

THE DEVELOPMENT AND CONSERVATION OF CANADA'S MARINE RESOURCES

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O t t a w a

"If we really desire to exploit the sea fully, if it is knowledge that we need to accomplish that purpose...then we had better make the necessary costly investment and put full effort into the job of acquiring the knowledge."(2)

INTRODUCTION

Rightly or wrongly, Canada has a reputation for selling out on resources. Many people feel that for a country which boasts almost unparalleled wealth in resources, it has very little control over their development. A feeling exists among many Canadians that Canada has not taken proper advantage of its privileged resource position in terms of development, management and conservation and that because of this the Canadian economy suffers.

The intricacies of modern trade are extremely complex and the intent of this paper is not to offer solutions to existing economic problems or to be judgmental of historical policies. It does however propose guidelines for the attitude which must colour any decisions taken concerning the development and conservation of our last resource frontier -- our aquatic or marine resources.

In this respect it is fervently hoped that the title of this paper does not confound. Resource management is a very complex problem and solutions are never simple or straightforward. At the current stage in the development of management science, it must be admitted that we do not have all the answers. In fact, it could be said that at present it is doubtful whether or not we even know all the right questions. It is suggested however that the adoption of certain basic ecological principles (in other words the use of a generous amount of good old common sense) and the development of a coordinated, well-funded, multi-disciplinary research program could keep us from repeating the mistakes of the past and enable us to formulate a rational approach to the development of Canada's marine resources.

(1) Prepared for the Commonwealth Parliamentary Association (May 11, 1979).

(2) Lionel Walford, Living Resources of the Sea: Opportunities for Research and Expansion, Ronald, 1958.

THE HYDROSPHERE

Before we talk about the wealth the mysterious waters of the world conceal or contain, it is important that we realize that water itself is a precious resource. It should actually be considered to be much more valuable than oil and treated as such. After all, we can do without oil. We wouldn't be as comfortable, but it must be admitted that as a simple source of calories or of hydrocarbons used in the production of synthetic polymers, oil is not indispensable. Water, on the other hand is essential for the functioning of all life processes. And, as living organisms, intimately associated with and most definitely not apart from the biosphere, we are absolutely dependent upon water for our continued survival.

Life on this planet evolved in the water and in this age of awareness of the past our aquatic roots should never be forgotten, or even more unforgiveable, denied. Water is a precious resource which must be recognized as such and treated as such. Profligate waste should be avoided and contamination should be kept minimal.

Unfortunately, many of those who do accept the idea that water is a vital commodity don't go quite far enough. They usually think only of freshwater as a valuable resource -- one that needs protection. But increasing knowledge of the dynamic role the oceans continue to play on Earth indicates that marine or saltwater must also be recognized as a resource which must not be fouled. We left the seas eons ago but they still continue to affect us directly.

The oceans are not only a provider

which can be harvested occasionally to provide needed materials, and they are most definitely not an open sewer which can magically make our refuse disappear. They are a complex system which helps determine the gaseous composition of the air we breathe and which ultimately regulates meteorological conditions on this planet.

Chemically speaking, the waters of the Earth contain vast amounts of dissolved carbon dioxide and some oxygen. Biologically speaking the photosynthetic inhabitants of the ocean produce much of the atmosphere's oxygen and they remove much of its carbon dioxide by turning it into carbohydrate. These two processes not only help control the proportion of gases all the inhabitants of this planet respire, but they also indirectly regulate the Earth's temperature because the latter depends to a large extent upon the concentration of gases in the atmosphere.

The proportion of water which exists as a vapour in the atmosphere, as a liquid on the earth or as a solid in the form of ice or snow depends on temperature. But the temperature of the Earth depends to a large extent on the relative amounts of water in the various states of matter! Too much water vapour in the air would have enhanced the greenhouse effect and trapped additional heat radiation leaving the Earth, rendering it permanently, insufferably hot -- as happened in the case of the planet Venus. Too much water in the form of ice would have locked the earth into a permanent ice age. We must recognize then, that for a variety of reasons, the health of the earth's waters are of paramount importance to our survival. We must husband this resource carefully because a gross alteration of the hydrological cycle could bring about a rather abrupt change in the climatic conditions our geologically recent exper-

ience has led us to believe are normal on Earth.

Canada has been blessed with abundant resources of water. It is bordered on three sides by three oceans and has one of the longest and most productive coastlines in the world. In addition it possesses the lion's share of the entire world's freshwater resources. This liquid wealth is only now beginning to be fully appreciated, but let us hope it is in time. An inheritance like this must not be squandered.

CANADA'S AQUATIC RESOURCES

Having accepted the fact that the molecule derived from the union of two hydrogen atoms with one oxygen atom comprises a valuable resource in itself, we can go much further to see what resources water contains, supports or hides. Aquatic resources may be categorized in many different ways but the seas ultimately provide us with energy, minerals and biological material.

A. Energy Resources

The waters of this earth are not an inert wetness which lies passively on the surface of this planet. They constitute a dynamic force which essentially regulates the meteorological conditions of our world. The main reason the earth's waters are so influential is that they possess vast stores of energy; copious amounts of potential energy in the form of heat and abundant kinetic energy associated with movement.

1. Heat Energy

One tantalizing scheme for deriving utilizable energy from the oceans envi-

sages

"producing energy by using heat engines to harness the small temperature variations between the sun-heated surface of the tropical seas and the cold deep water." (1)

However, as indicated in the quotation, a usable temperature difference between surface and deep waters is mandatory for this system to work efficiently, so this scheme is not likely to figure significantly in Canada's energy future. In fact the location of the sea's most profitably exploitable thermal resource is roughly estimated to lie only in "the 1,700 mile-wide region around the equator between the Tropic of Capricorn and the Tropic of Cancer." (2)

2. Tidal Power

By contrast, energy derived from the tides has a particularly bright prospect in providing Canada with energy derived from water movement. The highest and strongest tides of the world rush unimpeded into the Bay of Fundy and with rising oil prices the raw energy of these tides may soon become economically exploitable.

"The funnel shape of the 145-mile-long bay helps magnify the rushing force of the water as its high tide comes in and raises the water level as much as fifty-three feet twice a day. The present Canadian scheme is to build a complex of dams, which would trap large volumes of water at high tide and send it flowing down into the dam structure to turn turbines." (3)

There is presently only one working

(1) Mark Swann, "Power from the Sea", in Jonathan Bartlett ed., The Ocean Environment, The Reference Shelf Series, Vol. 48, No. 6, 1976, p. 55.

(2) Ibid., p. 58.

(3) "Tide Power for Canada", in Johnathan Bartlett ed., The Ocean Environment, The Reference Shelf Series, Vol. 48, No. 6, 1976, p. 65.

tidal power project -- a French 240,000-kilowatt (2400 megawatts) installation off Malo. However, one Canadian proposal for a huge complex generating 13,000 megawatts would make it the single most productive energy source in the world.

Energy is in high demand and a generating capacity of this magnitude would be a boon to the Canadian energy picture, but there are many problems associated with harnessing the tides, not the least of which would be the questionable environmental effects of such a large scale development. Any project which alters productive coastline or estuarine ecosystems must not be taken lightly or entered into without massive research designed to forecast the ultimate biological consequences of environmental modification.

3. Wave Power

The surface of the ocean is almost always in motion and waves on the ocean's surface contain prodigious amounts of energy. If this energy could be tapped waves could provide an inexhaustible powersupply. Jerome Williams of the U.S. Naval Academy made the following analysis of the potential for waves to be tapped as a usable energy source:

"If we consider tides 40 feet high during a twelve hour period, the power contained per unit of sea surface is about 3×10^{-4} horsepower per square foot. On the other hand, taking average waves in the North Atlantic, perhaps 5 feet high sustained during a six second period, we can expect power densities of about 3×10^{-2} horsepower per square foot. Note that the waves -- and these are not unusually high waves -- contain about a hundred times as much energy per square

foot per unit of time as do tides, making utilization of the energy in waves somewhat more attractive than that of the tides." (1)

Wave power generation is also less likely to cause environmental damage than other forms of energy production derived from harnessing the movement of water. In fact, in many places where breakwaters should be constructed to protect fragile coastlines, wave power generators could not only produce power but improve the environment as well.

As with any form of power production which depends upon an intermittent energy source -- the sea is occasionally calm -- there may be significant problems associated with power storage in "down" periods. However, the prospect of using excess power to carry out electrolysis of water should solve this problem and allow storage of surplus energy in the form of hydrogen.

4. Hydro-electric Power

Most of Canada's easily accessible freshwater hydro potential has been tapped already although there may still be some room for expansion. It is expected however that cost/benefit analyses may soon indicate that further development is not desirable either because of economic or environmental considerations.

B. Mineral Resources

The waters of the world contain many valuable minerals in suspension or solution but they also simply cover up vast mineral wealth. Offshore sources of fossil fuels are accounting for an increasingly large proportion of world oil and gas production and mineral bearing known as rich resources of valuable metals. It is inevitable that the significance of offshore mineral resources

(1) Raymond Schuessler, "Wave Energy", in Jonathan Bartlett ed., The Ocean Environment, The Reference Shelf Series, Vol. 48, No. 6, 1976, p. 68.

will escalate in importance as the technology of recovery develops and as land-based deposits become depleted.

1. Minerals

Vast areas of the deep seabed in the central Atlantic and Pacific oceans are dotted with ferro-manganese nodules -- potato-shaped mineral deposits that are rich in nickel, copper, cobalt and manganese. In the Pacific alone these nodules amount to approximately 1.5 trillion tons and they are accumulating at the rate of six million tons per year. (1)

Presently, Canada does not need to exploit seabed minerals but our resources should be inventoried so that when mining does become necessary we will know where the resource lies, and how best to recover it without damaging the environment.

Concerning rights to aquatic resources, Canada feels that -

"...coastal states should have sovereign right over the resources of both seabed and water column out to 200 miles and jurisdiction over scientific research and conservation..." (2)

but it also agrees that -

"...the seabed and its resources constitute the 'common heritage of mankind' and belongs to everyone..." (3)

The question of what resources belong to whom has not yet been settled on the international stage and this is really

the only reason mining of the seabed has not passed the experimental stage. But it will! And since the recovery of submerged minerals may well represent -

"the first attempt to develop an international management system of some of the earth's resources," (4)

Canada should develop good resource management and conservation plans for use within territory of our own jurisdiction, so that we will be able to offer good management advice and influence development on a world scale.

2. Hydrocarbons

In the next one to two decades, there is every possibility that as much as one-third of the world's oil and gas production will come from offshore deposits located for the most part on the continental shelf. (5) Development of offshore sources of fossil fuels will almost certainly be an essential component of Canada's future energy development and exploration is currently active in the Arctic and off the Eastern Coast.

The full extent of our offshore oil and gas reserves is still unknown; published estimates seem to change rapidly. However, one thing seems clear. At least some of the deposits will be found in extremely hostile environments such as under the ice infested waters of northern Labrador. This means that commercial development may be slow compared with on-land development since accessibility will depend to a large extent upon technological innovations which will allow harsh environments to be coped with in a safe fashion.

(1) Canada, Department of External Affairs, Information and Legal Operations Divisions, The Future of the Oceans, Ottawa, 1975, p. 13.

(2) Canada, External Affairs, Bureau of Public Affairs, Canada and the Law of the Sea, rev. ed., 1977, p. 32.

(3) Ibid., p. 31

(4) Ibid., p. 31.

(5) Canada, Department of External Affairs, Information and Legal Operations Divisions, The Future of the Oceans, Ottawa, 1975, p. 7.

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It is important however that we retain the proper perspective concerning oil and gas development. The "oil era" will merely constitute a small blip on the timescale of man's stay on Earth. It is a short and temporary stage that we of this generation are fortunate or unfortunate enough to be experiencing. We must continually remind ourselves that the energy which can be derived from fossil fuels is limited and that this age, which is characterized by a petroleum based technology, will actually be a short-lived phenomenon. For this reason it is imperative that no one be left unconvinced; oil and gas development is beneficial only if it does not disrupt traditional cultures, undermine the traditional resource base, or irreparably damage the environment. Surely the "boom-and-bust" syndrome has at last been laid to rest in Canada and we will never again sacrifice long-term considerations for short-term benefits.

The petroliferous resources of Canada's offshore may help assure energy self-sufficiency for Canada's future, but when it comes to priorities, renewable resources must always come first. Someone must be willing to say, "If oil development in a particular sector poses too great a risk to the environment -- to renewable marine resources -- leave it in the ground!" This means that if oil and gas are found in commercial quantities in the offshore, they must only be developed with cultural, economic and environmental priorities kept foremost in mind.

C. Biological Resources

The new ecological awareness of modern western society has probably arisen out of the realization that some of the resources we once thought of as limitless are now entering the declining phase in production. In other words, it has developed as much out of necessity as out of enlightenment. Nevertheless, the

recent serious shortages of essential commodities such as oil have made us newly appreciative of the fundamental nature of living systems and have put new emphasis on the importance of properly managing renewable resources.

In the main, renewable resources are of biological origin because only living systems naturally utilize energy to recycle material into new and regenerated form. Unfortunately, the importance of Canada's living aquatic resources has perhaps been neglected over the years as an important part of the abundant riches this country has to offer. Canada's wealth of resources is legendary, but as we penetrated the great land mass of North America and grew and developed apart from the sea, many of us lost sight of the fact that marine resources are very important to Canada's economic well-being.

In any event, by their very nature, Canada's living aquatic resources are the most important part of the bounty offered us by the seas. And because of this, all other development, whether it be mineral or energy, must take place only if it does not adversely affect living resources. We must not only conserve and preserve species, we must protect the whole marine ecosystem which collaborates to produce a myriad of useful end products.

1. The Fishery (1)

Canada boasts some of the richest fishing grounds in the world but our fishery has not always fared well. For a variety of reasons such as poor fisheries planning, foreign fishing competition, outdated equipment, interception of species at the wrong time in their life cycle and pollution of inland waters, Canada's fisheries have seen some hard times.

(1) For the purposes of this paper "The Fishery" refers to any living marine creature which is harvested from a natural unmanipulated habitat.

This is most unfortunate but hopefully the tide has turned. There is some evidence that new harvesting policies, modernization of antiquated equipment, and better coordinated and conceived research systems may be beginning to pay off in a more healthy fishery. This is encouraging and shows that when an effort is made poor situations can be improved. Certainly, if the right decisions are made, the declaration of the 200-mile limit has the potential to allow Canada to better reap the benefits of its wonderfully rich natural fisheries.

The fishing fleet however is not the only part of the fishery. Harvesting of shellfish and seaweed is an extremely important and rewarding endeavor and it seems that these two aspects of "The Fishery" should become more important as eating tastes change and as more people become aware of the profits to be made from these practices.

As far as harvesting sea mammals is concerned, it is difficult to understand why the seal hunt causes such an outcry. There is no reason to discriminate against the harvesting of a species based upon its appearance. Ecologically it is difficult to differentiate between the value of a baby seal and a baby sea cucumber -- a creature which is almost universally considered ugly. "Equality before the law", should apply to all living organisms in terms of whether or not we use them. All living resources should be managed so that species survival is never threatened. If we do otherwise we are merely making value judgements which are logically if not emotionally indefensible.

2. Mariculture

Primitive man has often been described as a hunter-gatherer; someone who travel-

ed the countryside gathering plants and hunting animals for sustenance. This is a very inefficient and demanding way to eke out a living because the ratio of energy spent searching for food to the energy derived from the catch is very close to one; no net gain is achieved. However a few thousand years ago, in one great stride forward, man developed agriculture and went a long way towards solving this problem. Agriculture allowed man to store up food reserves for times of famine and it also allowed him to provide nutritional aid to both plants and animals in the form of food or water when environmental conditions were harsh. Thus, with food always available and with comparatively little energy spent in acquiring it, the cost/benefit ratio diminished rapidly and provided man with free time and energy to begin the long slow process of developing civilization.

Unfortunately, when we step off dry land we revert to our primitive state. In terms of harvesting the sea we are still essentially hunter-gatherers; more sophisticated than our forbears perhaps, but nevertheless still hunter-gatherers. This is most regrettable, especially when one considers the fact that water covers at least seven-tenths of the earth. Essentially, it means that even though we are living in the twentieth century we are still reaping the blessings of the major portion of this planet with a cave-man approach!

The answer to this longstanding problem lies in the science of mariculture or aquaculture or sea-farming as it is often called. Although little large-scale commercial development has taken place, some organisms do definitely grow quite well under managed conditions but the potential for sea farming is virtually untapped. There are trout farms, salmon

farms, lobster hatcheries, shellfish farms, etc., but much more can be done. For instance the oriental custom of growing several species in an artificial ecosystem, rather than the Western habit of concentrating on one species, produces a more healthy system and generates much better results in the terms of harvestable biomass.

The seas and inland waters of Canada offer staggering untapped biological potential for aquaculture. However, at present Canada's waters appear to be either unmanaged or mismanaged. Serious research into how best to "cultivate" some of our plentiful waters should assume top priority in our research programs. The world's population is growing at a tremendous rate. The majority of cultivatable land has been put under the plough and there is not likely to be another "green revolution" in the near future. Has the time not come then for the "blue revolution"?

CONCLUSION

Canadians are privileged to live in one of the most naturally rich nations in the world but many people do not realize that much of that wealth is intimately associated with either salt- or freshwater. This attitude is changing however. Now that petroleum has become a scarce commodity on world markets oil exploration is active in offshore areas and this is forcing us to become much more aware of the full resource potential of the maritime portions of our country. We are only just beginning to recognize that although Canada has rich land-based resources, the future may well lie with the seas.

Much of the world's oil will soon come from offshore sources and mining for minerals may soon be necessary as certain land-based deposits become depleted. From a biological point of view, the seas can provide a cornucopia of materials which may help feed the ever-increasing number of hungry human stomachs. But all the benefits which may be derived must be acquired only after intensive research has been carried out about how best to procure the resources without disturbing the myriad life-forms supported by the seas.

All non-living material which is deemed necessary to support civilization must be produced in a manner which does not threaten living material. This must be our credo, not because of an altruistic sense of responsibility, but because it makes good common sense. If the waters of the earth can offer renewable resources indefinitely, we must not jeopardize them by producing nonrenewable resources in an irresponsible manner.

The future is not ours. It belongs to our descendants! Our responsibility is to develop and conserve marine resources, so that they will not only provide much-needed materials now but continue to do so for posterity.

