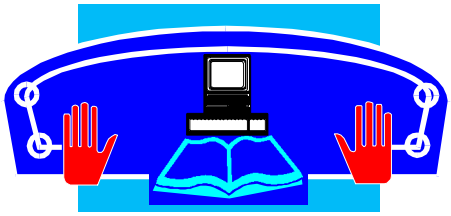

Western Region; Freshwater And Arctic Research Directorate
Type of Study: Resource Management Fisheries, Fisheries Canada General
Date of Report: 1982
Author: Canada-fisheries & Oceans(dfo)
Catalogue Number: 3-15-10

INTRODUCTION

The Western Region is the largest (3.4 million km^2, 53% of Canada) and perhaps most diverse of the departmental regions. In the Northwest Territories and in the Arctic Ocean, the Region exercises the complete departmental mandate for fisheries and marine mammal management. In Manitoba, Saskatchewan and Alberta, the Federal Government has delegated some authority for the day-to-day management of inland fisheries. However, federal authority is present and required with respect to product and plant inspection, fish health protection, small craft harbours and the control of transboundary pollution. Furthermore, as the major departmental centre for inland waters, the Western Region is responsible for the development of new knowledge of fisheries habitat and resource development problems of national significance, and has developed as a research centre of national and international prominence for inland waters.

HISTORICAL PERSPECTIVE

The Western Region had its origin in the establishment of a system of whitefish inspection that began in 1944. Responding to provincial requests for federal participation in a program to overcome certain difficulties in whitefish marketing, the Federal Department of Fisheries established a system of whitefish inspection in the Prairie Provinces. By 1971, this inspection program had expanded to include a variety of federal fisheries activities, including resource management and economics components, which collectively became known as the Operations Directorate of the Fisheries Service.

Paralleling this were similar developments in the area of fisheries research. The Fisheries Research Board of Canada established the Central Fisheries Research Station in Winnipeg in 1944 in response to provincial requests for federal government participation in a program to improve the quality of whitefish produced for export. In 1957, the research station was relocated in London, Ontario and undertook studies of the Great Lakes as well as continuing the program in the Prairie Provinces and the Northwest Territories. The station moved back to Winnipeg in 1966 and formed the nucleus of the Freshwater Institute.

In 1972, Operations and Research were located in a common facility on the campus of the University of Manitoba, which facility was named The Freshwater Institute, In 1975, the two Directorates were integrated to form the Western Region of the Fisheries and Marine Service, now the Department of Fisheries and Oceans.

PRESENT ORGANIZATION

In 1981/82, the Region began a redirection of its activities and a reorganization which lead to a much stronger research and management role in the Arctic. Research and related activities are centered in the Freshwater and Arctic Research Directorate, the Resource Assessment Section of the Arctic Operations Directorate (Figure 1) and certain components of the Southern Operations Directorate and Economics and Marketing Services Directorate.

Freshwater and Arctic Research Directorate

Arctic Management Research

This section is responsible for providing information leading to an understanding of the biological processes in the Arctic. The activities listed below are in direct support of regional management responsibilities in the Arctic and are seen as priority items:

- Basic biology and population studies of marine mammals.
- Specific physiological studies of marine mammals.
- Population dynamics studies (experimental and case history of key exploitable fish species (charr, whitefish, lake trout, Arctic cod).
- Long-term marine and freshwater ecological studies at selected field camps to determine patterns of fluctuation and processes of energy flow.

Fish Habitat Research

This section is responsible for the process research on the structure and function of freshwater and Arctic habitats. The work includes the studies of the physical, chemical, and biological processes and how the impact of man's activities alters, or threatens, the aquatic habitats of freshwater and Arctic environments. The major physical and chemical threats to fisheries habitats are primarily energy-related and include the following:

- Emissions of oxides of sulphur and nitrogen (acid rain).
- Heavy metals resulting from fossil fuel refining, combustion, exploration and production, metal mining, roil"ling and smelting, hydroelectric development (reservoirs), etc.
- Radionuclides resulting from fossil fuel combustion, uranium mining and milling, reactor wastes.
- Organics resulting from industrial processes, agriculture and forestry.
- Nutrients resulting from municipal and industrial wastes, diversions and agriculture (fertilizers, irrigation, etc.).
- Physical alterations resulting from fossil fuel mining, exploration, production and transport, metal mining and processing, hydroelectric development, irrigation, municipal and industrial water supply systems (reservoirs and diversions) .

Resource Development

This section is primarily responsible for the enhancement and rehabilitation of the fishery resource and includes those programs listed below in order of priority:

Development of inland fisheries enhancement pilot programs in cooperation with provincial governments.

Fish pathobiology, including fish disease inspection and research.

Experimental hatchery operations.

Fish production systems, including waste-heat aquiculture studies.

Chemical Research and Analytical Services

This section is responsible for conducting research on chemical issues relating to fisheries and aquatic habitats. To a large extent these studies are conducted on a cooperative basis with the other organizational units in the Region. In addition to its research activities, this unit has been assigned the lead role in providing analytical chemistry services to other regional program areas on a cost-recovery basis.

OTHER ORGANIZATIONAL UNITS PERFORMING RESEARCH-RELATED ACTIVITIES

Arctic Operations Directorate

The Field Services and Resource Assessment Sections of this Directorate carry out research-related activities. Field Services is responsible for local resource and habitat monitoring and assessment. Resource Assessment is responsible for field surveys, stock and habitat assessment and monitoring programs and works closely with Field Services as needs dictate. They conduct surveys which enable DFO to review environmental impact statements effectively, to produce sensitivity maps, distributional and migration pattern maps of major resource components necessary to the development of quota proposals. Activities include the following:

- Surveys in the Eastern Arctic to identify and assess stocks, and to trace annual migration patterns of narwhal, beluga, walrus and ringed seal.
- Surveys in the Beaufort Sea, Amundsen Gulf, Mackenzie Delta, Tuktoyaktuk Peninsula and environs to identify stocks, trace migration patterns and assess stocks of whitefish, Pacific herring, beluga, bowhead and ringed seal.
- Stock assessment and monitoring surveys of Arctic charr whitefish and lake trout fisheries - both sport and commercial fisheries.
- Surveys of temporal and spatial habitat use by fish and marine mammals in the Beaufort Sea, Mackenzie Delta, Amundsen Gulf, Lancaster Sound, Baffin Bay and Davis Strait.
- Characterization of these habitats (sensitivity, vulnerability, composition).

Monitoring programs in areas of intensive industrial development such as mining, pipelines and hydrocarbons.

Southern Operations Directorate

The Fisheries Development Section of this Directorate is responsible for administration of research related to the gear development, product development, market promotion, engineering research, exploratory fishing, technology transfer and field engineering programs. The Technical Services Section provides certain analytical chemistry services to other operations and research units in the Region.

Economics and Marketing Services Directorate

This Directorate provides economic analysis and advice relevant to research problems. Habitat problems and resource rehabilitation problems are of particular concern.

SELECTED RESEARCH ACTIVITIES

The Freshwater Institute is recognized worldwide as a centre of excellence for research on freshwater fisheries and habitat problems. Primary publications by Institute staff regularly make up over 20% of the Departmental total. The activities described in this section are illustrative only and are certainly not all encompassing.

Eutrophication

During the 1960's and early 1970's, rapid increases in algal growth were causing deterioration of water quality and fisheries of the Great Lakes and other lakes in North America and Europe. In 1965, the International Joint Commission recommended that expanded support be given to detailed investigations of the sources, nature and concentration of pollutants and mechanisms for the control of pollution problems in the Great Lakes.

In order to address these problems, the Department of Fisheries and Oceans (at that time, the Fisheries Research Board of Canada) established the Experimental Lakes Area (ELA) near Kenora, Ontario as a site for an experimental approach to the chemical alteration of whole-lake systems. Laboratory experiments had suggested that several nutrients were responsible for the algal growth, particularly phosphorus, nitrogen and carbon. Now, at this unique facility, it was possible to test these hypotheses under controlled field conditions.

Our experiments showed that eutrophication could be successfully controlled by restricting the inputs of only one element, phosphorus. While control of several nutrients is not possible, several inexpensive methods can control or remove phosphorus. These findings, along with monitoring studies by the Ontario Ministry of Environment, led Canada to become the first country to ban phosphorus from laundry detergents, which supplied over 50% of the

phosphorus to many eutrophic lakes, and to require phosphorous removal from municipal **sewage** discharged to the Great Lakes. Many of the US States bordering the Great Lakes, followed Canada’s lead. As a result, Lakes Ontario and Erie are now recovering from eutrophication.

Enhancement of Inland Fisheries

Walleye and whitefish are the premium valued commercial and recreational fish species in Western Canada. The pressures of intensive fishing and various environmental variations and man-made disturbances have resulted in sign ficant declines of fish stocks. For example, on Lake Winnipeg, Winn pegosis and Manitoba, the production of walleye has fallen to 1.8 mill on kg., less than 40% of historical levels.

Freshwater Institute biologists and economists are working in cooperation with provincial government officials to develop programs to increase production from walleye and whitefish fisheries. Research on procedures for rearing young fish to a size suitable for successful stockings, habitat rehabilitation and altered management procedures is making it biologically and technically feasible to return depleted fish populations to historically high levels.

Acid Rain

Acid rain, generated by the emission of sulphur and nitric oxides, caused by the burning of fossil fuel and the smelting of sulphide ores, is endangering thousands of commercial and sport fishing lakes in Canada and in the United States.

The Experimental Lakes Area (ELA) is in vulnerable terrain but it has not suffered from acid rain and thus makes an ideal testing site. In a controlled experiment to test the effects of acidification in fish, Freshwater Institute scientists began, in 1976, to add sulphuric acid to a small lake. In the first three years, enough acid was added to the lake to be comparable to 20 years' exposure near Sudbury. The results so far prove that aquatic ecosystems are damaged at much higher pH values than previously believed.

Other experiments are comparing the effects of sulphuric and nitric acids, acid and metals in combination and effects on marshes and bogs. These experiments are yielding results which will serve as guidelines for future lake management and are useful in negotiating a reduction in acid-causing emissions with the USA.

Marine Mammal Research in the Arctic

Industrial development in the Arctic is growing at a considerably faster rate than in the rest of Canada. It is estimated that 20% of all major capital projects in Canada to the year 2000 ($400 Billion) will be in the Arctic. Most of these will be energy projects that have potential to seriously affect marine mammal and fish populations. These developments coupled with growing Native land claims problems are resulting in significant resource-use contacts.

In 1981, the Freshwater Institute initiated a resource assessment and research program on marine mammals. The first studies have been aerial surveys of Beluga whales in Hudson Bay and Cumberland Sound and harvest monitoring in the Western Arctic. Future research will concentrate on critical harvested populations, population biology and on animal vs shipping interactions.

Pulse Fishing

In much of northern Canada where employment opportunities for local people are scarce, the fishing resource provides employment and sustenance for many people. These fisheries operate in the face of severe biological and economic constraints. The numbers of fish in any one lake are small and the growth rate slow, consequently annual harvests must necessarily be low. Coupled with this are the economic problems of transportation (primarily air) and the relatively large fixed costs to set-up operations on a remote lake.

Research at the Freshwater Institute indicates the possibility of modified management procedures that could make these fisheries economically viable. In a series of studies on whitefish lakes near Yellowknife, Arctic charr rivers, Arctic coast, and walleye/pike lakes, northern Manitoba, scientists have investigated the potential of “pulse” or “rotational” fishing.

In a pulse fishing operation instead of an annual harvest, lakes are fished very heavily for one year and then allowed to lie fallow for several years. The catch in that one year is much higher than under annual fishing and since fixed costs of setting-up operations remain the same, the economic viability of fishing is improved.

Research has concentrated on the level of fishing that can be sustained, and the response of the population in terms of growth and survival. Results to date are promising and implementation of such a management scheme will proceed as fishermen and managers respond to the economic problems of the fishery.

Development of Toxicity Testing Protocols

In the late 1960's and early 1970's, the recognition of the detrimental effects of chemical pollutants led to a rapid shaping and development of public environmental consciousness. The ultimate goal of new environmental legislation is the prevention or reduction of future environmental deterioration. The enforcement of these well-intentioned laws, however, 'requires the capacity to evaluate and predict the kinds and extent of harmful changes a chemical might cause in the aquatic environment.

In 1972, recognizing that capacity to make the necessary evaluations and predictions, scientists at the Freshwater Institute embarked upon a program to develop a series of protocols for toxicity testing.

A major result of this effort was the development of standardized culture techniques for freshwater invertebrates used for toxicity testing and the development of a series of test procedures for a variety of freshwater organisms. The use of such standardized procedures will do much to eliminate the inconsistencies and uncertainties that arise when attempting to interpret disparate results in different geographical, or under different environmental conditions.

Cooperation with the University of Manitoba

Located on the campus of the University of Manitoba, the Freshwater Institute is able to benefit from and contribute to an academic community. Cooperative research projects have been established between Institute scientists and professors in many departments including zoology, microbiology, botany, entomology, computer sciences, food sciences and engineering. Eighteen Institute scientists have cross appointments with the Univeristy as Adjunct Professors (without stipend) and may give some lectures as well as supervise graduate students. At present, 15 to 20 MSC and PhD students are being supervised and close to 30 students have received graduate degrees on work supervised by Adjunct Professors since 1972. On a less forma' basis, Institute staff regularly provide assistance to students and frequent' Y participate on supervising committees for graduate students.