EXECUTIVE SUMMARY

"The sea was swarming with fish, which could be taken not only with the net but in baskets let down with a stone, so that it sinks in the water."
– John Cabot's crew off the Atlantic coast in 1497

Why We Need New Indicators

In the late 1980s, Nova Scotia's fishery for cod and other groundfish seemed to be booming. The media reported steady catches, high exports, and strong contributions of the fishery to the province's Gross Domestic Product (GDP), the conventional measuring stick of the economy.

A few years later, many fisheries were collapsing and the fabric of many coastal communities began to unravel. Our conventional economic measuring sticks – such as catches, exports and GDP – did not warn of the impending disaster. While catches were kept high, the decline of the groundfish stocks remained hidden from public view, as we focused excessively on a narrow set of economic measures that failed to incorporate all that we value in the fishery – notably healthy fish stocks within a healthy ecosystem, supporting strong fishing communities and a sustainable fishing economy.

Another example of failing to measure what we value may be found in the marine oil spills that have occurred in the ocean ecosystems of Nova Scotia and beyond. Every such oil spill is good news for the economy, because cleaning up the mess causes money to be spent, producing an overall positive effect on our conventional economic indicators such as GDP. Yet, as with the collapse of fish stocks, oil spills clearly represent a decline in well-being and sustainability and not an increase in prosperity as our conventional measures of progress imply.

If the protection of the marine environment is important to us, we clearly need a set of measures that better reflect the reality of what we value and that assess the well-being of the fishery and the marine environment more accurately. Unlike the confusing signals sent by our economic growth statistics, genuine indicators of fisheries and marine environment health would move in a positive direction to reflect positive outcomes, and decline in response to declining fish stocks, oil spills and other liabilities. Such declining indicators can also send early warning signals to policy makers that could potentially avoid disasters like the collapse of the groundfish stocks.

Such indicators would enable us to track over time the state of Nova Scotia's fish stocks, the fishery's contribution to our economy, the quality of the marine environment, the well-being of the communities that depend on the ocean for their livelihood, and the effectiveness of the institutions that govern fishing activities and ocean use. Developing such a comprehensive, accurate and meaningful overall assessment of the state of the fishery and the marine environment is a crucial challenge for society, particularly in a region like Atlantic Canada whose well-being has historically depended on the ocean.

Framework of the GPI Fisheries and Marine Environment Accounts

The *GPI Fisheries and Marine Environment Accounts* for Nova Scotia represent an initial response to this challenge, through the creation of a framework of indicators that can be monitored and applied on a regular basis to evaluate the well-being and sustainability of the fisheries and the marine environment.

Remarkably, this is among the first, if not *the* first, such effort to appear anywhere in the world. The report has been prepared as one of the components of Nova Scotia's Genuine Progress Index (GPI), a comprehensive set of measures that enable us to assess our social, economic and environmental well-being more accurately. The GPI includes a full set of natural resource accounts that value our *natural* and *social* wealth just as our conventional accounts value our produced or manufactured wealth.

Each indicator in the *GPI Fisheries and Marine Environment Accounts* measures one particular aspect of the marine system, dealing with the ecosystem, socioeconomic progress, the well-being of coastal communities, and the institutional integrity of fishery and ocean management. The indicators are therefore organized into major categories, reflecting the fundamental components of well-being and sustainability that must be simultaneously achieved within a process of sustainable development:

- *Ecological Indicators*
- *Socioeconomic and Community Indicators*
- *Institutional Indicators*.

The first of these categories includes aspects specific to fish stocks, as well as those pertaining to the marine ecosystem more broadly. The second category includes the conventional economic indicators, as well as those describing the current state and sustainability of the social, economic and community aspects of the fishery and other ocean use sectors. The third category concerns matters of financial, administrative and organizational capability, including the manageability and enforceability of resource use regulations, and organizational integrity in ocean management.

Within these three categories, a very wide-ranging set of indicators has been examined in this report. These indicators, listed at the end of this Executive Summary, were selected primarily on the basis of perceived importance and data availability.

Some Results of the GPI Fisheries and Marine Environment Accounts

- Many fish species, especially many groundfish species, declined in recent decades, while others, notably shellfish, did not. Shrimp, for example, appears to have increased in biomass since 1995 and the lobster biomass (as reflected in catch levels) appears to have been relatively constant since 1990.

- While there was no overall trend in the size (at specific ages) of herring or cod between the early 1970s and late 1990s, the average size of pollock decreased considerably, suggesting significant changes in that stock.

- Many non-target species are poorly understood compared to commercially important species such as cod, herring and shrimp, even though the health of these non-target species may be important for commercial species and for the marine ecosystem as a whole. Studies of non-target fish species are very rare. One recent study drew attention to the plight of the barndoor skate, a species that has been severely depleted through unmonitored and uncontrolled capture in Atlantic Canadian trawl nets. Further in-depth study is needed of the health of non-target species, as part of the emerging ecosystem approach to fishery management.

- High levels of bycatch, discarding and dumping of fish can be a serious problem for the health of the fisheries and marine ecosystem. Even though it is very important to understand both the level of bycatch, discarding and dumping of fish and also the trends in these activities, it is not presently possible to track progress in reducing bycatch and discard amounts. This is a serious data gap and a challenging task. Major research efforts are needed to monitor these important indicators of sustainability in fisheries more effectively.

- Population trends of North Atlantic right whales are subject to uncertainty, but there is general agreement that the current population now (just under 300) is above what it was at its lowest level, but far below levels that existed prior to exploitation.

- Ocean gear can adversely affect the ocean bottom, which provides shelter, spawning, nursery grounds and feeding for many fish species. It is therefore important to monitor the human impact on the ocean bottom far more effectively than at present, particularly through studies of fishing grounds impacted by trawling. One estimate suggests that on the American side of George's Bank, an area two to four times the size of the bank was trawled *each year* between 1976 and 1991. Since this location is adjacent to Canadian fishing grounds, these results may provide insights into potential trawl impacts in Nova Scotian waters.

- Concentrations in seabird eggs of PCBs, DDE, HCB and dieldrin – chemical contaminants present in the marine environment surrounding Nova Scotia – all declined overall between 1972 and 1996, suggesting some 'genuine progress' in this aspect of marine environmental quality.

- Government data indicate that Nova Scotia accounts for about 47% of the total number of locations closed to shellfish harvesting in Atlantic Canada. It has been estimated that area closures have increased by an average of 34 square kilometres per year for every year since 1975, and by 264 sq. km. since 1995 alone, a 38% increase in less than five years.

- The value (adjusted for inflation) of fish landed by Nova Scotians increased steadily from 1961, the first year for which data are available, to reach a peak of $701 million in 1987 and the declining to a value of $482 million in 1997. Despite this drop, landed values in 1997 were double what they were in 1970. This can be explained by the increased effort in harvesting species such as lobster that command a high market value. Meanwhile, the fishery

GDP has declined by about one-third in the last decade, and its *percentage* contribution to provincial GDP has declined even more as total provincial GDP has continued to grow.

- Employment 'per fish' taken from the sea can be measured as the number of people employed in Nova Scotia's fishing industry *per unit of harvest* (i.e. per tonne of fish caught), or *per unit of landed value* (i.e. per million dollars in landed value). The first of these indicators has been increasing fairly steadily since the mid-1980s, due largely to the decline in total landings by weight, while the employment per unit of landed value declined in the late 1980s and early 1990s, and then began to increase in the late 1990s.

- Natural capital includes the value of fish stocks remaining in the ocean. In 1997, the natural capital in Nova Scotia's cod stocks was about $74 million lower than in 1982. In 1997, Nova Scotia's haddock stocks had depreciated by about $53 million compared to the level in the early 1980s. The measured 'depreciation' of cod stocks around Nova Scotia since 1990 appears minimal, but caution is needed in interpreting natural capital calculations, since serious resource declines are masked by price rises when natural capital values are assessed according to changing market prices.

- The annual value of ecosystem services for the oceans off Nova Scotia is calculated very roughly as $US119 billion (1997 dollars). The enormity of this figure highlights the fact that the total value of ecosystem services provided by Nova Scotia's marine environment is clearly not captured in the fishery's GDP. Indeed the value estimated here is more than 340 times greater than Nova Scotia's fishery GDP has ever reached.

- Distribution of access to fisheries, and of the benefits produced by the fisheries, is an important part of a GPI account. DFO data show that in one part of the fishery, the ITQ-managed Scotia-Fundy mobile gear groundfish fishery, ownership of 'quota' (representing effective access to the fishery) became concentrated in fewer hands between 1990 and 1998. This arose through a decline in the total fleet size, from roughly 350 vessels to under 150, and a less even distribution of the catches among existing boats. By contrast, the distribution of catches in the *lobster* fishery, while not entirely even, shows no trend over time, remaining roughly constant. However, in terms of *access* to the fishery, there is apparently a recent trend toward the buying up of control over lobster licenses, increasing effective ownership concentration.

- The dependence of Nova Scotian fishers on the various marine species has varied over the years. There is some evidence of a reduced reliance on single fisheries, and thus a more diverse set of fishery livelihood options, over the course of the past century. This may imply greater resilience within fishing communities, a positive trend. On the other hand, the steadily increasing dependence on the shellfish fishery following the groundfish collapse in the early 1990s may be a danger signal of reduced resilience in the future if the shellfish fishery should be threatened for ecological reasons.

- When fishers hold licenses to fish multiple species, this can enhance resilience in the fishery and in coastal communities.There was little change between 1985 and 1993 in the proportions of fishers holding single, double or multiple species licenses, but there has been a gradual

positive trend towards greater multi-species licensing between 1993 and 2000. In 2000 more than 86% of fishers held licenses for at least 2 species, up from fewer than 76% in 1993..

- Between 1931 and 1990 in Nova Scotia, there have been decreases of approximately 5% in both the proportion of young fishers (15-24 years) and the proportion of older fishers (45-65 years) while the proportion of middle-aged fishers (25-44 years) increased by roughly 10%.

- In the aquaculture sector, there have been upward trends in the produced value of each component of aquaculture (shellfish, finfish, and 'other'), as well as in the generation of full-time employment. Finfish, notably salmon, dominate in value terms, but shellfish production generates an important source of employment in many parts of the province. More research is needed on the potential impact of aquaculture both on the ocean habitat (through pollution, disease transfer, etc.) and on fisheries (through habitat impacts, market interactions, etc.)

- There is no consistent trend suggesting that the Nova Scotia fisheries are becoming more or less safe overall for fishers, but the current average of 50 accident claims per year for every 1,000 fishers employed (a 5% rate) remains high.

- Available data suggest that in the three years leading up to the early 1990s groundfish collapse, DFO expenditures decreased significantly on basic scientific work (such as ecosystem and ocean science studies), and on surveillance and enforcement of fishery regulations. Assessing the sufficiency of institutional resources is an important part of a GPI analysis, and requires more extensive development of institutional indicators.

Key Themes in the GPI Fisheries and Marine Environment Accounts

- *The Big Picture*. In the past, there has been a tendency to look at the fishery separate from other ocean uses, and to look at a given fishery, or the harvesting of a particular specie or set of species, as separate from other fisheries, ignoring connections among them. In other words, there has been too much compartmentalization.

  The picture that emerges from this report is an integrated one that recognizes the complex interconnections within the marine ecosystem, and among the humans reliant on that ecosystem. The set of indicators explored here reflects some of the breadth needed to monitor and assess our fisheries and the marine environment more fully and comprehensively than has been the case to date.

- *No Simple Answers*. It does not seem possible to draw a simple conclusion about the current state of Nova Scotia's fisheries and marine environment. The results present a sense of the complexity within the marine environment: There are major problems, reflecting in part the set of crises experienced in Atlantic fisheries in recent years, with some indicators at low levels. On the other hand, other indicators are stronger, and many show no clear trend at all.

  This reinforces the need to use multiple indicators, and to look at each indicator individually, to understand its particular nuances, rather than merely adding up the results. Indeed, this is

the major reason that **GPI***Atlantic* has avoided a 'bottom line' composite Genuine Progress Index, but is slowly constructing each component of the index as a separate entity.

- *A Focus on Resilience*. Resilience is a crucial requirement of sustainability, reflecting the ability of an ecosystem or a human system to 'bounce back' from shocks and to maintain its integrity. For ecosystems, genuine progress is assessed by the capacity to maintain the ecosystem's health over time, in response to human-induced or environmental stresses. Possible determinants of ecosystem resilience include biodiversity and the 'integrity' or well-being of the ocean habitat.

  On the human side, the socioeconomic system and coastal communities must be able to 'bounce back' from dramatic changes in the natural resource base or in the overall economic system. Socioeconomic and community resilience may require attention to such indicators as debt levels, diversification of total fishery landings across multiple species, access of individual fishers to multiple fisheries, diverse age structure among fishers, economic diversification within the fishery, and community-level economic development initiatives that expand diversity and reduce reliance on a single industry.

- *The Ocean's Natural Capital*. To account fully for the 'benefits' of a given harvest, measures of catches and exports must be accompanied both by a measure of the value of the fish remaining in the ocean after the fishery has taken place, and by a measure of ecosystem health. Together, these measures reflect the values of '*natural capital*', the natural assets that include not only the fish in the sea, but also the quality of the water, the ocean bottom habitat, and other elements of the marine environment.

  Some of the benefits that natural capital provides are obvious (like fish to eat), while others, such as the value of habitat provided for non-commercial species, may not be directly apparent to humans. Given the interdependence of all components of the marine ecosystem, it is prudent to recognize *all* benefits, since all have significant and real value. For example, the less visible benthic (ocean-bottom) environment keeps commercial fisheries functioning, among other roles. It is therefore important to monitor the full range of natural capital services if we are to assess accurately the economic health of the fishing industry and other components of the marine economy.

  This report provides an initial, and admittedly overly-simple, effort to assess the state of natural capital over time. By introducing a 'balance sheet' of underlying resource health, on which the fishing industry depends, the GPI approach provides a more accurate and comprehensive measure of resource industry strength and health than conventional accounting systems.

- *The Need for Natural Resource Accounts*. Among the key messages of this report is the importance of publicly accessible natural resource accounts. Had fisheries accounts been included in our core measures of progress in Atlantic Canada in the 1980s, information would have been available to policy makers and the general public to encourage conservation actions *before* the collapse of the cod and other groundfish stocks and the economically devastating moratorium that followed. A major role of the Genuine Progress Index, and of

natural resource accounts in general, is to provide timely early warning signals to policy makers that will allow appropriate responses to resource depletion, to help prevent such catastrophic losses in the future.

Challenges in Future Development of the Accounts

GPI*Atlantic* believes that, quite apart from any specific results, the value of this report lies in providing a prototype for a new approach to looking at fisheries and the marine environment in the form of an integrated set of GPI indicators. However, the set of indicators in this report is by no means exhaustive. In particular, greater attention has been paid to fisheries data than to the marine environment, reflecting the relative abundance of environmental indicators already, and the consequent challenge of developing an accompanying set of fishery indicators. In future versions of these accounts, it will be important to incorporate more detail with respect to the marine environment.

There are good reasons why a set of fisheries and marine environment accounts has not been attempted previously, and these constitute major challenges for future development of these accounts. In particular, data availability is such a major issue in this area that even Statistics Canada did not include fisheries data in its new Canadian System of Environmental and Resource Accounts. A major goal of the report is therefore to highlight where gaps exist in the information base.

The indicators chosen for this report were mostly ones for which data were available to assess trends over time. Nevertheless, clear gaps in data were apparent, and a challenge for future development of these accounts lies in overcoming such data limitations. In particular, there is a need for new databases and improved data availability on community well-being and sustainability, and on institutional indicators.

Another 'data challenge' for the future lies in integrating a wider range of sources of knowledge within the database that is used to generate marine indicators. The indicators in this report are based on whatever numerical data are available, even though these data may sometimes involve relatively short time series. Such data typically omit the rich knowledge and historical accounts of fishers, other ocean users and those in coastal communities – the kind of 'data' that do not fit easily into graphs but which are no less accurate, profound and insightful than statistical data.

A reliance on relatively recent experience – for which data are more available and/or more reliable – may, for example, present a distorted picture of the health of our fish stocks. As the quotation from John Cabot's crew in 1497 (at the start of this summary) indicates, a reliance on recent statistics will lead us to forget that large healthy fish and large healthy fish populations were once standard fare! Efforts are therefore needed in the future to integrate the various sources of knowledge about fisheries and the marine environment more fully.

Discussions of data availability, and indeed of additional data sources that have yet to be utilized, highlight another major challenge for the future. The process of improving the *Fisheries and Marine Environment Accounts* must be an ongoing one, requiring a participatory approach that

involves government departments, academic institutions, non-government organizations, the many users of the ocean environment, and others.

It is hoped that the prototype presented here can be further developed through such a process, and implemented on a regular basis. To this end, **GPI***Atlantic* invites feedback to improve methodologies, data sources and indicator selection.

A Closing Comment

A carefully formulated GPI analysis can assist greatly in providing the information needed for informed decision-making. It can also assist our society and Nova Scotia as a whole to achieve a key policy goal – ensuring that our natural resources are used in a sustainable manner that benefits citizens, communities, and the natural environment both now and in the future. The GPI *Fisheries and Marine Environment Accounts* are intended as a starting point in that endeavour and as a contribution to that process. The diverse set of indicators discussed here need future refinement, but they already go beyond conventional measures, and are ready to be used and applied by policy makers, fishers and other ocean users, coastal communities, and indeed everyone concerned about the health of our fisheries and the marine environment.

Indicators Included in the GPI Fisheries and Marine Environment Accounts

Ecological Indicators

Primary Commercial Species

- Fishable Biomass
- Catch Levels
- Size at Age
- Condition Factor
- Age Structure

Non-Target Species

- Discard Rates
- Right Whales: Population and Reproduction

Resilience and Biodiversity

- Shannon-Weiner Index
- Area of Bottom Habitat Impacted

Marine Environmental Quality

- Organochlorine Contaminants in Seabird Eggs
- Contaminants in Mussels
- Area of Shellfish Closures

Socio-Economic / Community Indicators

Economic Valuation of Fishery Resources and the Marine Environment

- Total Landed Value
- Fishery Gross Domestic Product (GDP)
- Value of Fishery Exports
- Employment per unit of Landed Weight
- Employment per unit of Landed Value
- Market Price
- Natural Capital (Fish Stock Value)
- Annual Depreciation (or Appreciation) in Natural Capital
- Value of Marine Ecosystem Services

Distributional Indicators

- Distribution of Access and Catch among Fishers within a Fleet Sector
- Distribution of Catch among Fishers within a Fishery
- Distribution of Landed Value by Vessel Length

Resilience

- Debt Levels among Fishers
- Reported Bankruptcies
- Bankruptcy Liabilities
- Distribution of Landed Value across Species
- Proportion of Fishers with Multiple Licenses
- Age Distribution of Fishers
- Diversification of Employment Sources

Aquaculture

- Value of Aquaculture Production
- Employment in the Aquaculture Sector

Workplace Safety

- Accident Claims Registered per 1000 Fishers
- Accident Claims Compensated per 1000 Fishers

Institutional Indicators

Sufficiency of Institutional Resources

- Total Expenditures
- Distribution of Expenditures by Category

Acceptability of Institutional Expenditures

- Expenditures as a proportion of Landed Value