundy.

The rivers that empty to these bays drain a combined watershed area of over 69,000 square miles (170 000 square kilometers), formed by lands shared by three American states, Massachusetts, New Hampshire, and Maine, and three Canadian Provinces, Quebec, New Brunswick and Nova Scotia. The Gulf supports a diverse and dynamic range of marine and coastal habitats and species resulting from unique physical characteristics related to current and tidal action that includes some of the highest tidal ranges in the world. Nearly one third the population of the United States (over 75 million people) and Canada (over 9 million people) live within a one day drive of the Gulf.

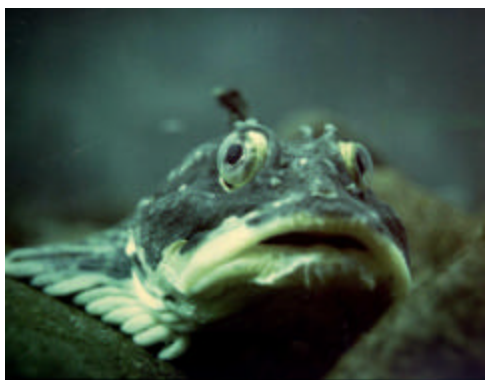
The Gulf is home to twenty-nine species of plant and animal life that are considered endangered or threatened, including the northern right whale, for which there are estimated to be less than 300 animals remaining in the world. With over 4500 islands, the Gulf is a haven for migratory birds, colonial species and waterfowl.



Gulf of Maine Council

STATE OF THE ENVIRONMENT

The Gulf of Maine could be considered a relatively clean and productive environment when compared with other, more impacted areas of the global seas. However, every year environmental pressures on this complex ecosystem increase. The Gulf coastlines are increasingly popular development areas, as is evidenced by population growth and the urbanization of coastal communities. Coastal employment is growing at five times the population rate. There are over 2000 point sources for discharges in the Gulf area, which on the American side alone includes over 1000 industrial facilities. Power plants, waste treatment facilities, and the raw or partially treated wastes of countless municipalities all discharge eventually to Gulf waters.



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Although not as commonly understood, non-point sources of pollutants, such as general surface runoff, contribute large volumes of detrimental material to aquatic and marine ecosystems. The rivers that drain into the Gulf, especially the Saint John River with its massive watershed, carry large volumes of sediments and contaminants to the Gulf each year. Bacteria from animal wastes and septic systems; sediment from construction, transportation,

agriculture and forestry sector operations; mining wastes; residual pesticides and fertilizers; hydrocarbons from automobile and boating operations; and large volumes of air borne contaminants, all find their way to surface water systems and to the Gulf.

Physical loss or degradation of important coastal and marine habitats began in this Region with early European settlements. Dykes were used to drain vast areas of coastal marshes, much of which continues as either viable or derelict agricultural lands today. Harbour development and infill projects, coastal recreation and residential development, transportation and utility corridors, and the harvesting of coastal forests and coastal marine plant communities are all contributory to significant changes in the Gulf ecosystems, and to the continuing decline of important habitats, commercial stocks and sensitive species.



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Through the concerted effort of many scientists and volunteers, the knowledge base on the interactive physical, chemical and biological processes that create the unique environment of the Gulf of Maine is growing dramatically. As our knowledge base increases, so does the conviction that the marine and coastal environments of the Gulf of Maine are being adversely affected by human activities, resulting in imminent and permanent loss of important habitats and species. Damage to the Gulf ecosystem directly and indirectly affects the continued viability of coastal communities through related impacts to fisheries, recreation and tourism.

# The Global Programme of Action Coalition for the Gulf of Maine (GPAC)

*The changes we must make in the ways in which we live and develop will be fundamental and far-reaching; they will demand our full dedication. The task will be easier if we work together: no single group can succeed by acting alone. Michael Beazley, Caring for the Earth.*

*We ourselves feel that what we are doing is just a drop in an ocean. But the ocean would be less because of that missing drop. - Mother Teresa*

**B**eginning in 1996, in Durham, New Hampshire, the CEC has assisted a group of individuals from an array of coastal sectors (including environmental advocacy and community action groups, research and educational institutes and organizations, business and industry, three levels of government, and aboriginal peoples) in the formation of a bi-national cross-sectoral partnership, the Global Programme of Action Coalition for the Gulf of Maine (GPAC).

The goal of the GPAC is to establish a collaborative bi-national; cross-sectoral organization dedicated entirely to the implementation of the GPA in the Gulf of Maine Region. Primarily volunteer based, the GPAC has worked to develop a consensus on priority land-based activities that are contributing to the deterioration of marine habitats in this critical ecosystem, and to take action, or encourage others to take action, to curb their impacts.



## STRUCTURE AND FUNCTION

The GPAC determined that successful implementation of the GPA could only be achieved through the participation of all affected members of the community. It was clear that those 'without (effluent) pipes' could not successfully prescribe and implement significant change without the cooperation and voluntary participation of those 'with pipes.' Participation was needed from all resource users, not just large industry. One of the clearest needs in implementation of the GPA was recognition of group and individual responsibilities for damaging land-based activities. To this end, the GPAC has recognized the shared responsibility of proponents, managers and users from municipalities and other agencies of

government, First Nations and Founding Tribes, resource industries (agriculture, forestry and fishing), land developers, transportation and communication, and the recreation and tourism sector.



Throughout its course, the GPAC struggled to gain participation from sectors such as business and industry, research, municipalities and First Nations and Founding Tribes. GPAC is one of the first cross-sectoral, bi-national organizations that has included the representation of aboriginal peoples from both the United States and Canada. Throughout its short history, the GPAC has continued to evolve and to refine its membership, and to draw on additional participation from the wider community.

The GPAC was established with approximately forty members, a group size that has remained relatively stable. Task Groups, chaired by a GPAC member, but open to others, were created to assist with specific activities and issues. Bi-national workshops were convened to poll the knowledge and opinions of a larger, more diverse group of individuals and sectors. To date, over 350 persons have been directly involved in some aspect of GPAC activity.

#### GUIDING PRINCIPLES

Development and operation of the GPAC and its activities was based on the following strategic principles:

- Strategic identification, synthesis and integration of existing work in the Gulf of Maine should reduce overlap and needless repetition of effort.
- Cross-sectoral, multi-disciplinary, bi-national consensus is needed on the identification and ranking of significant habitat and toxic contaminant issues in the region.
- Integration of effort can be achieved through collaborative partnering with existing institutions, organizations, communities and the private sector that are already at work in environmental management in the region, or can be encouraged to participate.

#### PROGRESS TO DATE

Since the formation of GPAC in the summer of 1997, a significant program of consensus building, strategic planning, and project implementation has been accomplished, largely through the voluntary efforts of all members and within a total financial budget of less than \$500,000 CAN. GPAC has become a strong animating force in the region, challenging, supporting and inspiring the activities of its members and others that have come within its sphere of influence.

In a little over three years, GPAC has realized the following measurable achievements:

- six cross-sectoral, bi-national meetings of the Coalition;

- two major international, multi-sectoral workshops;
- seven comprehensive scoping papers on conditions in the region related to pollution and habitat disturbance;
- consensus on fifteen priority environmental issues common throughout the Gulf of Maine region;
- development of targeted strategies to address these issues;
- implementation of five pilot projects in response to these strategies;
- strategic assessment of GPA targets in the Gulf of Maine; and
- ongoing interaction and information sharing with the Bight of the California's sister pilot project.

As a result of the interactive work by this group of highly committed individuals, there has been considerable advancement in the development of four critical elements for GPA implementation:

- a base of critical scientific information on the Gulf Region's natural systems and built environments;
- strong collegial relationships among key scientists, decision-makers and advocates, both internal and external to the Region;
- consensus on the scope of the GPA in the Region, and the priority issues for action; and
- approximately 350 persons, from all sectors of the community, who have voluntarily participated in some aspect of the GPAC activities in the Region and who represent a considerable resource for future advancement of the GPA.

#### CHALLENGES FACED BY THE GPAC

In its short history, the GPAC has achieved measurable progress in the first steps towards implementation of the principles of the GPA in this region. However, much more work is needed in the establishment of regional management targets and objectives, the implementation of directed programs of action, and in the identification of realistic, measurable criteria for the evaluation of progress and effectiveness.

The GPAC though a notable success in its role as synthesizer and animator, cannot take on the responsibility for implementation of the needed programs of change. These activities will benefit most from direct participation by coalitions and partnerships among jurisdictional authorities, affected sectors and interested parties.

To date, progress achieved by the GPAC has largely been a result of the financial and administrative support provided by the Commission for Environmental Cooperation. The three year program that supplied that support ends in 2000. Currently the GPAC is struggling to identify financial support for the core coordination and administration.

# GPA Priority Issues in the Gulf of Maine

*The technological penetration of the ocean is daring, inspiring, and quite possibly, potentially disastrous. IF the ocean is to be a jumbo resource, its exploitation must be carefully husbanded. The ocean can no longer take care of itself. It requires as much respect for its weaknesses as its strength. The concept of an all powerful ocean is today obsolete.* Wesley Marx, *The Frail Ocean*

**W**ithin the Gulf of Maine Region there are many important environment and development issues that require attention. The GPAC set out to identify those issues relevant to land based activities that had a regional context. More than 100 participants at the GPAC Workshop on setting priorities for the Gulf of Maine (Saint John, New Brunswick, Canada. 27-29 April 1998) described a range of activities that require more resources and more action. Participants also reached a consensus on fifteen pollutant and habitat issues considered to be most appropriate to the GPA and in need of immediate attention.

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## PRIORITY POLLUTANTS IN THE GULF OF MAINE

- 
- |                    |  |
|--------------------|--|
| ▪ <b>PATHOGENS</b> | ▪ <b>DIOXINS/FURANS</b>                          |
| ▪ <b>NITROGEN</b>  | ▪ <b>PETROLEUM HYDROCARBONS</b>                  |
| ▪ <b>BIOCIDES</b>  | ▪ <b>POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)</b> |
| ▪ <b>MERCURY</b>   |  |

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## PRIORITY HABITAT ISSUES IN THE GULF OF MAINE

- 
- |   |   |
|---|---|
| ▪ <b>SEWAGE AND EUTROPHICATION IN COASTAL WATERS</b>                | ▪ <b>PROTECTION AND RESTORATION OF SALT MARSHES</b>                     |
| ▪ <b>IMPACTS OF AQUACULTURE ON HABITATS</b>                         | ▪ <b>HARVESTING OF LOW TROPHIC - LEVEL SPECIES</b>                      |
| ▪ <b>DEVELOPMENT ADJACENT TO AND DISRUPTIVE OF COASTAL HABITATS</b> | ▪ <b>USE OF MOBILE FISHING GEAR IN ESTUARIES AND COASTAL EMBAYMENTS</b> |
| ▪ <b>TIDAL AND FRESHWATER HYDRAULIC OBSTRUCTIONS</b>                | ▪ <b>ABSENCE OF NO-TAKE RESERVES</b>                                    |

Other issues identified by the GPAC and its associates were placed on a 'B' list (meriting attention by others, or by the GPAC as resources became available) (Appendix B). Included within this list were emerging or 'horizon' issues, those that may not now pose a serious or known threat to marine or coastal environments, but hold the potential for future damage.

Following the identification of the fifteen priority GPA issues in the Gulf of Maine, the GPAC convened to develop a plan of action to further define these issues, and to organize appropriate action plans. The GPAC formed five Task Groups to advance research, knowledge and strategic planning on each of the priority issues.

## T A S K G R O U P O N S E W A G E A N D E U T R O P H I C A T I O N

The Task Group on Sewage and Eutrophication was formed based on a commonality of issues identified at Workshop I on 27-29 April 1998. These included the specific issues of sewage and eutrophication in coastal waters, pathogens, nitrogen, and the impacts of aquaculture on habitats.

### ***Sewage and Eutrophication in Coastal Waters***

*Eutrophication* is a phenomenon in which nutrients entrained in water promote excessive growth, or blooms of algae and other aquatic plants. As these plants die and decay, the resultant bacterial action consumes much of the oxygen in the water, suffocating fish and other aquatic life.

Sewage wastes enter the Gulf of Maine through the untreated or poorly treated discharges of 378 wastewater treatment plants, from contaminated groundwater discharges, and as a result of combined sewer overflow; and agricultural runoff. Little

information exists on the extent to which local and regional ecosystems and habitats are affected by the deposition of these wastes, and by the resultant changes in sediment and water quality. There is growing concern in the Region as shellfish beds and coastal beaches continue to be closed for harvest and recreation as a result of contamination with these wastes.

Eutrophication within the Gulf Region can vary seasonally, yearly and geographically, and its relationship to the causes, effects and periodicity of marine and estuarine algal blooms and red tides is not well understood.

### ***Pathogens***

A *red tide* is typically a reddish discoloration of seawater caused by a large increase, or bloom, in the numbers of microscopic marine organisms. Red tides typically occur during the summer months

Pathogens can include bacteria, viruses and other microbes associated with human and animal faecal wastes, as well as toxic marine dinoflagellate species. Faecal wastes enter the marine environment through discharges of untreated sewage, wastewater treatment plants, farm wastes and aquaculture operations, and in surface runoff from agricultural and urban areas.

Despite their low impact on ecosystems, the presence of pathogens can have a significant impact on economic resources such as shellfish harvesting, on

human health, and on access to resources for cultural and recreational purposes. More research is needed to determine the sources and effects of pathogens in marine and coastal environments and their persistence and fate in salt water. Current systems and indicator organisms used for pathogen detection and quantification in the Region require re-examination and standardization in order for accurate conclusions to be drawn on whether pathogen occurrence is increasing or decreasing.

## ***Nitrogen***

*Nitrogen* is an important element found in all living matter. Nitrogen exists in water in the form of dissolved nitrogen gas, inorganic nitrogen compounds (nitrates, nitrites, and ammonium compounds) and in organic compounds including the proteins of living and dead organisms.

The magnitude of the impact of nitrogen on the Gulf Region ecosystem is not well known. Increased levels of nitrogen in embayments and nearshore coastal waters may cause eutrophication and algal blooms.

Nitrogen can be released to the environment in the discharges of wastewater treatment plants, aquaculture and agricultural operations, and through the surface application of manures and fertilizers in suburban and agricultural areas. Nitrogen, together with phosphorus, is a significant contributing factor to eutrophication in aquatic environments, and as such has considerable potential to affect economic and cultural use of marine and coastal resources.

Nitrogen is also released to the air from combustion and decay processes, power generation and other industrial emissions. Airborne nitrogen can be transported significant distances before deposition in land and water environments. In the Gulf of Maine Region, airborne transport and deposition of contaminants is a growing concern.

## ***Impacts of Aquaculture on Habitats***

Aquaculture in the Gulf of Maine includes commercial rearing of stocks of fish, shellfish and algae. Preferred aquaculture sites include protected embayments and estuaries where natural productivity rates are high.

Issues related to aquaculture in the Gulf of Maine are primarily directed at salmonid pen culture and shellfish grow out programs. Aquaculture is considered the fastest growing segment of US agriculture, with the expansion in the western North Atlantic spurred by declines in wild stocks, the demand for seafood, and government incentives. In intensive aquaculture operations, considerable waste, including uneaten food and faecal matter, can be generated and discharged directly into the receiving waterbody. A wide range of chemicals such as antibiotics, pesticides, hormones and food supplements are also used by the industry. These chemicals are generally applied with feed and can enter the environment through uneaten food or faeces. Other issues include the potential for

disease transfer to wild species, and the escape of non-native, and/or genetically enhanced species to the wild, where they can dominate the native stocks.

## TASK GROUP ON TOXICS

The Task Group on Toxics includes in its focus six priority persistent pollutants; biocides, mercury, dioxins/furans, polycyclic aromatic hydrocarbons (PAHs), and petroleum hydrocarbons. Persistent pollutants are compounds that do not readily degrade in the environment, and which tend to bioaccumulate in the food chain, and in humans.

### ***Biocides***

Biocides are poisonous chemicals, including pesticides that kill living organisms and have important impacts on aquatic life and habitats.

Biocides have been used within the Gulf of Maine watershed with measurable amounts having reached the sediments and biota of the Gulf. Chemical compounds in use as biocides consist of chlorinated biocides (DDT, lindane, dieldrin, aldrin, chlordane, toxaphene, DDD and DDE) and organophosphorus biocides (parathion, malathion, chlorothion, systox, metasystox, disyston, and dicapthion) in addition to carbamates, dithiocarbamates and pyrethroids. These chemicals have been used widely in the

Region as insecticides, biofouling controls, fungicides and herbicides. Tributyltin (TBT) is used as an antifouling paint in marine industry. Chlorine gas and chlorine based compounds are used as a bactericide in wastewater treatment where chemical reactions can generate many chlorinated compounds which have been implicated in human health effects, in addition to harmful effects on aquatic life.

Not enough information is available on the kinds and amounts of biocides contributed to the Region through industrial, commercial and individual activities such as forestry, agriculture, aquaculture, antifouling paints, antibiotics, disinfectants, lawn care and treated lumber. The use of biocides to increase industrial and resource yields may also result in large-scale death of non-target species.

### ***Mercury***

Mercury bioaccumulates in the food web and can occur in significant concentrations in the tissues of high trophic level species. The toxicity of mercury is influenced by its chemical form, environmental conditions (i.e. temperature, dissolved oxygen and salinity) and the presence of other metals), the sensitivity of the organism, and the stage of its life history at which it is exposed. Inorganic mercury is less toxic to aquatic organisms than methyl mercury.

The amount of mercury deposited into the global marine environment is estimated to have increased four-fold since the industrial revolution. Approximately 60% of atmospheric deposition to the northeast states and eastern Canadian provinces comes from within the area.

Mercury enters the atmosphere as a result of the combustion of wastes, inputs from manufacturing sources, and the combustion of fuel, and can be transported large distances before being deposited on the land and in the water. The largest identified source of mercury contaminated emissions is municipal waste incinerators. Mercury is also present in historically contaminated sediments, typically found within estuaries and rivers in the Region.

Mercury that has accumulated in the aquatic food chain can pose a particularly high human health risk for First Nations and coastal communities who practice subsistence fishing. When fisheries are closed due to the presence of unacceptable levels of mercury in the fish or shellfish (e.g. swordfish) there can be significant and long lasting negative effects to the economies of coastal communities.

### ***Dioxins/Furans***

Chlorinated *dioxins and furans* are organic compounds based on two linked benzene rings in which chlorine atoms can be located at any of eight sites. Their toxicity varies according to the location of these chlorine atoms. Of the 210 possible dioxins and furans, 17 are of particular concern.

Polychlorinated dibenzodioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs) are highly persistent in the environment, have a strong affinity for fine-grained sediments, and will accumulate in biological tissue. Dioxins (PCDDs) are particularly resistant to biological breakdown, concentrate in fatty tissues, and are not readily excreted. Depending on exposure and concentration, dioxins and furans can have significant impacts to human health, but are known to effect human health even at low-level persistent exposures.

Dioxins and furans originate from a number of anthropogenic sources in the Gulf of Maine region. These include accidental releases during chlorophenol production; aerial application of pesticides; dry cleaning distillation residues; thermal or combustion sources (i.e. municipal waste incinerators, automobile exhaust, combustion of fossil fuels); escape from contaminant reservoirs (i.e. sewage sludge, compost and contaminated soils); the effluent of pulp and paper mills using chlorine bleaching processes; and the burning of bark removed from logs that have been stored in salt water.

### ***Petroleum Hydrocarbons***

Petroleum hydrocarbons can be classified into two major group, open-chain (e.g. methane, ethane, propane, butane, ethylene and acetylene) and cyclic hydrocarbons (e.g. gasoline, benzene, toluene, anthracene, and naphthalene)

It is estimated that, worldwide, 2.35 million tons of oil per year enter the marine environment. Anthropogenic sources include chronic discharges from storage facilities and refineries, discharges from ships, urban runoff, and atmospheric deposition. In total the volume of hydrocarbons discharged to the Gulf as a result of small, chronic spills, may be greater than the volume spilled from storage and handling facilities.

Hydrocarbons spilled in marine environments can cause a wide range of ecosystems impacts that vary widely depending on the type of product involved, the environmental and climatic conditions into which it is released, and the volume of material discharged. Where there are large spills of heavy product, marine organisms may be physically killed as a result of suffocation, drowning or hypothermia. Lighter more refined hydrocarbon products are typically more chemically toxic to marine organisms, cause a wide range of lethal and sub-lethal short- and/or long-term effects to health, and may be mutagenic or teratogenic.

Some compounds found in petroleum hydrocarbons, such as benzene, have been linked to cancer in humans, and exposure to petroleum-based solvents is known to have serious impacts on human health. Hydrocarbons will also impact human use of coastal and marine resources through tainting of edible fish, coating of shorelines, beaches, boats and fishing gear, and disruptions to marine industries and tourism.

## ***Polycyclic Aromatic Hydrocarbons (PAHs)***

*Polycyclic aromatic hydrocarbons (PAHs) are a group of organic molecules containing two or more benzene rings fused together with at least two common carbons. There are numerous PAH compounds, each having a varying degree of toxicity.*

PAHs are derived from raw and refined petroleum products and the combustion of wood, coal and petroleum in the engines of automobiles, lawnmowers and power plants. Of the petroleum hydrocarbons compounds released to the environment, PAHs are

among the most worrisome. Noted for their pervasiveness and persistence in the sediments of urban or industrialized harbours, PAHs have important impacts on human health, and may have significant impacts on marine ecosystem health.

While PAHs are among the better understood of the pollutants identified in the Gulf Region, little research has been conducted on their detrimental effects to the marine environment. More information is needed on the source and effects of specific PAH compounds, with an emphasis on non-point sources of PAHs (both current and historical), their presence in urban runoff, and the role of marine engines as a source of PAHs.

### T A S K G R O U P O N C O A S T A L D E V E L O P M E N T

The Task Group on Coastal Development focused on aspects of land and water development adjacent to and/or disruptive of coastal and marine habitats. All human development, whether related to agriculture, forestry, mining, transportation, utilities, energy production, or residential and tourism development, has a potentially negative effect on coastal and marine environments. Physical alteration of coastal habitats, although unevenly distributed throughout the Gulf region, is increasing in parallel with the growth of urban sprawl, tourism and ecotourism.

## ***Growth Management***

*Growth management is based on a strong commitment to the containment of human development in compact areas of the landscape to promote the efficient use of land and water resources.*

Growth in human development throughout the Region is increasing the pressures on available land and water resources. Increasing populations in coastal areas are straining available municipal resources such as water supplies, and can place unachievable demands on the capacity of natural systems to assimilate the impacts and the wastes generated. Conflicts over land and water use are arising with increasing frequency, as water edge property becomes more attractive to new economy sectors such as local and regional tourism and aquaculture.

Growing pressures from land-based development in these and more inland areas are believed to be having cumulative effects on near-shore environments - effects such as increased siltation, changes in hydraulic function and the loss of energy-producing and filtering species and communities. "Ecotourism" pressures on sensitive marine and coastal habitats and species are raising serious concerns for the sustainability of these fragile resources.

Within the Gulf Region the true costs associated with increased development are seldom known. There is little accurate information on the valuation of coastal and marine resources, and less on the direct and indirect economic effects of the misuse and/or loss of these resources. Within jurisdictions there can be conflicting policies for limiting and for attracting development to coastal areas. Integrated planning and management initiatives are badly needed to manage growth sustainably, but are hindered by the lack of a shared vision for land development and resource use in the coastal zone.

### ***Environmental Protection***

Erosion and sedimentation are caused when soils are exposed to the elements, loosened and transported by precipitation events and wind to nearby watercourses.

Sedimentation occurs when the velocity of the water is too slow to maintain the soil particles in suspension, and they settle to the bottom. Sediments smother aquatic habitats and species, and will continue to affect watercourses and coastal areas if they are re-suspended and re-deposited.

As development pressures continue to increase, there is loss and/or disruption of sensitive terrestrial and marine species and habitats through infilling, erosion and sedimentation, and channeling of surface watercourses. Undeveloped lands remain vulnerable unless protected through designation, acquisition, and/or protective easements. Development policies and practices can also considerably affect natural patterns for stormwater runoff, and for groundwater recharge. Buffer zones to protect sensitive watercourses and shorelines from construction, farming and logging practices are not universally enforced throughout the Region.

### ***Sustainable Rural Communities***

Sustainable development is defined as development that permits the use of resources but does not detract from their availability for use by future generations.

Many coastal communities in the Gulf of Maine have seen serious economic reversals as a result of downturns in the fisheries and other resource industries. Others are experiencing unprecedented growth pressures from increasing residential development and seasonal tourism.

Seasonal and commuter development can place serious drains on municipal resources and services, may be in conflict with more traditional resource use, and can

inflate local economies, without providing sufficient tax revenues to ensure the long-term stability of the community. Communities within the region also do not share environmental and social goals for development, and can be in conflict with each other in attempts to attract prospective new industries.

As suburban sprawl claims more of the rural land resources, valuable agricultural and ecological resources are being consumed, affecting the quality of life that was the main attractant for the new residents.

TASK GROUP ON PHYSICAL ALTERATIONS TO WATER FLOW AND SALT MARSHES

The Task Group on Physical Alterations to Water Flow and Salt Marshes was formed to focus on issues such as the impact of tidal and freshwater hydraulic obstructions and the protection and restoration of salt marshes.

***Tidal and Freshwater Hydraulic Obstructions***

Hydraulic obstructions can result from the construction of road and railroad crossings, causeways, culverts and other structures that impede tidal exchange and reduce the penetration of seawater into coastal habitats, and limit fish passage.

Most hydraulic obstructions were constructed without attention to ecological criteria. In some instances, obstructions, which reduce the penetration of salt water into marshes, have permitted the invasion of less salt tolerant non-native species that compete with marsh species.

The construction of dams, causeways, bridges and other hydraulic obstructions can have far-reaching effects on downstream freshwater and coastal habitats and on the distribution and abundance of freshwater and marine species. Hydraulic obstructions are common throughout the Gulf Region, and in some instances have resulted in significant changes to hydraulic conditions and sedimentation patterns.

The resulting physical disturbance to habitats can have site-specific impacts as well as cumulative impacts resulting from interference with mixing and circulation patterns, salinity distribution, ambient water temperatures and nutrient concentrations in both the local area and the Region. Remedial measures would include the restoration of natural flow conditions and the provision of fish passage to coastal watersheds.

***Protection and Restoration of Salt Marshes***

Salt marshes are marine intertidal areas with soft substrate, colonized predominantly by grasses. They occur only where there is regular flooding by salt water and nearby sources of fine sediment. Salt marshes form on stable or emerging coastlines when sediment accumulates in sheltered intertidal areas in estuaries, behind spits, bars or islands, and in protected bays. Salt marshes are among the most productive ecosystems in the world. They are often nurseries for juveniles of commercially important fish species and are important feeding and breeding habitats for waterfowl.

Much of the physical alteration of the Region's salt marshes occurred over the past 300 years as a result of the dykes built to drain fertile coastal marshlands for agricultural use. Alteration to coastal marshes still occurs to promote agriculture, to control mosquitoes, to create new land for development projects, and for transportation and utility corridors. The role of the Gulf of Maine salt marshes as coastal energy pumps and filters remains poorly understood.

Conflicts can arise between government programs to reclaim salt marshes for human use, and wetland protection programs. Controversy also exists over the creation of freshwater marshes

intended to enhance habitat for specific wildlife species, in areas that were formerly salt marshes. Protection and remedial actions under consideration in the Gulf of Maine include introduction of "No Net Loss" policies for salt marshes, restoration of fallow dykelands, protection of shoreline buffers, restoration of tidal flow to salt marshes, and initiatives to control the spread of invasive plants.

## TASK GROUP ON RESOURCE USE

The Task Group on Resource Use was formed to address the priority issues on the harvesting of low trophic-level species and habitat, the use of mobile fishing gear in estuaries and coastal embayments, and the absence of no-take reserves.

### ***Harvesting of Low Trophic-Level Species***

Low trophic-level species in the Gulf Region include sea plants such as kelp and rockweed, and planktonic species such as krill. Often described by government departments responsible for resource use as 'underutilized species', pressures to harvest low trophic species have been growing as closures of fisheries of other failing stocks have increased.

Harvesting of low trophic species in the Gulf of Maine Region may not be sustainable and may have cumulative effects on the marine and coastal food chain, as well as on available habitat for related organisms. A better understanding of the ecological roles played by low-trophic species is needed before valid conclusions can be drawn on either the sustainability of these harvests or their impacts on marine and coastal environments, and on other fisheries and coastal industries.

### ***Use of Mobile Fishing Gear in Estuaries and Coastal Embayments***

Mobile fishing gear includes heavy trawls or dredges that are dragged repeatedly over the bottom. The use of the gear can alter bottom topography, destroy benthic plants, and disturb the microstructure of benthic habitats.

There is scientific and commercial debate as to the nature and ecological significance of the impacts of the gear use, and on the ability of the disturbed habitats and populations to recover rapidly. Also of concern are the by-catches of non-target species produced by the use of such technologies. Such by-catches, which are generally discarded over the side, may have potential impacts on the structure and diversity of marine communities.

Estuarine and coastal embayments of the Gulf of Maine are subject to intensive fisheries for a variety of shellfish and finfish. The use of mobile fishing gear, including new gear technologies, in coastal embayments and estuaries can have widespread impacts on benthic (ocean bottom) marine habitats in the Gulf Region.

### ***No-Take Reserves***

No Take reserves are a more stringent protected area designation than most parks and reserves and are defined as marine ecosystems which are excluded from all forms of human activity and disturbance, including fishing, pollution, mineral extraction and recreation.

Little is known about how coastal and marine ecosystems function in a natural state, with limited human interaction. Current understanding of the ecological functioning of the marine environment of the Gulf of Maine region is largely limited to research conducted on ecosystems already affected by human activities. No-take reserves are needed to serve as benchmark areas for long-term research in ecosystem dynamics. The need for no-take reserves should be distinguished from the more general need for Marine Protected Areas, which have a greater variety of conservation objectives and permit varying degrees of human presence and human use.

# Priority Actions in the Gulf of Maine

*Lives of great men all remind us, we can make our lives sublime.  
And, departing, leave behind us, footprints on the sands of time.*

*Henry Wadsworth Longfellow*

One of the general objectives concerning international cooperation and coordination, as set forth in Agenda 21, is to support and supplement efforts of States to promote integrated management and sustainable development. Within the Gulf of Maine Region, the GPAC has been working to advance these principles, and to ensure that the objectives of the GPA are achieved in a timely context.

The GPAC has, over a period of two years, consulted with over three hundred persons to advance our understanding of the state of knowledge on each of the priority issues in the Gulf of Maine. Emerging from the strategic analysis of the findings of each of the Task Groups is a compelling list of immediate actions needed in the Region.

## INFORMATION GAPS

A common theme that emerges from this analysis is the need for more knowledge on the dynamics of the Gulf of Maine ecosystem. There are considerable gaps in information on basic ecology, species life cycles, and ecosystem structure. More information is required on the sources of pollutants, their fate in coastal and marine environments and their direct and indirect effects on species and habitats. There is insufficient data on ecological conditions that existed before European contact. There is insufficient information on the disruption, alteration and loss of habitats and species. There are problems with the collection, recording, storing and sharing of existing information. Public education on the tangible and intangible values of marine and coastal environments is in its infancy, although public support is and will continue to be, a critical cornerstone for all existing and future conservation and protection initiatives.

## SUSTAINING ECONOMIES AND ENVIRONMENTS

Sustainable planning and management for land based activities in the Region must be rooted in science and cognizant of the impacts and costs of inaction. Only with clear definition of the direct and indirect linkages between ecosystem stability and the quality of human environments will measurable progress be attained. Notwithstanding that significant gaps exist in the knowledge base, there is a need for all sectors to take immediate action to curb those activities that are contributing to degradation of the Gulf of Maine ecosystem. Application of the principles of intergenerational equity and the precautionary approach support actions that err on the side of conservation of biodiversity and the protection of ecosystems.

## PRIORITY ACTIONS

The precautionary approach is applied through preventive and corrective measures based on existing knowledge, resources and capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty cannot be used as a reason for postponing cost-effective measures to prevent degradation of the marine environment. The GPAC, while recognizing that substantive change is generally not accomplished in the short term, is committed to fostering immediate implementation of a suite of Priority Actions, as a first step towards measurable progress in the implementation of the GPA.

The Priority Actions have been assembled within the context of the GPAC Task Groups. Readers will quickly comprehend that most of the Actions identified exist within broader contexts, where the responsibility for implementation can and must be shared across all sectors of the community. First Nations and Founding Tribes have been assumed to play a role in all Priority Actions.

## PRIORITY ACTIONS ON SEWAGE AND EUTROPHICATION

Continued loss of productive shellfish beds and recreational areas is not an acceptable future for the already beleaguered communities of the Gulf of Maine. Continued contamination of marine and coastal waters as a result of anthropogenic sources of pathogens and nutrients is not compatible with growing demands for water-based recreation and tourism, nor is it acceptable to the residents of coastal communities.

- Achieve a better understanding of the fate and survival of pathogens in marine and estuarine waters.
- Define existing and potential future conditions for airborne transport and deposition of nutrients to the Gulf of Maine, with specific reference to ecosystem functioning such as residence time, flushing rates, biological uptake and release, and the relationship to other ecosystem components.
- Identify appropriate pathogen indicator species, sampling protocols and data recording instruments, to improve information on existing and potential point and non-point sources, quantities and impacts to marine and coastal ecosystems. Pay special attention to non-point sources such as urban/suburban and agricultural runoff.
- Develop new biotechnologies that identify human and non-human sources of faecal contamination.
- Advance existing knowledge of the causes, distribution and effects of harmful algal blooms in the Gulf of Maine, with special reference to the role of nitrogen.
- Define the ecosystem and habitat effects of aquaculture.
- Adapt monitoring programs to include routine measurements of dissolved oxygen and include/develop other useful indicators of eutrophic conditions.
- Acquire information on non-point sources of nitrogen in coastal embayments to better understand residence times, flushing rates and cycling of nutrients.

## PRIORITY ACTIONS

- Establish data management networks to ensure that information can be shared in a timely and efficient manner.
- Inventory storm water collection and disposal systems to locate illegal or unintended cross connections with sanitary wastes systems and make appropriate corrections.
- Inventory untreated sanitary and combined sanitary and stormwater outfalls.
- Discourage combined sanitary and stormwater collection and disposal systems.
- Continue improvements to municipal sanitary waste collection, treatment and disposal systems to reduce continuous and/or periodic discharges of pathogens and nutrients, especially during storm events.
- Develop and implement measures to review and upgrade performance of on-site sewage treatment systems and animal waste management systems.
- Improve data collection and modeling systems for assessing and forecasting changes in population growth and land use, especially in those areas that exhibit considerable change between seasons.
- Develop new government policy (Canada/US, federal, state/provincial) to regulate open water aquaculture operations.
- Develop new standards for site selection and maximum sustainable densities of aquaculture operations.
- Develop and implement aquaculture management strategies and certification programs for operations that reduce pathogen and nutrient loading to local ecosystems, and operate in a non-impactive manner.
- Take all opportunities for the application of existing environmental legislation as a means of enforcing standards of operation in the aquaculture industry.
- Share aquaculture knowledge and experience between jurisdictions.

## PRIORITY ACTIONS ON TOXICS

Variations in the methods of regulation, data collection, and data management and lack of research in critical areas are constraining comprehensive understanding between jurisdictions on the sources and quantities of toxic chemicals discharged to the Gulf of Maine.

- Pursue reductions in the mercury emissions from waste incinerators.
- Improve legislation, regulation and enforcement mechanisms that manage PAH contaminated marine and coastal sediments.
- Develop and implement provincial and federal regulations in Canada for the containment and/or disposal of TBT residues from sandblasting grit and/or hydroblasting wastewater.

## PRIORITY ACTIONS

- Define the sources for and quantities of atmospheric deposition of dioxins and furans in the Gulf of Maine.
- Define the sources, quantities and kinds of mercury in the waste streams of the Gulf of Maine watershed.
- Determine the effects of biocides used in aquaculture on receiving marine and coastal ecosystems.
- Define the effects of coastal sources of PAHs on human and ecosystem health.
- Clarify threshold levels of mercury toxicity in both humans and wildlife.
- Improve our understanding of the ecosystem impacts of atmospheric deposition of contaminants and existing levels of contamination in sediments.
- Improve our understanding of the effects of both catastrophic spills and sub-lethal, chronic discharges of petroleum hydrocarbons, with special reference to intertidal and sublittoral communities, and the tainting of fish.
- Improve our understanding of the contribution of household use of biocides to total loadings in the Gulf of Maine.
- Improve public understanding of the time necessary for reduction of mercury levels in fish and wildlife once the contributing sources are minimized or eliminated.
- Improve data collection, management and information sharing on the release of mercury from sediments as a result of natural disturbance events, including natural microbial cycling.

## PRIORITY ACTIONS ON COASTAL DEVELOPMENT

Lack of shared vision on the appropriate use of coastal lands is contributing to conflicts over land and water use throughout the Gulf. More education and communication is needed as a first step towards educating decision-makers, and moving forward on watershed based integrated resource management plans.

- Pursue the identification, definition and ratification of a shared vision for development in the coastal zone of the Gulf of Maine.
- Develop growth management strategies at the regional, watershed and local level based on established principles of integrated resource management.
- Assess cross jurisdictional government policies and programs in support of coastal, urban and rural development to identify those initiatives that act in opposition to sustainable development practices, and to ensure that conflicting policies and programs are eliminated.
- Inventory existing and potential future land use in the coastal zone of the Gulf of Maine, taking care to identify public and private resources of natural and/or undeveloped landscapes.

- Evaluate and strengthen mechanisms for the protection of private and public undeveloped lands with ecological significance, including financial incentives for voluntary participation.
- Review the capability of existing legislation, regulation and enforcement programs to measurably reduce erosion and sedimentation caused by all sectors, including development, agriculture, forestry, transportation, and utilities.
- Identify the economic, environmental and social needs of sustainable coastal communities especially as relates to the continued viability of communities in stress.
- Define economic values for coastal and marine resources to more fully understand the linkages between natural resources and sustainability of coastal communities.
- Improve data collection and modeling systems for assessing and forecasting changes in population growth and land use, especially in those areas that exhibit considerable seasonal variation.
- Recognize and provide long term support for non-government organizations actively involved in the promotion of sound development practice.
- Improve public understanding of population growth and urban sprawl issues.
- Identify and fill information gaps on current and projected patterns of growth in the Gulf of Maine watershed, and alternatives to traditional development practice.

#### P R I O R I T Y   A C T I O N S   O N   P H Y S I C A L   A L T E R A T I O N T O   W A T E R   F L O W   A N D   T O   S A L T   M A R S H E S

Historic development practices throughout the Gulf of Maine watershed have left a legacy of dewatered marshlands and physical obstructions to water and fish movement. Although more research is required to fully understand the role played by these coastal marshes in the overall sustainability of coastal and marine ecosystems, immediate action is needed to protect, conserve and restore these significant habitats.

- Improve municipal, provincial/state and federal legislation, regulation and enforcement mechanisms for the protection of significant coastal habitats, especially salt marshes.
- Develop and strengthen jurisdictional agreements, protocols and mechanisms to facilitate permitting and approval processes necessary for wetland restoration projects, using the Delaware Bay Dykelands Restoration initiative as a model.
- Develop cooperative policy, agreements and protocols between jurisdictions to eliminate or minimize the creation of tidal restrictions during road and rail maintenance and to facilitate the restoration of natural flow and fish passage in priority areas.
- Develop an accurate, shared inventory of coastal wetlands in the Gulf of Maine, including historical wetlands, areas under protection, and areas threatened by existing or future development.

## PRIORITY ACTIONS

- Develop and implement regional planning and management initiatives to assess the spread of invasive plants.
- Develop measurable criteria for assessing the success of wetland restoration projects.
- Select and implement demonstration wetland restoration projects in characteristic areas.
- Assemble data on tidal restrictions and flow obstructions and prioritize hydraulic flow restoration projects.
- Improve knowledge of tangible and intangible costs associated with physical alteration to coastal habitats, and the community and ecosystem benefits that can be accrued from protection and restoration initiatives.
- Develop print, audio, video, interactive CD and Internet communication and education products to communicate accurate information on ecosystem linkages to human health and economic well being.

## PRIORITY ACTIONS ON RESOURCE USE

The lack of comprehensive information on marine and coastal ecosystems is contributing to the difficulties inherent in assessing impacts and recovery times for habitats and species affected by commercial fishing operations.

- Undertake regional planning and management initiatives to map the ecoregions of the sea floor of the Gulf of Maine, as a first step towards the identification of locally and regionally important benthic habitats and areas sensitive to human impact (e.g. fishing gear).
- Develop a science-based regional policy and framework for protected area designation and management. The process must be transparent and accountable to the affected community, with commitment and responsibilities identified by both federal and provincial/state agencies.
- Develop and implement municipal legislation, regulation and enforcement mechanisms to support the establishment and management of protected areas at the local level.
- Establish defensible ecological, social and economic criteria for the selection and management of no-take reserves.
- Identify and protect representative near-shore habitats that serve as undisturbed refuges and nursery grounds for important finfish and shellfish stocks.
- Develop a clear, shared policy for the management of low trophic level species in the Gulf of Maine.

- Define sustainable levels for rockweed harvesting in Nova Scotia (currently estimated at about 5% of the standing crop), including the impacts on ecosystem productivity and the loss of rockweed as habitat for other species.
- Support the use of conservative methods for catching fish through deployment of low impact gear types.
- Improve our understanding of the relationships between benthic marine habitats and fisheries productivity with special emphasis on gear types, habitat types and rates of recovery.
- Develop a comprehensive database of existing conservation and protection measures, projects and resources, including the benefits and costs of no-take reserves.
- Assess the productivity of fish stocks in the Gulf of Maine.
- Assess habitat restoration technologies used in other areas to identify measures appropriate to the Gulf of Maine.
- Improve communication and information sharing among participating organizations.
- Improve public education and communication programs (such as conferences and workshops) in support of the need for no-take reserves.
- Improve public communication and education on the ecological roles, relationships and functions of rockweeds.

# Appendix A - Documents

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## Appendix B – GPAC Reserve Issues

*As compiled by the participants at the GPAC Issues, Priorities and Actions Workshop, Saint John, New Brunswick Canada, 27-29 April 1998*

<b>“B” (RESERVE) LIST</b>	<b>HORIZON/OTHER ISSUES (POTENTIALLY SERIOUS FUTURE PROBLEMS)</b>
arsenic cadmium chlorine gas chromium copper greenhouse gases lead organic carbon PCBs phosphorus sediments silver tin zinc	invasive species (ballast) ocean dumping of dredge spoils pharmaceuticals