

Chapter 1

State of Fear or State of Oblivion? What Coastal Zones Are Telling Us about Global Change and Why We Need Integrated Coastal and Ocean Management on a Global Scale

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Abstract

Globally, our coastal zones and oceans are providing significant evidence of the reality of climatic change and global warming. Yet we are still a long way from approaching an effective regime for managing ocean and coastal resources. This chapter outlines on a global scale the ways by which oceans and coasts are exhibiting the effects of climate change and the potential impacts on huge concentrations of the world's population. Canada is used as an example of a country that has made advances in ocean and coastal management over the past decade, but not nearly enough considering the level of risk for resources, environments and people. The chapter challenges scientists and researchers to step beyond academic boundaries and contribute in a serious manner to the public debate about global climate change, its impacts on oceans and coasts and the implications for public policy. Finally, the author calls for the United Nations to establish a Commission on Ocean and Coastal Management to bring these critical issues to the global political agenda, and to provide the necessary support to regional, national and sub-national efforts to manage the world's oceans and coasts on a sustainable basis within the context of global climate change.

1.1 Prelude

There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact.

(Mark Twain, *Life on the Mississippi*, 1883)

Mark Twain's famous caustic quotation about the foibles of scientific theories and projections is used by Michael Crichton at the beginning of his 2004 *New York Times* best-seller novel *State of Fear* (Crichton, 2004). In this novel, Crichton uses his significant talents

2 Integrated Coastal Zone Management

as a writer of commercial fiction to take on those who believe that global environmental change, and global warming in particular, is being caused significantly by human activities. In addition to challenging the scientific basis of global warming, Crichton launches a vigorous attack on key environmental principles such as sustainable development and the precautionary approach. He even goes as far as to equate global warming with past discredited scientific theories such as eugenics where pseudoscience and politics were so intertwined that they had enormous negative impacts on the world.

So what has all this to do with integrated coastal zone management (ICZM)? Why should the broad interdisciplinary community of scientists, engineers, managers, policy makers and communities that live, work and study in our coastal zones and oceans around the world be concerned with a work of commercial fiction? Surely, those of us who are scientists and serious researchers should not need to concern ourselves with such trivia. In fact, nothing could be further from the truth. After all, not many coastal and ocean scientists have had a book that has made it to the *New York Times* best-seller list, and like it or not the public mood around issues of immense importance like global change can be heavily influenced by popular, commercial fiction. While being a work of fiction, Crichton writes in the world of 'faction' whereby elements of fact are mixed in with a good story to create a work of popular appeal. In a similar fashion to Dan Brown's blockbuster *The Da Vinci Code* (Brown, 2003), readers can easily get confused between what is fact and what is fiction, and the inclusion of references, figures, tables, data and in the case of *State of Fear* an annotated bibliography and a detailed Author's Message section (Crichton, 2004) add to the air of authenticity for the entire work.

Popular literature has an impact on perceptions and opinions, and as scientists we must look at how we can communicate our knowledge, expertise and insights to a broader community, and not just to our academic and scientific peers. This is a dilemma and a significant challenge because we have been trained to speak to and be judged by our scientific peers, and not those who we consider to be outside of that favoured group.

1.2 State of fear or state of oblivion?

Globally, our coastal zones and oceans are providing significant evidence of the reality of climatic change and global warming. In many ways, our oceans and coasts are among the natural systems that are most vulnerable to global climatic change. Yet we are still a long way from approaching an effective regime for managing ocean and coastal resources. Despite mounting scientific and anecdotal evidence to the contrary, there is still a great deal of scepticism amongst the general public, politicians and decision-makers about the reality of global climate change and about the sensitivity of the world's oceans and coasts to such change. While the science of global warming has become increasingly overwhelming, the management response has been less than stellar. True, we have made significant advances in ocean and coastal management over the past decades, but not nearly enough considering the level of risk for resources, environments and people throughout the world. As scientists and researchers we have a responsibility to step beyond the academic boundaries of our expertise and contribute in a serious manner to the public debate about global climate change, its impacts on oceans and coasts and the need to manage human actions and

activities accordingly. This begs the question of whether environmentalists are actually creating a 'state of fear' about the impacts of human activity on global climate, or are politicians and decision-makers living in a state of oblivion about the human potential to inflict significant changes on the global climatic system. If the latter is the case, then what are the implications for our planet?

It might be suggested that it would be more appropriate to describe our current state as one of 'denial' rather than 'oblivion'. However, given the actual climatic changes that are occurring and the current and potential impacts of those changes on global oceans and coasts, 'oblivion' may not be too strong a word to use. The *American Heritage Dictionary* provides one definition of the word 'oblivion' as 'official disregard'. So while world leaders may not be oblivious to the issues and concerns about our oceans and coasts, they are certainly disregarding the urgent need to take immediate and effective action to reverse the trends and reduce the detrimental impacts of the present global condition. Arguably, they are living in a state of oblivion!

For ocean and coastal management, the implications of global climate change are especially significant because of the great potential to radically alter the sustainability and habitability of oceans and coasts around the world. The question is how we get that message out to the general public and politicians alike, and how do we get them to take the actions necessary.

1.3 Reaching out

The backdrop for this book was a gathering of scientists, engineers, managers and policy makers in Norway in June 2007 to discuss the importance of ICZM through the auspices of the International Council for the Exploration of the Seas (ICES). In the country of Gro Harlem Brundtland, arguably the 'birthplace' of the concept of sustainable development, it was particularly appropriate to consider the importance of reaching out to the broader global community and the efforts to promote an integrated approach to manage the world's oceans and coasts. Indeed, the very purpose of Brundtland's milestone work that resulted from her World Commission on Environment and Development, the 1987 report *Our Common Future* (Brundtland, 1987), was to do just that – to speak to the general public, to the people of the world and so to their politicians and governments. Brundtland challenged all of us to raise the level of concern about how we are managing our planet, and what it means for future generations and, indeed, the future of the planet itself as a safe and sustainable home for humankind.

Building on Brundtland's challenge, the 1992 World Conference on Economy and Development in Rio de Janeiro developed the *Agenda 21* statement, which remains as a clarion call to action on how to change the way in which we use and exploit our environment and natural resources. This is essential so that not only we may live in harmony with a planet that will sustain us into the future, but also, and perhaps this is the most radical aspect of *Agenda 21*, we will actually be able to sustain the planet for its future survival. Within *Agenda 21*, Chapter 17 (UN, 1992) dealt specifically with oceans, coastal and estuarine environments. This chapter has inspired numerous governmental and non-governmental efforts to promote integrated coastal zone management and ocean management, including the World Bank's

4 Integrated Coastal Zone Management

Noordwijk Guidelines for Integrated Coastal Zone Management (World Bank, 1993) and the Organisation for Economic Co-operation and Development's *Recommendations on Integrated Coastal Zone Management* (OECD, 1993).

Many authors have attempted to bring the importance of nurturing and cherishing our oceans and coasts to a more general audience, including Rachel Carson's pioneering work *The Sea Around Us* (Carson, 1951) and more recent works such as *The Living Beach* by the renowned Canadian author Silver Donald Cameron (Cameron, 1998). Also, global warming is an increasingly popular theme for writers, such as Tim Flannery's highly acclaimed *The Weather Makers* (Flannery, 2006), and former US Vice President Al Gore has been promoting action on global warming through his documentary film and book *An Inconvenient Truth* (Gore, 2006). That book did reach number one on the *New York Times* best-seller list in June 2006, and with the documentary winning an Oscar in 2007, Gore exemplifies the kinds of impacts that individuals can have when they shed the limitations of their traditional roles and speak more directly about issues of importance in a language that can be widely understood. The battle for the hearts and minds of the general public is well and truly in full swing.

In North America during 2006 and 2007, a series of spectacular and disturbing trends in climate (successive record average high temperatures), weather patterns (hurricanes, tornadoes and severe storms) and environmental events (droughts, fires and floods) have turned public opinion back towards the environment and climate change in particular, even though these events in and of themselves may have nothing to do with global warming. In Canada, a new conservative federal government elected in January 2006 with a very pro-oil industry agenda and a strong anti-Kyoto stand has been forced to backtrack on its inherent indifference to the environment (and global warming in particular) in response to the astonishing and rapid changes in public opinion. In the US, the George W. Bush administration will not go down in the history books as being environmentally friendly, but it is to the credit of many of the individual states (helped and perhaps lead by California) that the US has moved further towards meeting its Kyoto targets than Canada. Again, public reaction has been a significant force behind these regional and local level initiatives and has had a demonstrated impact on a national and global level, despite the indifference and often outright hostility of President Bush and his administration. The election of Barack Obama as president will hopefully be accompanied by a dramatic change in the way the US has addressed issues of global climate change over the past 8 years.

Perhaps most importantly, a series of major reports over the past year from the Intergovernmental Panel on Climate Change (IPCC) has strengthened the scientific basis for global warming and largely offset political and industrial efforts to undermine public confidence in the science behind climate change and produce an electorate of global warming sceptics (IPCC, 2007a). As the *Summary for Policy Makers* states:

Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.

(IPCC, 2007b)

Each of these IPCC reports has been released with much public fanfare, and they have moved the debate from one where the science of human-induced global warming was just

a theory to one where there is widespread acceptance of some significant level of proof. While detractors might accuse the members of the IPCC of selectively looking at the scientific evidence that supports their pre-convictions, those who know the IPCC and its highly political and bureaucratic nature (being essentially a creature of the UN) understand that it is a very conservative body and has taken a long time to get to the point where it was willing to claim direct evidence demonstrating anthropogenic causes of global warming.

1.4 What are oceans and coasts telling us about global warming?

The debate about global warming is extremely important for ocean and coastal management. Within the IPCC’s integrated framework for climate change (as depicted in Figure 1.1), oceans and coasts form a significant component of the human and natural systems response to climate change. With over 23% of the world’s population living within a 100 km distance from a coast and at elevations of less than 100 m above sea level (including 23 of the world’s

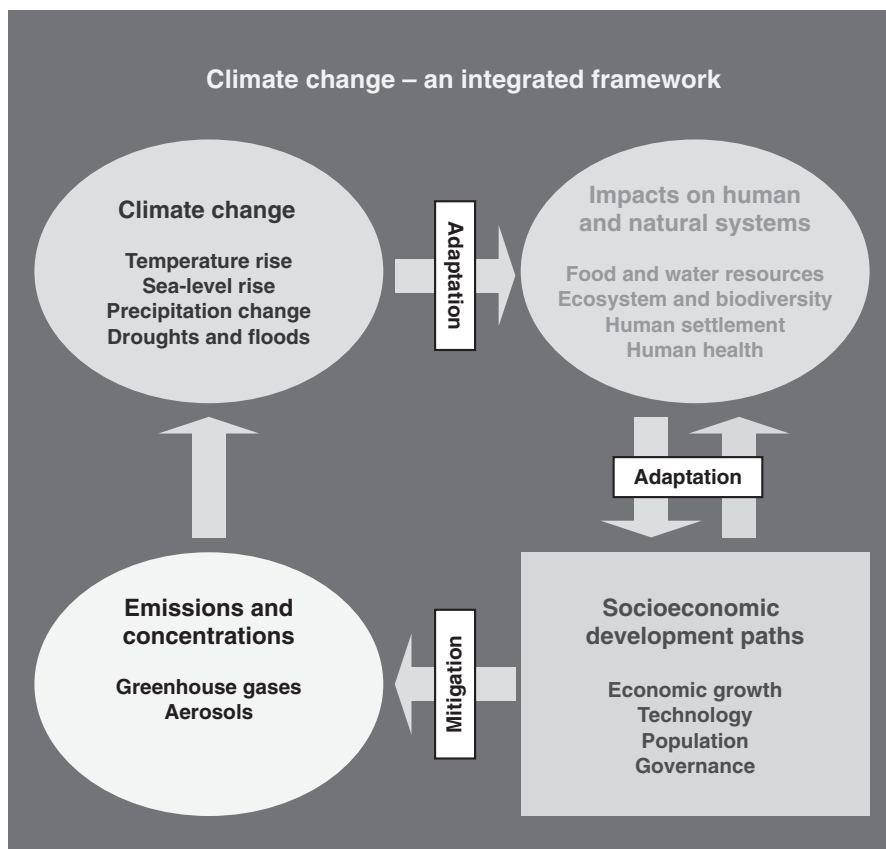


Figure 1.1 IPCC integrated framework for climate change.

6 Integrated Coastal Zone Management

39 cities with populations over 5 million), the potential coastal impacts of climate change on global populations are enormous. Those of us who have been researching this field over the past 35 years have long argued the importance of coastal zone management in order to manage effectively the rapid coastal population growth compared with non-coastal regions of the world, and consequently the increased hazards that are faced by those expanding coastal communities as well as the accelerated destruction and overexploitation of coastal environments and resources. Global warming considerably exacerbates those threats and the exposure to risks faced by those coastal populations. Indeed, some of the greatest potential adverse impacts of global warming are faced by coastal environments and communities.

In reviewing the areas of concern around the globe that are being experienced, observed and measured within the context of global warming, it is difficult not to be alarmed by what our oceans and coasts are telling us about the state of our planet's environment. The cumulative impacts of climate change are now being felt in ways that can actually be measured with some high degree of accuracy. These changes and trends, if continued unabated, predict dire consequences for planet Earth and we would be foolish not to recognise them and take action while we still can.

1.4.1 Loss of polar ice sheets

Thinning of the polar ice sheets is being measured at astonishing rates in recent years, with predictions of major loss of ice cover over the next 20 years in both the Arctic and Antarctic. The 2005 Arctic Climate Impact Assessment Report (Symon et al., 2005) estimates that summer ice in the Arctic has decreased by almost 27% in the past 50 years, that sea ice loss has increased by 20% over the past 30 years, and that the sea ice is thinning at a rate of 7–9% per decade. Some implications of this include the following:

- The opening up of the Arctic Ocean to year-round marine transportation through the Northwest Passage with the associated impacts of increased marine shipping and pollution.
- Potential changes in the Arctic gyre and currents that will impact life and feeding cycles for polar marine species and those animals that rely on them for food.
- Huge impacts on marine mammals and migratory species, such as polar bears, who use the ice for feeding.
- Higher shoreline erosion rates due to increased exposure of coastlines to longer fetches, stronger wave action and nearshore currents.
- Increased sub-aerial erosion of coastal cliffs and bluffs and subsidence of coastal lowlands due to the melting permafrost.
- Wholesale changes to nearshore sediment transportation and deposition regimen along the Arctic coasts.
- Major impacts on coastal plain settlements and infrastructure due to increased average temperatures, higher precipitation, permafrost melting, and changes in migratory patterns of marine and terrestrial animals upon which the inhabitants depend for their food and livelihood.

Indeed, monitoring of Arctic sea-ice break-up in 2007 has indicated a significant increase in the rate of melting, and predictions of an ice-free Northwest Passage have now been accelerated to 2030 and are being revised on an alarmingly consistent basis.

Table 1.1 Sources of sea-level rise 1961–2003.

Source of sea-level rise	Rate of sea-level rise (mm per year)	
	1961–2003	1993–2003
Thermal expansion	0.42 ± 0.12	1.6 ± 0.5
Glaciers and ice caps	0.50 ± 0.18	0.77 ± 0.22
Greenland ice sheet	0.05 ± 0.12	0.21 ± 0.07
Antarctic ice sheet	0.14 ± 0.41	0.21 ± 0.35
Sum of individual climate contributions to sea-level rise	1.1 ± 0.5	2.8 ± 0.7
Observed total sea-level rise	1.8 ± 0.5 ^a	3.1 ± 0.7 ^a
Difference (observed minus sum of estimated climate contributions)	0.7 ± 0.7	0.3 ± 1.0

Source: IPCC, 2007b, p. 7.

^aData prior to 1993 are from tide gauges and after 1993 are from satellite altimetry.

1.4.2 *Increased sea-level rise*

Accelerated sea-level rise associated with increased ocean water temperatures and polar ice cap melting is one of the most widely known impacts of global warming. As Table 1.1 shows, the 2007 IPCC report states that sea-level rise has accelerated since 1993 and is increasingly explained by climate change. Sea-level rise is accompanied by associated risks of flooding and inundation of low-lying coastal lands, and increased susceptibility to coastal storms, tsunamis and other extreme events. While not the result of global warming, the Indian Ocean tsunami of 2004 brought home the devastating power of the ocean and the high level of danger to which coastal communities in low-lying coastal zones are exposed. The comparatively low level of damage and loss of life along those coastlines that had retained their natural mangrove forests provide an example of the importance of retaining and restoring mangroves and other environments (such as coral reefs) that dissipate wave energy in order to provide natural protection against such hazards as tsunamis. However, sea-level rise makes it increasingly difficult for such natural environments to maintain their capacity to protect coastlines and low-lying coastal plains in their present location. The inevitable trend is for coastlines to retreat landwards as sea-level rise increases the erosive power and the surge effect of waves, tides and currents.

1.4.3 *Impacts of changing ocean currents*

Temperature changes and influxes of cold water from melting polar ice have the potential to impact the nature and location of global ocean currents. The North Atlantic is especially susceptible here given the potential of the Gulf Stream to change its flow and its temperature characteristics due to increased influxes of cold water from the Arctic Ocean and Greenland ice sheets. With the increased melting of the ice sheets and sea ice, the Labrador Current could become much stronger with the effect of pushing the Gulf Stream southwards in the northwest Atlantic. The potential impacts on the climate of Western Europe could be significant, with a worst-case scenario suggesting that the Gulf Stream could be shut off from reaching the eastern side of the Atlantic (Flannery, 2006).

1.4.4 Increases in ocean acidity

The German Advisory Council on Global Change (Schubert et al., 2006) has measured increases in the acidity of oceans and the possibility that the oceans are reaching some kind of limit in their ability to absorb increased carbon dioxide from the atmosphere. The potential impacts on marine environments and species that are sensitive to water acidity levels are enormous. Scientists are measuring detrimental effects of acidification on coral reefs and other species that rely upon the building of calcite shells, the long-term growth and reproduction of squid and certain fishes, and the potential for an imbalance in phytoplankton growth resulting in an imbalance in the oceans and a loss of biodiversity (Flannery 2006; Schubert et al., 2006; IPCC, 2007c).

1.4.5 Deterioration of coral reefs

A combination of increased water temperatures, rising sea levels and increasing ocean acidity will have a serious impact on coral reefs, especially those in sub-tropical coastal areas. Coral reefs are being identified as under increasing threat (Schubert et al., 2006), and any acceleration of coral reef destruction resulting from climate change will have serious and immediate impacts. Not only would this mean the destruction of some of the most highly productive ecosystems in the world, but also the impacts on the coastal zones that are protected by coral reefs would be significant. Small island nations are particularly at risk and are actively planning for the impacts of climate change, with some of them already considering the possibility of complete inundation and eventual evacuation (Tompkins et al., 2005; IPCC, 2007c).

1.4.6 Changes to living marine species

Already reeling from major collapses of commercial marine species, the environmental changes resulting from climate change could result in further collapse of marine animal populations, both commercial and non-commercial. Continued use of and improvement in commercial harvesting techniques will render critical stocks and habitats unsustainable as the changes in oceanic environmental conditions exert increased pressure on the ability of marine species to procreate. While overfishing is still identified as the primary reason for marine stock collapse, the impacts of climate change are accelerating an already catastrophic deterioration of marine ecosystems and loss of biodiversity. Recent studies even project that all commercial fish and seafood species will collapse by 2048 unless serious mitigation efforts are commenced (Worm et al., 2006).

1.4.7 Increased hazardousness of coastal zones

As global oceanic changes are reflected in the increased exposure of coasts to storms, flooding, erosion and tsunamis, coastal zones will become increasingly hazardous places to live. Higher rates of flooding, erosion, damage to human infrastructure and loss of life

will result in increased risks for coastal populations and infrastructure across the globe. The IPCC states that:

Many millions of people are projected to be flooded every year due to sea-level rise by the 2080s. Those densely populated and low-lying areas where adaptive capacity is relatively low, and which already face other challenges such as tropical storms or local coastal subsidence, are especially at risk. The numbers affected will be largest in the mega-deltas of Asia and Africa while small islands are especially vulnerable.

(IPCC, 2007c)

Nicholls et al. (2007) provide an excellent assessment of the state of the world's coastal systems in relation to climate change. Table 1.2 summarises their assessment and presents a daunting overview of the challenges for global ocean and coastal management in an environment of climate change and global warming. Finally, the Working Group on Climate, Oceans and Security under the Strategic Oceans Planning to 2006–2016 initiative of the Global

Table 1.2 Climate drivers and biophysical effects on coastal systems.

Climate driver (Trend ^a)	Main physical and ecosystem effects on coastal systems
CO ₂ concentration (↑)	Increased CO ₂ fertilisation; decreased seawater pH (or 'ocean acidification') negatively impacting coral reefs and other pH-sensitive organisms
Sea surface temperature (↑, R)	Increased stratification/changed circulation; reduced incidence of sea ice at higher latitudes; increased coral bleaching and mortality; poleward species migration; increased algal blooms
Sea level (↑, R)	Inundation, flood and storm damage; erosion; saltwater intrusion; rising water tables/impeded drainage; wetland loss (and change)
Storm intensity (↑, R)	Increased extreme water levels and wave heights; increased episodic erosion, storm damage, risk of flooding and defence failure
Storm frequency (?, R)	Altered surges and storm waves and hence risk of storm damage and flooding
Storm track (?, R)	
Wave climate (?, R)	Altered wave conditions, including swell; altered patterns of erosion and accretion; reorientation of beach planform
Run-off (R)	Altered flood risk in coastal lowlands; altered water quality/salinity; altered fluvial sediment supply; altered circulation and nutrient supply
Air temperature (↑, R)	Increased permafrost melting; increased surface, through, and ground water flow; increased sub-aerial erosion (slumping, gullyng, erosion, etc.) along Arctic coastlines

Source: After Nicholls et al. (2007).

^a Trend: ↑, increase; ?, uncertain; R, regional variability.

10 Integrated Coastal Zone Management

Forum on Oceans, Coasts, and Islands (<http://www.globaloceans.org/planning/index.html> – accessed 28 February 2008) predicts the following regional impacts of climate change on the coastal areas of the world:

- Africa – by the end of the twenty-first century, sea-level rise is projected to affect low-lying coastal areas, with further degradation of mangroves and coral reefs; the cost of adaptation to sea-level rise estimated to be at least 5–10% of gross domestic product.
- Asia – predicted significant sea-level rise will result in greater risks of flooding and seawater intrusion; loss of coral reefs is estimated at 24% in the next 10 years and 30% within 30 years.
- Australia/New Zealand – continued coastal development and population growth will lead to higher risks from sea-level rise.
- Europe – sea-level rise will cause a loss of up to 20% of wetlands resulting in increased risk of flash floods, coastal flooding and coastal erosion; coastal flooding predicted to negatively impact up to 1.6 million people annually.
- Latin America – sea-level rise will negatively impact Mesoamerican coral reefs; increased risk of flooding in low-lying coastal areas due to sea-level rise.
- North America – continued coastal development and population growth will lead to higher risks from tropical storms.
- Polar regions – potential navigable northern sea routes for shipping.
- Small islands – sea-level rise may lead to increased storm surge, erosion and inundation, leading to threats to vital infrastructure; deterioration of coastal conditions, including coral bleaching and beach erosion.

1.5 The global response

So what are we doing about all of this? In January 2006, the Global Forum on Oceans, Coasts and Islands met in Paris for its third forum. This conference followed on from the Ocean Policy Summit held in Lisbon in 2005. The Global Forum is the nearest thing we have to a world organisation for the sustainable management of oceans and coasts. Funded through the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Environment Programme (UNEP), the Global Forum brings together a wide range of governments, groups, non-governmental organisations (NGOs), and individuals from around the world to facilitate collaboration and cooperation, to promote integrated coastal and ocean management (ICOM) and to encourage the expansion of efforts to protect, conserve and sustain ocean and coastal resources. The Global Forum collaborated with the Third World Ocean Network conference in Boulogne-sur-Mer (also in January 2006), which is linking aquariums, museums and marine tourism to educate the public about the plight of the oceans. The Third Global Forum, *Third Global Conference on Oceans, Coasts, and Islands: Moving the Global Oceans Agenda Forward*, which was attended by 403 delegates representing 78 countries, identified some critical issues for ICOM globally, and they are worth thinking about (Cicin-Sain et al., 2006a, b):

- The targets of eliminating illegal, unreported and unregulated fishing, and fishing over-capacity by 2004 and 2005 have not yet been met, and 75% of fish stocks are classified

by Food and Agriculture Organization (FAO) of the United Nations as fully exploited, overexploited or depleted.

- In many of the poorest countries, a cycle of extreme poverty coupled with excessive exploitation of the environment needed for survival still prevails, contributing to marine pollution and excessive resource depletion.
- The goal of establishing representative networks of marine protected areas by 2012 will not be met until 2085 at the present rate of designation, although some countries, such as Australia, Palau, the Cook Islands and Costa Rica, have made significant progress in establishing marine protected areas with a view towards protecting marine and coastal biodiversity.
- Although half of the world's 43 small island developing state, as well as a number of other countries, have adopted ecosystem-based management and coastal and ocean management programs, no international organisation is responsible for tracking progress in the establishment of these program. In addition, there is no regular collection of information on the social and economic well-being of coastal communities.
- Sixty states have initiated national plans of action to address land-based sources of marine pollution under the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities, which accounts for 80% of marine pollution.
- According to the UN Millennium Project, urgent action is needed to achieve the Millennium Development Goals (MDGs), but it remains to be seen if sufficient action has occurred to move closer towards their achievement. Much effort has been put into the development of indicators to measure achievement towards the targets and goals, but little emphasis has been placed on oceans, coasts and coastal populations.
- One area where tangible progress is being made is in the protection of marine biodiversity and networks of marine protected areas (MPAs). Implementation of the biodiversity and MPA goals established by the 2002 World Summit on Sustainable Development (WSSD) has benefited from the connection to the International Convention on Biological Diversity and its Secretariat, which provide a well-organised structure and process for advancing biodiversity around the world. The large majority (71%) of nations reporting to the Convention on Biological Diversity indicate that they have designated MPAs and/or have plans to improve existing MPAs; while 51% report that development of an MPA system or network is underway, and 29% report that an MPA system or network is already in place.
- There are now more than 700 ICZM initiatives in more than 90 nations around the world, but there are no standardised evaluation criteria for measuring their performance in achieving the goals established by the WSSD and MDGs, although there are efforts towards this direction.

While there is a huge variation in the level, commitment and effectiveness of formal ICZM programs and initiatives around the world, nonetheless progress is being made even if it is painfully slow and lagging far behind the management needs of the world's oceans and coasts. Sadly, these efforts might be more acceptable under a relatively stable global environment, but in the context of global change and increasing global warming they are woefully and pitifully inadequate. The commitment to ICZM on a global level is simply not there, and Canada is an example of the good, the bad and the ugly when it comes to ICZM.

1.6 Canada's experience in ICOM

As illustrated in Figure 1.2, Canada has a huge coastal zone and ocean area incorporating the longest coastline (243 797 km) and the second largest contiguous continental shelf area (2 877 623 km², but the total area exceeds 5.5 million square kilometers if one includes the 0–12 nautical mile territorial sea) of any country in the world. Despite these facts of global significance, Canada's experience in ICOM¹ has been characterised by periods of impressive advances separated by long periods of relative inaction.

A recent special issue of the journal *Coastal Management* has assessed the state of ocean and coastal management in Canada (Ricketts and Harrison, 2007a). Canada's marine and freshwater coasts include three oceans – Atlantic, Pacific and Arctic; the Gulf of St. Lawrence and the Great Lakes; and important seas, bays and straits, including the Beaufort Sea, Labrador Sea, Hudson Bay and the Davis Strait (Ricketts and Harrison, 2007b). There is a huge diversity of physical, oceanographic and biological characteristics, as well as significant socioeconomic dependence upon coastal and ocean resources and transportation. Because Canada has a relatively small population for its size, it is often assumed that there are few people living along the coast and hence little incentive for the government to be concerned about managing coastal and ocean resources. However, Manson (2005) shows that a growing number of Canadians are living in the coastal zone, and consequently are becoming increasingly exposed to coastal hazards (such as sea-level rise, erosion, flooding, earthquakes and tsunamis) and are putting increased pressures on the environmental and resource capacities of Canada's coasts and oceans. The sustainable development and management of Canada's coasts and oceans is an issue of national and international importance, and this has been reflected by increasing government interest in ICOM. Furthermore, Canada's coastal zones have been and continue to be severely impacted by environmental change.

Indeed, major crises in coastal economic development have been instrumental in influencing the development of ICOM in Canada. In 1992, Atlantic cod stocks became the first of a series of commercial fish stock collapses that sent a shiver throughout coastal communities in Canada. The impacts on government were enormous, as for the first time a coastal resource issue became a major political headache, and the public became aware of how predictions of a stock collapse by fisheries scientists had long been ignored, indeed stifled, by the responsible government agency for over 10 years. It is important here to note the brave and pioneering work of Dr Ransom Myers, whose untimely death from cancer in 2007 marked a huge loss to the global scientific community and the cause for sustainable fisheries management.

Before moving to Dalhousie University, Dr Myers was one of a number of fisheries scientists at the Department of Fisheries and Oceans (DFO) who raised the alarm about the reproductive future of the Atlantic cod stocks and called for a reduction in commercial fishing and a change to the way in which DFO was managing fish stocks and establishing

¹ In Canada, the term integrated coastal and ocean management (ICOM) is used rather than ICZM because of the fact that the involvement of the federal government (through the Department of Fisheries and Oceans) is primarily through its authority for the oceans, whereas responsibility for the coastal zones involves the jurisdictions of the provincial governments.

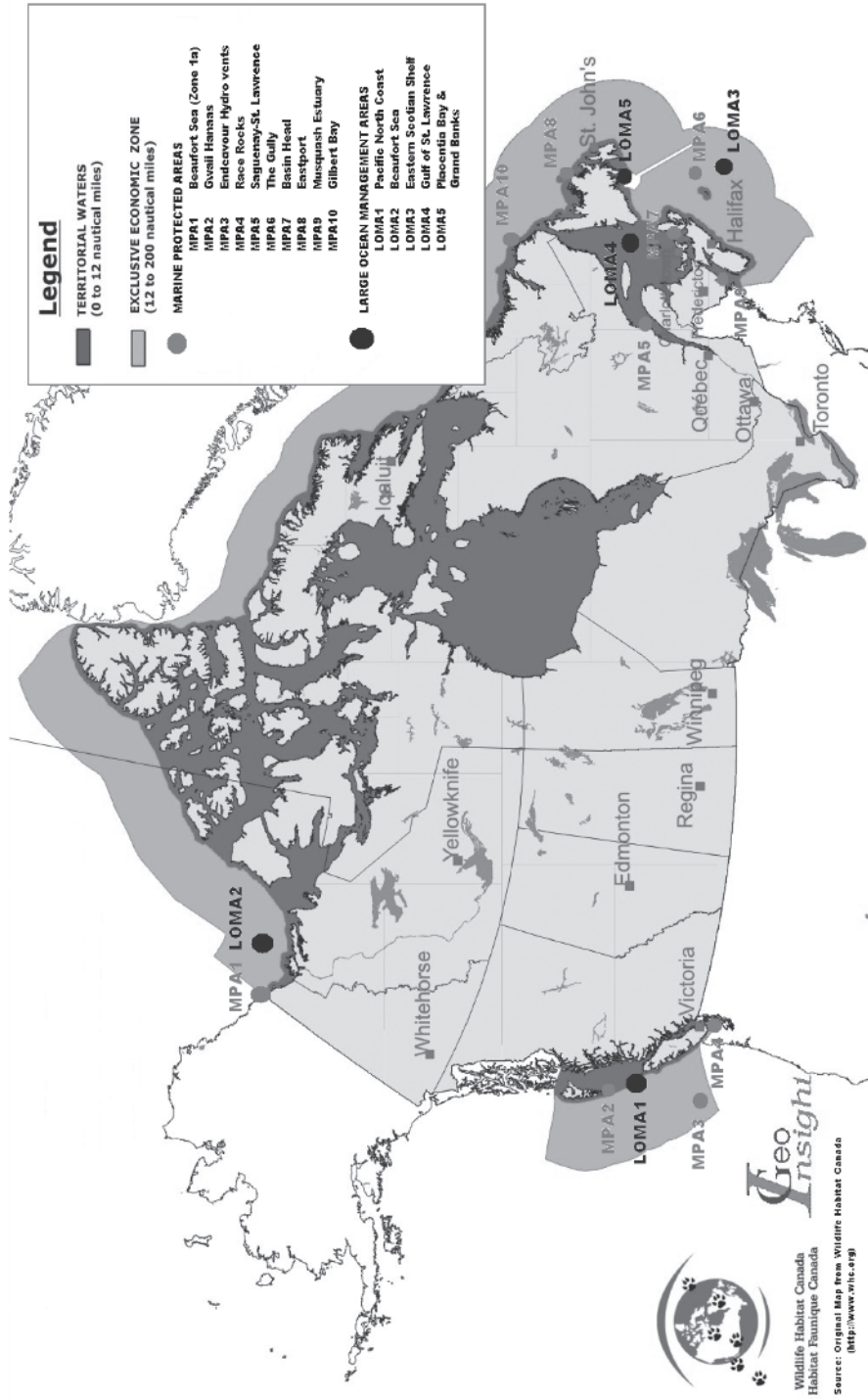


Figure 1.2 Canada's marine protection and management areas.

total allowable catch limits. Dr Myers's research was effectively shut down and he was forced to leave his position to seek academic freedom at a university. Later as a marine biologist at Dalhousie University and holder of the Killam Chair in Ocean Studies, Dr Myers went on to discover that 90% of the world's sharks, bluefish tuna, swordfish, cod and other big predatory fish had been serially stripped from the seas by industrialised fishing since the early 1950s. In October 2005, *Fortune* magazine declared him one of the top ten people in the world to watch, listing him between the then US Senator Barack Obama and the cofounders of Google.

1.6.1 The Canada Oceans Act

The collapse of the cod fishery helped promote government action, albeit slowly, towards ICOM, starting with the passage of the Oceans Act in 1997 (Government of Canada, 1996), and followed some 6 years later with the implementation of the oceans action plan (OAP) in 2004. Along a similar time scale, the Kyoto Accord was opened for signature in December 1997. However, partly due to the opposition of key provincial governments (which control much of the resource production in the country) at the time, the Government of Canada only ratified it in 2003, thus belatedly commencing the development of a plan of action to reduce carbon emissions in accordance with Kyoto targets. Although not linked at the time, ICOM and global warming are now very much related in terms of the urgency of action required to reduce greenhouse gas emissions and prepare for and, where possible, mitigate against the dramatic impacts on our oceans and coasts.

Without doubt, the Oceans Act was the most significant and hopeful development in Canadian coastal and ocean management to date. This clear expression of political will, missing so long from the ICOM equation in Canada, was finally a reality (Ricketts and Harrison, 2007b). The Oceans Act included three parts covering sovereign rights, a national oceans management strategy and the consolidation of federal legislation on oceans (see Figure 1.3), and the DFO was designated as the lead federal agency for ICOM in Canada. With this legislation, Canada effectively adopted the provisions of the United Nations Convention on the Law of the Sea (UNCLOS) (UN, 1982) including the establishment of a 200 nautical mile exclusive economic zone. The Act also incorporated three key principles of sustainable development, integrated management and the precautionary approach, and is the first comprehensive oceans legislation of its kind in the world. Within the context of the Oceans Act, DFO was legislated to lead and facilitate the development and implementation of a national strategy for the management of Canada's estuarine, coastal and marine ecosystems.

By 1998, DFO had begun to put flesh on the framework of the Oceans Act by releasing a review document entitled *Toward Canada's Oceans Strategy* (DFO, 1998). This proposed Oceans Strategy was to be built on the three principles of the Act and would focus on the goals of replacing the existing fragmented approach to oceans management with a collaborative, integrated approach; expanding working partnerships among oceans stakeholders and increase their responsibility and accountability; optimising the economic potential of our oceans while ensuring their conservation and sustainability; and positioning Canada as a world leader in oceans management. However, in the years following, there was little actual progress towards the development of an integrated approach to coastal and ocean

- ◆ **PART I: Sovereign Rights and Jurisdiction**
 - ◆ EEZ and Contiguous Zone
 - ◆ RATIFICATION OF UNCLOS

- ◆ **PART II: National Oceans Management Strategy**
 - ◆ Sustainable Development
 - ◆ Integrated Management of Ocean and Marine Activities and Resources
 - ◆ Common Heritage of Canada's Three Oceans
 - ◆ Ecosystem Approach to Maintain Biodiversity
 - ◆ Precautionary Approach
 - ◆ Economic Diversification and Wealth Generation
 - ◆ National Strategy for Management of Estuarine, Coastal, and Marine Ecosystems
 - ◆ DFO as Lead Agency – mandate to collaborate – federal, provincial, First Nations, coastal communities, etc.

- ◆ **PART III: Consolidation of Fedreal Legislation**

Figure 1.3 Key elements of the Canada Oceans Act 1997.

management. Despite the passage of the Oceans Act, the development of coastal and ocean management in Canada moved slowly, sporadically, and with more talk than walk. Most activity occurred within the various resource sectors, and at the provincial and community levels.

It was not until 2002 that some momentum developed with the long anticipated publication by DFO of *Canada's Oceans Strategy* (DFO, 2002), followed by Canada's ratification of the UNCLOS at the end of 2003. Then in February 2004, the federal government announced its intention to develop an OAP. Finally, some 7 years after the Oceans Act the government was proposing some action to implement its content. This fact was emphasised in 2005 by the Auditor General of Canada who released his findings of the actions taken by the Government of Canada to implement the Oceans Act (Auditor General of Canada, 2005). The report found that following the passing of the Oceans Act, oceans ceased to be a government priority and that 'after 8 years, the promise of the *Oceans Act* is unfulfilled'. However, despite lamenting the glacially slow progress in implementing the Oceans Act, the report did recognise the progress now being made by DFO under the OAP.

1.6.2 The oceans action plan

Phase I of the OAP is composed of a number of initiatives grouped under four pillars: international leadership, sovereignty and security; integrated oceans management for sustainable development; health of the oceans; and ocean science and technology. These pillars constitute the framework for action under Phase 1 of the OAP, as illustrated in Figure 1.4.

Oceans Action Plan: The Four Pillars

- I. **International Leadership, Sovereignty, and Security**
 - Arctic Marine Strategic Plan
 - Regional Cooperation – e.g. Gulf of Maine
 - Continental Shelf sovereignty
- II. **Integrated Oceans Management for Sustainable Development**
 - Ecosystem-based Management
 - Five pilot Large Ocean Management Areas (LOMAs)
- III. **Health of the Oceans**
 - Ballast water discharge regulations re. invasive species
 - Enhanced marine pollution surveillance and enforcement on continental shelf
 - Marine Protected Area Strategy – network of MPAs
- IV. **Ocean Science and Technology**
 - Marine and Ocean Industry Technology Roadmap
 - Oceans Science and Technology Partnership
 - Placentia Bay Technology Demonstration Platform

Figure 1.4 Four pillars of Canada's oceans action plan.

1.6.2.1 *Pillar 1: international leadership, sovereignty and security*

The initial passage of the Oceans Act in 1997 was followed shortly by Canada declaring its exclusive economic zone and ratifying the United Nations Law of the Sea Convention (UNCLOS III). Under the OAP, Canada will continue to play a leadership role in international oceans bodies (such as UNCLOS; Global Forum on Oceans) and will work closely on oceans stewardship with the United States and Mexico under the 2005 *Security and Prosperity Partnership of North America*. The OAP provides specific support for collaboration with the US in the Gulf of Maine, and to the Arctic Marine Strategic Plan, which was adopted by the Arctic Council in November 2004. Under this pillar, the OAP will also emphasise both the significant problem of overfishing in the Northwest Atlantic Fisheries Organization's (NAFO) regulatory area and elsewhere in the world's oceans, and the quest to confirm our sovereign rights over the full extent of the continental shelf (UNCLOS, art. 76).

1.6.2.2 *Pillar 2: integrated oceans management for sustainable development*

Integrated management (IM), based on an ecosystems approach, is one of the key requirements of the Oceans Act. The IM pillar is a key component of the OAP through the establishment of five large ocean management areas (LOMAs) – Placentia Bay and the Grand Banks, Scotian Shelf, Gulf of St. Lawrence, Pacific North Coast and the Beaufort Sea (see Figure 1.2). The LOMA is at the core of one of the specifically Canadian elements

of the approach to ocean and coastal management under the Oceans Act. This Canadian approach is one of starting out in the ocean (where the federal government has clear jurisdiction) and then moving landwards to bring in the provincial governments, municipal governments and other players and stakeholders in the coastal zone, to bring the LOMAs onshore. This is quite the opposite from traditional approaches to coastal and ocean management, such as in the US, where they have started with the coastal zone (and often a fairly narrow definition of that zone) and are now trying to incorporate broader ocean management approaches into the existing CZM structure. Because of Canada's difficulties in getting the federal and provincial governments to agree on a national approach to CZM, the federal government has chosen to move ahead in the area where it has sole jurisdiction (i.e. the ocean) and work with the provinces and key stakeholders to bring in the coastal zone as the IM process develops. This is occurring more quickly in some areas than in others (Gu enette and Alder, 2007).

1.6.2.3 *Pillar 3: health of the oceans*

Under this pillar, Transport Canada will develop appropriate regulations for ballast water discharge in order to reduce the risk of aquatic invasive species, and will enhance its pollution surveillance on the East Coast by doubling the number of its patrols and coordinating closely with Radarsat information. An amendment to the Migratory Birds Convention Act will make the enforcement of marine pollution cases more effective. A significant component of this pillar is the implementation of the *MPA strategy* under which Fisheries and Oceans Canada, Parks Canada and Environment Canada will work towards establishing a coordinating network of MPAs. As shown in Figure 1.2, some ten areas either have been designated or are slated for designation as MPAs under this pillar of the OAP.

1.6.2.4 *Pillar 4: ocean science and technology*

A number of ocean technology networks already exist across Canada which link together ocean researchers in various domains, ocean-related institutions and technology developers. Under this pillar, the 'oceans science and technology partnership' (OSTP) has been created to build on existing synergy and to lay the ground for more extensive cooperation in the future. Also, support is being given to the Placentia Bay Technology Demonstration Platform, which will use state-of-the-art systems to provide stakeholder access to data and information in support of effective management and sustainable development of coastal and ocean areas. On Canada's west coast, a number of university-based initiatives (primarily through the University of Victoria in British Columbia) are pushing forward the boundaries of knowledge about ICOM. These include VENUS, a joint Canada-US project that will create the largest cable-linked seafloor observatory in the world, and the larger scale NEPTUNE project that will cover the entire Juan de Fuca plate.

With the time and budget for Phase 1 of the OAP completed, the development of Phase 2 was underway when something happened that is part of the democratic process. In January 2006, the election of a minority Conservative government following 13 years of successive Liberal governments brought a considerable chill to the development and implementation of climate change policy and the Oceans Act in particular. All new governments go through

18 Integrated Coastal Zone Management

a period of review and reflection of the policies that they inherit from the preceding government, especially after such a long period of relative stability in the governing party. The Conservative government has moved considerably from its initial hostility to climate change, especially as embodied in the Kyoto Accord, and has started to embrace the need for the control of greenhouse gases albeit at a different rate and intensity to those agreed under Kyoto. Hopefully, there will be a similar shift in terms of ICOM and Canada's government will move forward to the second phase of implementing its responsibilities under the Oceans Act.

Canada is now well placed to develop and implement a structure and process of IM of coastal and ocean resources in a manner that is most effective and appropriate for the political, legal and constitutional circumstances of the country. The development of the next phase of Canada's OAP is critical to determining whether or not Canada is up to the challenge, and whether Canada will continue to take a global leadership role in ICOM. After a long period of gestation and then an accelerated period of progressive action, it would be tragic if Canada now slipped back from its current position of global leadership. Unfortunately, at the time of writing the jury is still out on this!

1.7 Promoting ICOM to a broader audience

Recently, public opinion has turned once again towards highlighting the environment, and 'recovering politicians' such as former US Vice President Al Gore are promoting action on global warming. Given this resurgence in public support for environmental issues and the need to address them on a global scale, what future lies for ICOM and what role should scientists and researchers play in this movement to mobilise action to address these critical issues?

As scientists of oceans and coasts, we have perhaps the greatest potential to educate the public about the reality of global warming and the importance of recognising the contribution that we as humans are having on global change. Also, global change provides a powerful argument for ICOM given that the world's coastal zones are among the most susceptible to global climate change, be it human induced or otherwise. One might have thought that the major environmental crises that have affected coastal zones over the past 10–15 years would have made a compelling case for ICOM on their own. Such events as the collapse of the northern groundfisheries, increased intensity of hurricanes and cyclones, the Indian Ocean tsunami, the melting of permafrost and the Arctic and Antarctic ice sheets, and the numerous signs of global sea-level rise all have major implications for the world's coastal zones. Yet we still do not have consensus about the need for an effective, global regime for ICOM. Why is that?

The answer lies in the singular failure to translate our scientific knowledge about the threats to oceans and coasts from our current unsustainable approach into a message that can be recognised and embraced by the general public and politicians alike. Those of us who are counted as scientists and researchers have consistently failed to take it upon ourselves to develop a clear and understandable case for the management of our oceans and coasts. We have chosen, instead, to prefer to talk amongst ourselves in a language that inspires great minds and intellect, but says little of meaning to elected politicians and decision-makers

and even less to the average citizen. There are many successful efforts underway to change this, but we must do more to ensure that the scientific message gets out to the public, politicians and decision-makers.

One example of a concerted effort to move the public and political ICOM agenda forward is the Coastal Zone Canada Association (CZCA), which was established in 1993 to help bridge the communication gaps between scientists, coastal communities, decision-makers, politicians and the general public. Through its seven biennial Coastal Zone Canada (CZC) conferences to date, the CZCA has attempted to translate the science of coastal management into advice for policy and calls for action. The CZC conferences have a broad and varied mix of participants and have all been designed to stimulate interactive dialogue and understanding across the spectrum of ocean and coastal stakeholder groups.

The CZCA has worked to create a meaningful dialogue between the wide range of stakeholders in the coastal zone. Since its creation in 1993, the Association has seen some success in influencing Canadian public policy on ICOM, and provides one example for other scientific organisations to use their collective expertise to influence public policy. The CZCA is not a lobbying organisation, but by creating real dialogue, developing conference statements and outputs that are directed towards influencing public policy, and through the influence and actions of individual members, the CZCA has been able to be an influence towards developing more effective ICOM policy in Canada. Table 1.3 provides a summary of the outcomes of the CZC conferences till 2006, and indicates some of the progress made towards moving ICOM to a higher priority within the public policy agenda in Canada. In particular, the *Rimouski Declaration* from CZC 1996 was influential in the development and content of the Oceans Act, while the most recent *Tuk Declaration* from CZC 2006 identified many concerns that have subsequently been addressed by the federal government in relation to resource management, climate change impacts and security in Canada's Arctic.

However, despite these advances, we have failed to influence public opinion in a sustained and significant way and remain susceptible to the swings of public support for serious action on environmental issues. In promoting marine research, organisations such as ICES must also engage in the broader debate of influencing public opinion and public policy to promote ICOM. When we come together in scientific gatherings, we should always have as one objective some kind of statement or message to bring to policy makers and the general public. We cannot simply continue to talk to ourselves as scientists and researchers and we must be prepared to engage in the broader debate that we have traditionally left to others. We have a responsibility to take our knowledge and our expertise beyond the limits of our scientific community and into the realm of public debate.

In their analysis of the importance of communications in accomplishing a global marine conservation strategy, Adabia et al. (2004) conclude that the key is to communicate globally and advocate regionally and locally. This involves a multi-scaled approach to marine conservation communications, requiring international, national and local campaigns tailored to reach target audiences in priority regions of the world. The integration and communication of climate and ocean science and policy to governments, decision-makers, civil society and the public is crucial for both the developed world and the developing world in order to build support for the necessary mitigation and adaptation measures, as well as the protection, conservation and sustainable management of our oceans and coasts.

20 Integrated Coastal Zone Management

Table 1.3 Outputs of Coastal Zone Canada (CZC) conferences 1994–2006.

CZC year	Location	Problems and issues	Outputs and solutions
CZC 1994	Halifax, NS	Lack of national policy discussion and development on ICOM in Canada Empowerment of communities and stakeholders	Call for action: recommendations on addressing poverty, empowerment, rights of indigenous peoples, integrating traditional knowledge into science
CZC 1996	Rimouski, QC	Lack of national ICOM policy in Canada Lack of follow-up on Agenda 21	Rimouski Declaration on Canada Oceans Policy Call for Canada Oceans Act Declaration for international action
CZC 1998	Victoria, BC	Lack of capacity for communities and stakeholders to participate in ICOM Need to involve youth	ICOM toolkit for communities Statement on youth action and perspectives
CZC 2000	Saint John, NB	Lack of capacity to measure progress in ICOM	Baseline 2000 Beyond 2000 Agenda for ICOM development ICOM toolkit
CZC 2002	Hamilton, ON	Getting freshwater and saltwater communities together Managing transboundary waters	Hamilton statement on managing shared waters Resource kit for managing transboundary coastal ecosystems
CZC 2004	St. John's, NL	Lack of implementation of ICOM components of the Canada Oceans Act	Conference statement on Canada OAP
CZC 2006	Tuktoyaktuk, NWT	Problems affecting Canada's northern coasts and communities Impacts of climate change on Arctic coastal zone	Tuk declaration Call for effective ocean and coastal strategy for the Arctic under OAP Creation of a northern CZC organisation

ICOM, integrated coastal and ocean management; OAP, ocean action plan.

1.8 Who speaks for the oceans?

There is a great need for a concerted global effort for sustainable management and protection of our oceans and coasts. The movement for managing the world's large marine ecosystems (LMEs) is an important force towards global ICOM. But what about the rest of the oceans, most of which is largely unknown? Who speaks for the oceans?

The sad truth is that nobody speaks for the oceans in a truly coherent and effective manner, and even less so for including oceans and coasts together as an essential step towards global sustainability. Defying Ocean's End is one initiative that presents a valuable agenda for global action on sustainable ocean and coastal management (Glover and Earle, 2004). Focusing on six key areas – ocean governance, marine protected areas, communications, the land–ocean interface, fisheries reform and aquaculture, and global science, the Defying Ocean's End initiative presents an agenda for action to build upon existing global initiatives in order to bring about a 'sea change' in awareness, action and behaviour towards the oceans. We need to link these with other global efforts, such as the Global Forum on Islands, Oceans and Coasts (including their new Strategic Oceans Planning Initiative), the Intergovernmental Oceanographic Commission and the World Ocean Network, but above all we need action and we need it sooner rather than later. The time has come for the United Nations to establish a Commission on Ocean and Coastal Management in order to bring ICOM to the global political agenda and to provide the necessary support to regional, national and sub-national efforts to manage the world's ocean and coastal resources on a sustainable basis. The aforementioned relative success in the area of biodiversity can be directly linked to support structures provided under the Convention on Biological Diversity. Furthermore, it is time to join forces with the IPCC in order to highlight the enormous implications of climate change on oceans and coasts, and to start taking serious efforts to reverse the path to oblivion and mitigate the impacts on coastal populations. If ICOM was not important enough to have as a UN global initiative before the issue of human-induced climate change emerged, then surely it is now. As Gordon Moore and Sylvia Earle state:

Our collective challenge is nothing less than the creation of a framework and steps for a practical agenda of global action – including coasts and impacts – to safeguard the ocean for generations to come.

(Glover and Earle, 2004)

Do we live in a state of fear or a state of oblivion? Or do we want to live in a state of awareness, reason and responsibility? Do we even think it our responsibility as scientists to do anything about it? The challenge of this chapter is that it is our responsibility and that we must care enough to take action collectively. The reality is that we must speak for the oceans and coasts – because if not us, then who?

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22 Integrated Coastal Zone Management

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