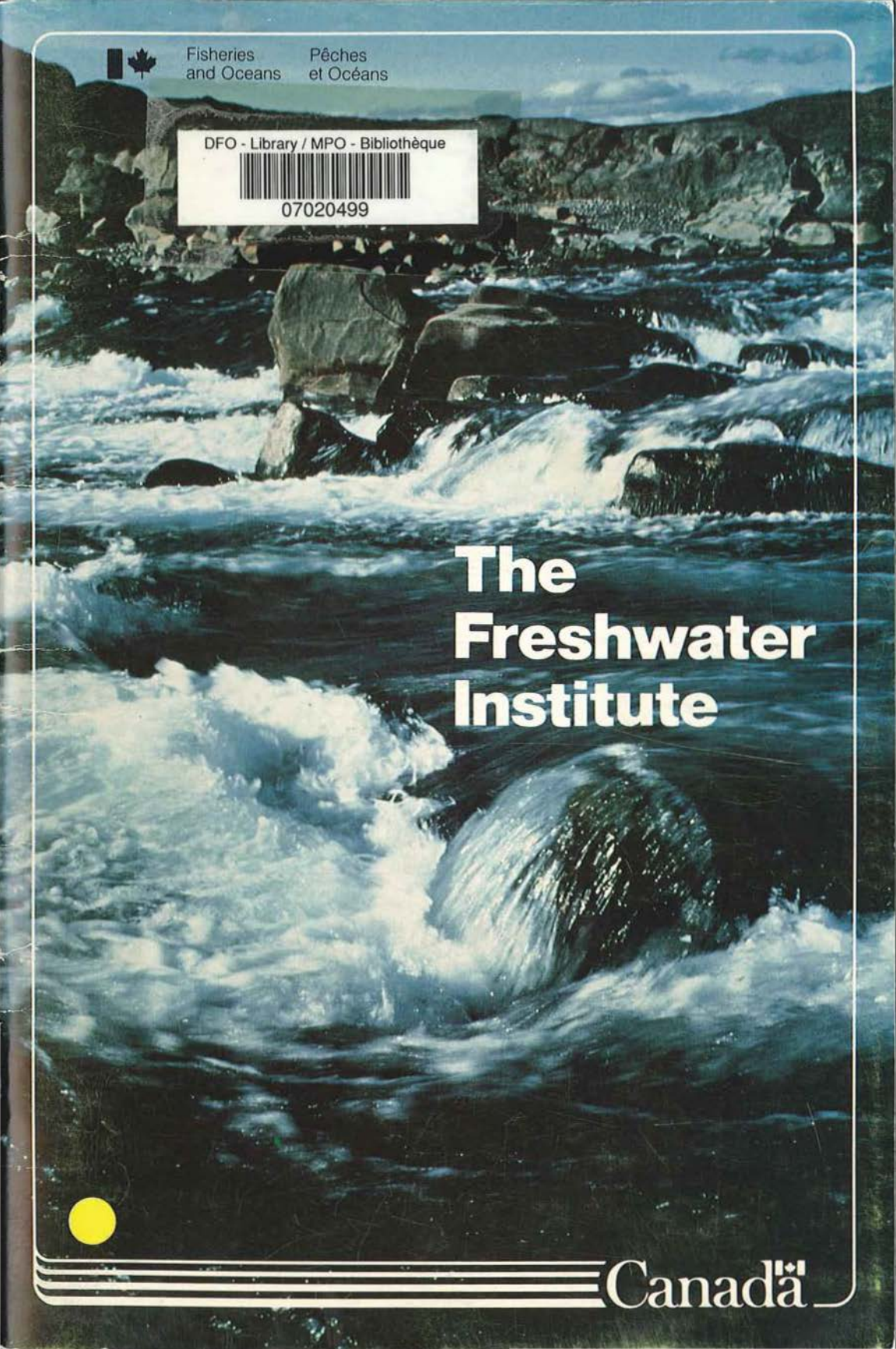
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The Freshwater Institute
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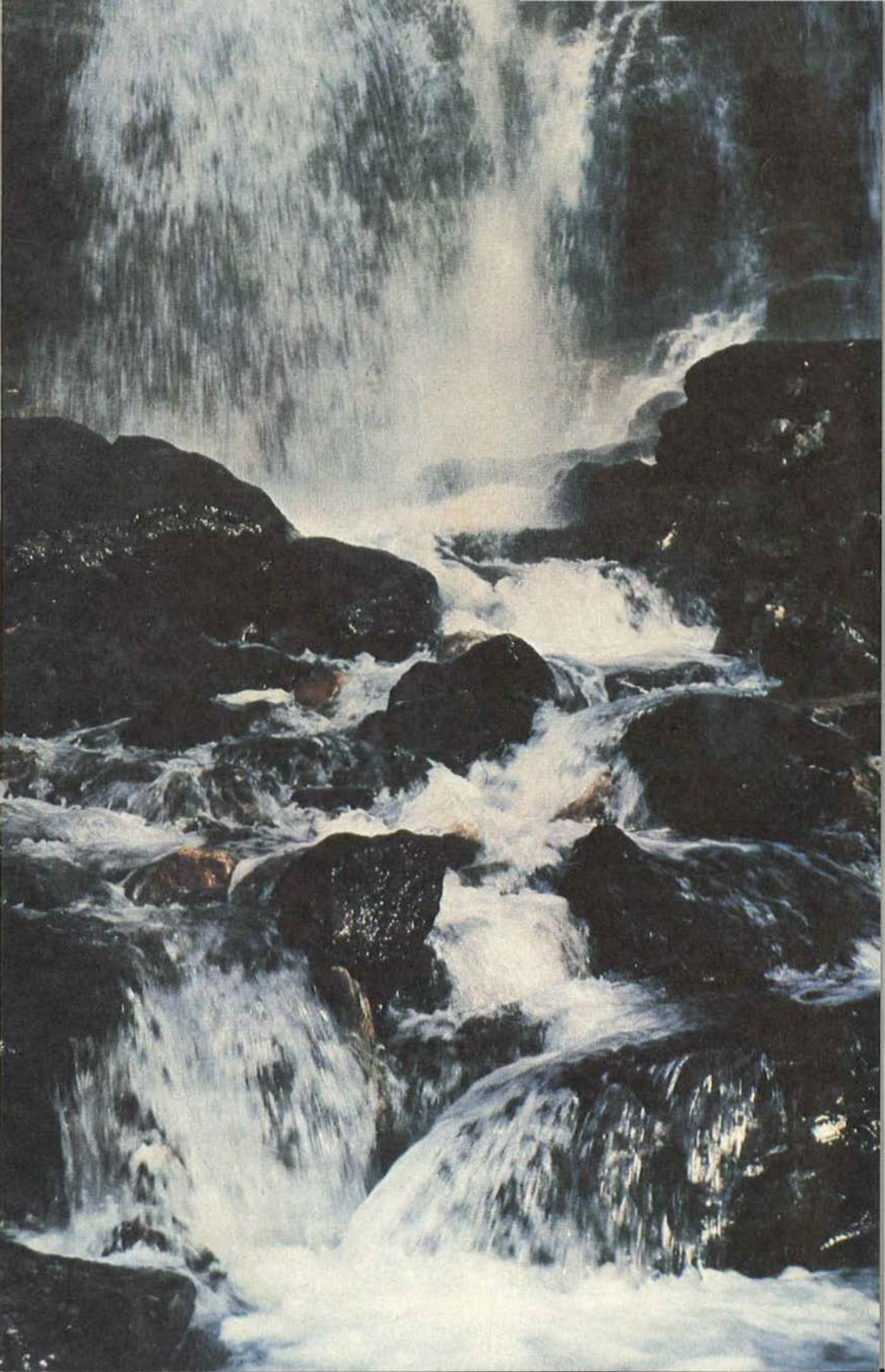


The origins of the Freshwater Institute date back to 1944 when the provinces invited the active participation of the federal government in the fresh waters of central Canada.

The Freshwater Institute

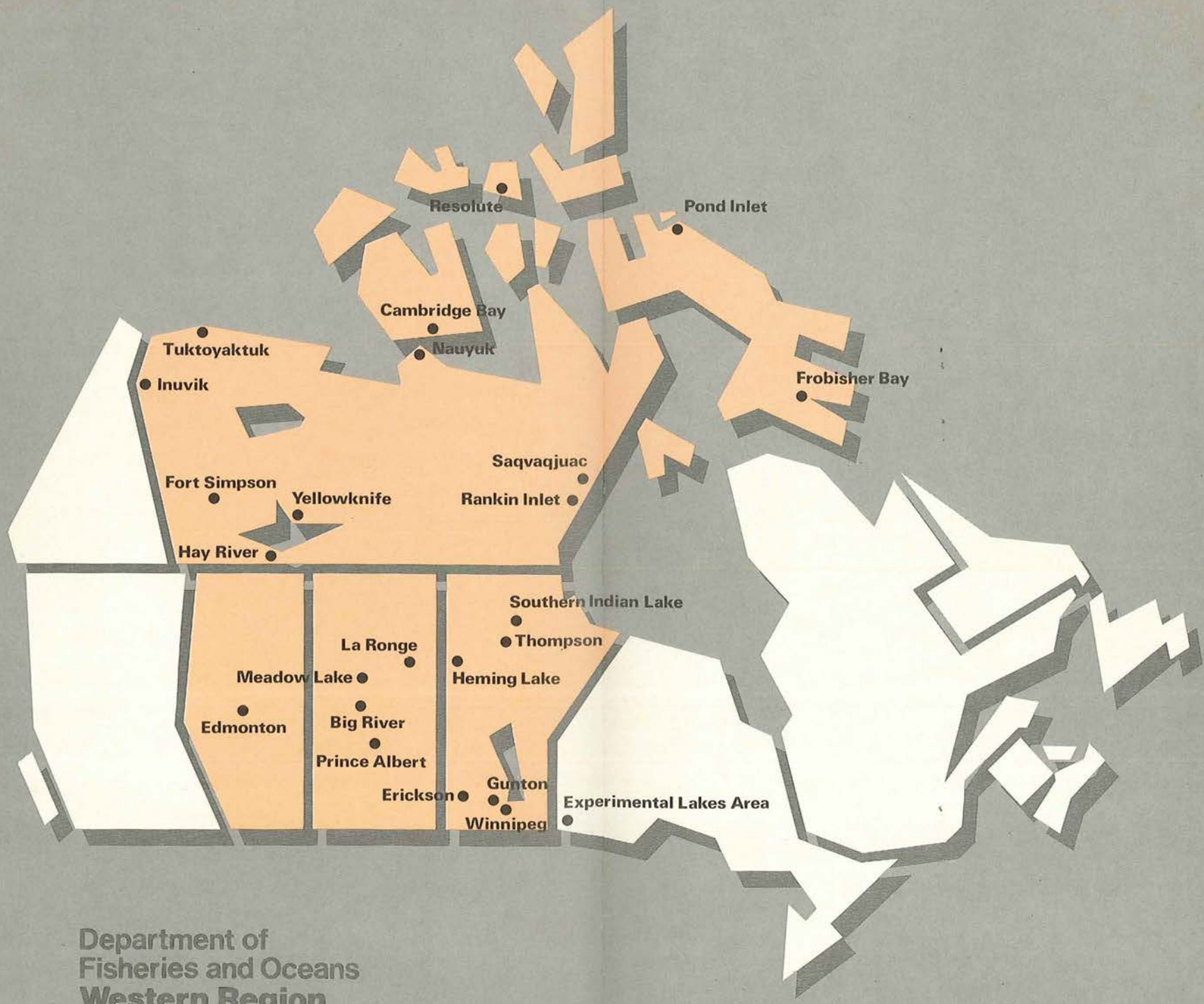
The Freshwater Institute is a national centre of expertise in aquatic biology and freshwater fisheries. Located on the campus of the University of Manitoba in Winnipeg, it serves as the headquarters for the western region of Canada's Department of Fisheries and Oceans.

Within the region's jurisdiction — Manitoba, Saskatchewan, Alberta, and the Northwest Territories — lies about 20 per cent of the world's fresh water. The conservation of the life it contains, a valuable and vulnerable national asset, is a continuing responsibility.

In the Arctic, specifically in the Northwest Territories (NWT), the western region has exclusive responsibility for the management of both the inland and coastal fisheries, which include marine mammals.

On the other hand, the management of freshwater fisheries in Manitoba, Saskatchewan and Alberta is a shared responsibility of the federal and respective provincial governments. While the provinces undertake the day-to-day regulation of their fisheries, such as licensing and administration of stock management, the Department of Fisheries and Oceans assumes responsibility for other aspects of the inland fisheries including fish habitat protection, fish health, and fish product inspection. Besides fulfilling these legislated roles, the federal government maintains its leadership in international affairs, scientific research, and fisheries technology and development.

It is because of the broad responsibilities of the Department of Fisheries and Oceans that a wide range of activities related to the many aspects of Canada's freshwater and Arctic near-shore marine



Department of
Fisheries and Oceans
Western Region

Walleye, highly-prized game fish and commercially as valuable as salmon, are the object of intensive study.

Central Canada contains millions of lakes suited to the intensive culture of fish.

ecosystems are conducted by the research and operational personnel of the Freshwater Institute. Research programs complement the operational components to achieve a common goal — the perpetuation and wise use of the fisheries resource.

Research

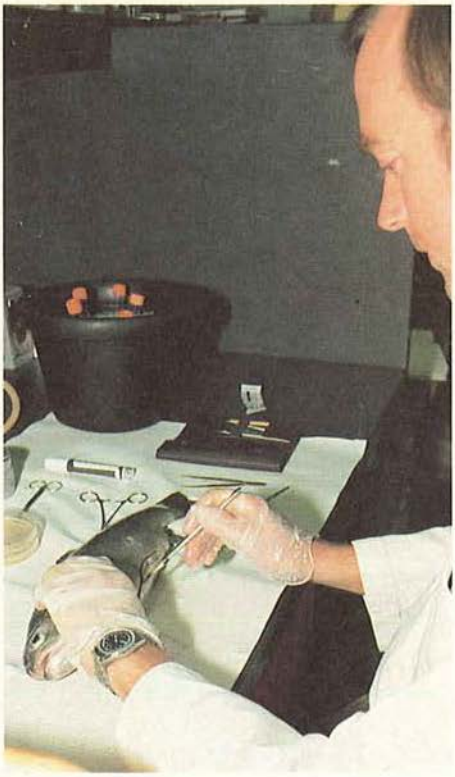
Because of the over-exploitation of some fish populations, and because of the increasing problem of environmental pollution which has further reduced the quality and quantity of some commercially valuable freshwater species, Institute researchers have been developing programs to provide enhancement and rehabilitation strategies to improve the fisheries of inland Canada.

Scientists are involved in an ongoing program of study of the population dynamics and early life histories of fish such as walleye and lake whitefish for the purpose of renewing and enhancing these fisheries. The harvest of walleye, for instance, has fallen drastically in recent years, and numerous stocks have disappeared completely. Cooperative federal-provincial enhancement programs that could lead to substantially increased production of walleye or lake whitefish in a number of large prairie lakes are under consideration.

Aquaculture studies are aimed at developing techniques for commercial and recreational fish farming. Institute scientists have developed techniques for extensive trout culture in Canada's prairie lakes and are

Physiological studies of fish contribute to an initial and fundamental understanding of fish disease and health.

Fish habits and habitats can be irreversibly altered by the erosion of shorelines in permafrost areas of Canada when lakes are flooded for hydroelectric development.



now developing methods of intensive and energy-efficient culture of fish in controlled environments by the application of waste heat and solar energy. This work is often integrated with the further development of techniques — cage culture, stocking, artificial rearing ponds — for the revitalization of existing wild populations of fish.

Aquaculture researchers are often called upon to provide assistance to trout farmers in much of central Canada and to provincial, national, and international agencies.

Increased aquaculture and enhancement activities, and in particular fish hatchery operations, depend upon healthy fish for their success. At the Institute, fish pathobiologists are working on the identification and treatment of infectious diseases specific to Canada's freshwater fish. In addition, a diagnostic laboratory at the Institute carries out hatchery certification services, by authority of the *Fish Health Protection Regulations*, to allow for the transport of healthy fish eggs into and from central Canada.

In northern Manitoba, research teams are examining how the relationships among the many different natural aquatic plant and animal communities are affected when man-induced changes considerably alter their environment. A major study concentrates on the effects on water quality and fish production in a permafrost area at Southern Indian Lake following the construction of a reservoir for the generation of hydroelectric power. The information discovered here, especially with respect to

A fish holding box constructed at an Inuit stone weir will help determine the potential of the Arctic charr fishery in the NWT.

Arctic charr.

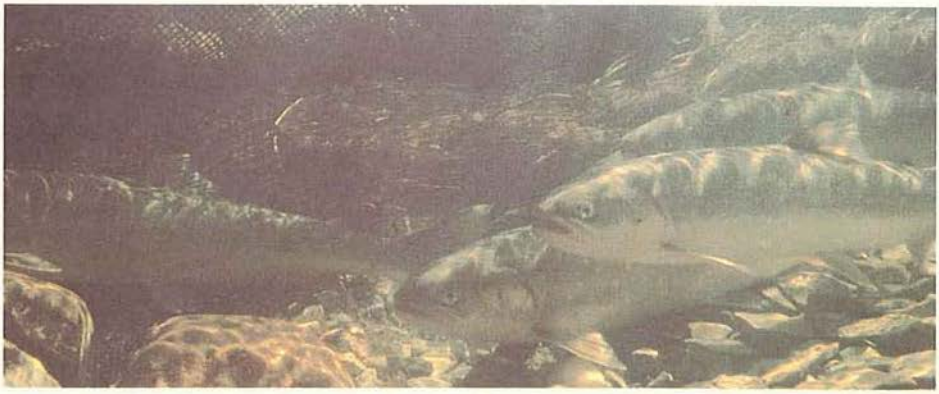
fisheries, should prove invaluable to the future industrial developments that are bound to take place in the North.

The region has a special responsibility to investigate and understand the aquatic ecosystems of the Arctic so that fish and marine mammals can be protected and managed for the benefit of all Canadians.

A number of applied research activities are centred at Saqvaqjuac, the Arctic field station north of Chesterfield Inlet on Hudson Bay.

Work there is concentrated on lake and estuarine systems, and the effects that industrial development like uranium mining, hydroelectric, pipeline and highway construction may have on these systems and the life they contain.

Around Canada's polar basin and southward into Hudson Bay, the anadromous Arctic charr is the object of intensive study. Traditionally a staple of the Inuit diet, this close relative of the salmon has become a prize catch for sportsmen and attempts to harvest Arctic charr for



Experiments range from the simple to the very complex. For instance, electrodes implanted into the brain of a trout will record the effects of a pollutant — injected through tubes into the nose — on the fish's sense of smell and perhaps its ability to navigate.

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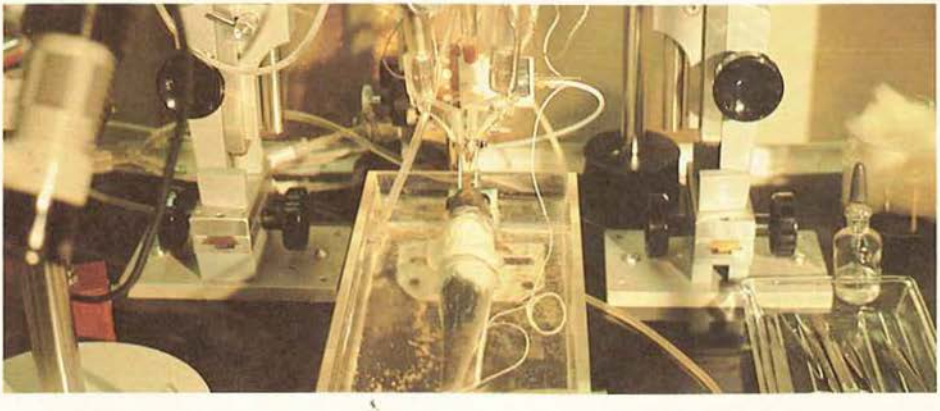
the southern and international commercial markets have increased over the past few years. Institute researchers are establishing details of its life history and are examining the productive capacity of Arctic charr populations over an extended period of time.

One of the major difficulties involved with the wise management of fish and marine animals is the ability to determine the different stocks of the same species within a large, mixed population. At the Institute, techniques based on biochemical genetics and molecular biology are beginning to be applied successfully to various mixed populations such as those found in the Great Slave Lake whitefish stocks, which constitute an important commercial fishery. In the future, these techniques will have useful application in assessing and defining the various marine mammal populations and sub-populations, like those of the beluga whales, in Canada's Arctic waters.

Another major responsibility of the western region is the area of fish habitat research. Pollutants such as acid rain, pesticides, synthetic and organic chemicals and industrial wastes enter the aquatic environment every day. Studies by Freshwater Institute scientists on the nature and behaviour of the pollutants in the aquatic systems and on the physiological, biochemical and behavioural changes that fish and other aquatic organisms undergo when subjected to them are fundamental to the perpetuation and success of Canada's freshwater fisheries.



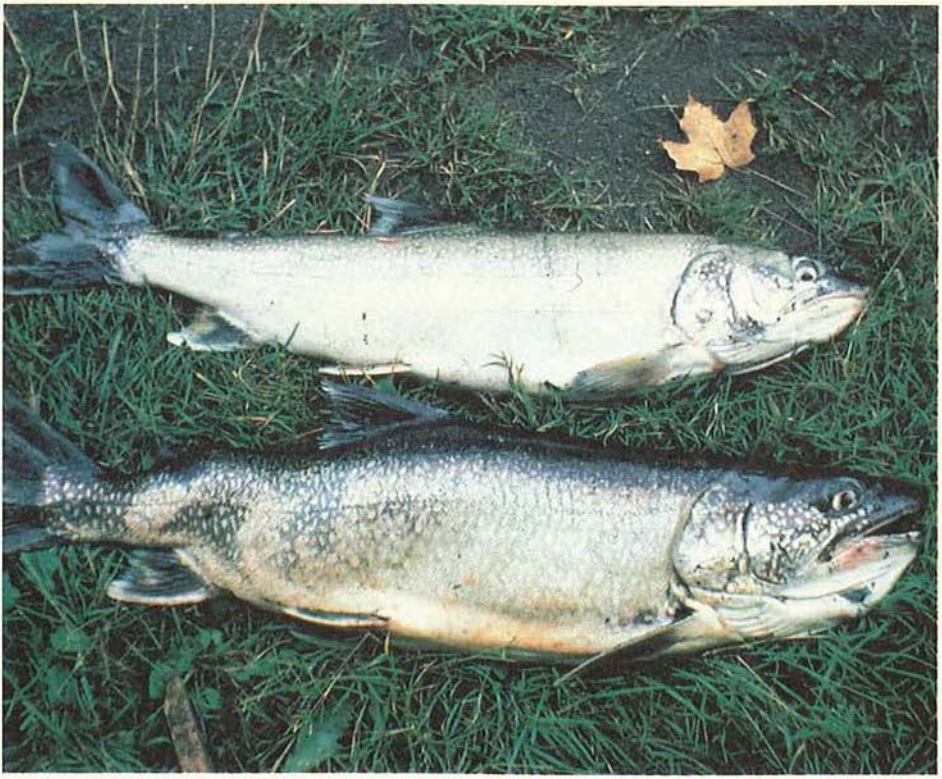
Scientists at the Institute are helping to develop a better understanding of how lakes, rivers and streams are influenced by human activities — the impact of an industrial culture on freshwater ecosystems.

Trap nets are used extensively in both fisheries research and management to assess the effects of man on aquatic ecosystems.

Manipulation and induced change simulating real-life ecological disturbances on entire lakes are the basic methods of what is called experimental limnology. Research into the sources and effects of radionuclides, heavy metals, man-made organic pollution, and of forest fires on lakes and their watersheds are areas of concerted effort at the Experimental Lakes Area (ELA) near Kenora, Ontario. Acid rain — what subtle and potentially lethal effects does it have on the intricate web of life in Canadian waters? At ELA, scientists are conducting whole-lake acidification experiments of a nature known nowhere else.

Acid rain and metals such as mercury, aluminum, cadmium, selenium and zinc react in various ways in aquatic systems. Possible adverse effects on the life stages of fish and other aquatic organisms are a major continuing threat to the freshwater fisheries. Yet, their exact influence over a long period of time is not known. Research is aimed at increasing the understanding of acidification and metal toxicology in natural fish stocks so that reparative and preventive measures can be designed.

These two lake trout came from the same Ontario lake where acid precipitation has been well documented. One fish is normal.



Research is also directed toward the development of biological and chemical techniques to identify and measure toxic substances and to assess their effects on aquatic organisms. Pure and applied research programs concern themselves with both the obvious and not-so-obvious effects of pollutants on fish and other aquatic life.

The Narwhal

One of the most enigmatic marine mammals found in Arctic waters is the narwhal (*Monodon monoceros*). The common name is Norwegian for "corpse whale" and refers to the resemblance of the whale's mottled skin to that of a drowned man. The scientific name is derived from the conspicuous and long tapering tusk, in reality a spiral modified tooth, which protrudes outward from the head of mature male animals sometimes to a length of two metres. Rarely, adult females will develop a tusk and there are sometimes twin-tusked animals. Newborn calves measure approximately 1.6 metres in length while fully grown males reach a length of 4.7 metres and females a slightly shorter length of 4.0 metres.

It has been suggested that the tusk of the narwhal is used to disturb potential prey on the ocean bottom, to pierce prey before killing it, to pierce thin ice to make breathing holes, as a defensive weapon, as a cooling mechanism, and as a sound transmitter. But a recent study by McGill University scientists suggests that the tusk is used for aggressive purposes.

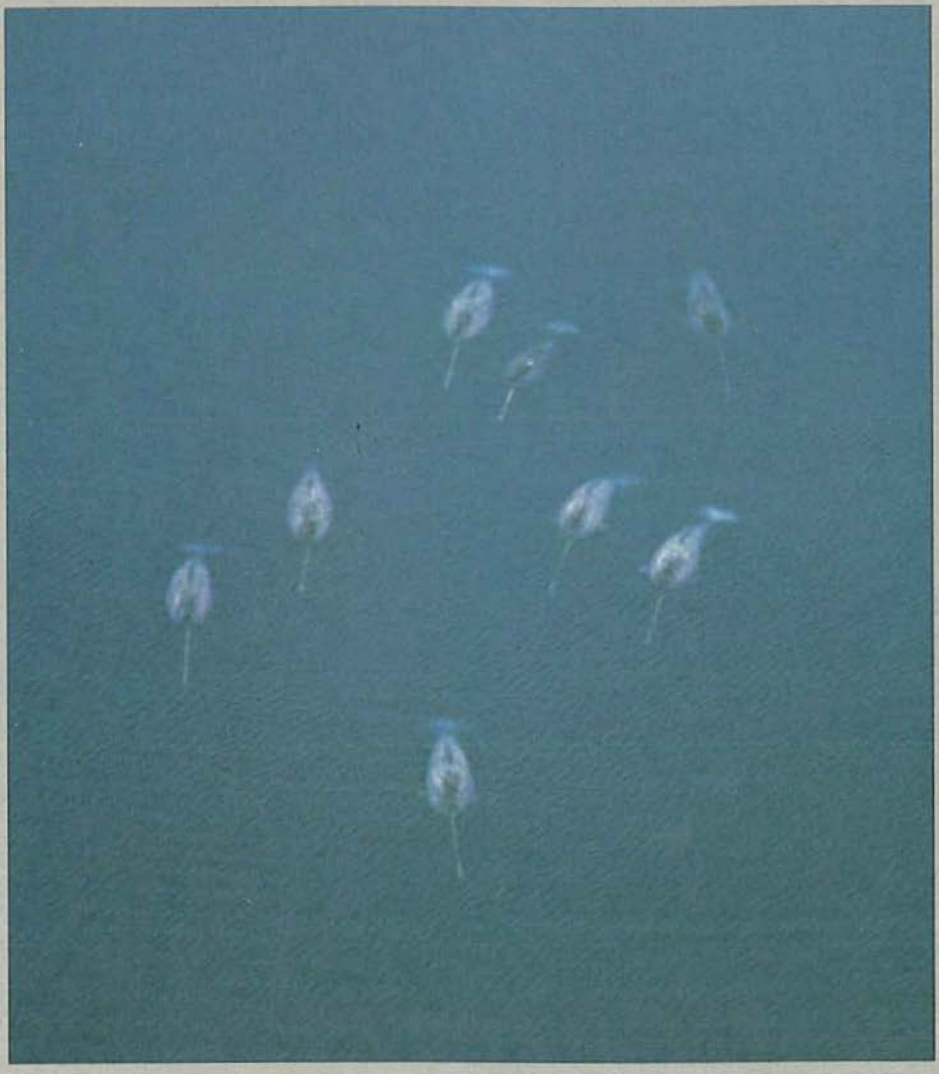
This conclusion was based on a number of observations such as the rapid tusk growth that occurs at sexual maturity, tusk crossing behaviour and the many scars found on the heads of adult males.

Scientists say there are strong indications the tusk is used in intra-specific aggression, most probably during the mating season when competition between males is probably at its most intense.

During the summer, narwhals are found in the Canadian Arctic along the east coast of Ellesmere Island, in Jones and Lancaster sounds and adjacent inlets, and in the western Foxe Basin area south of Baffin Island.

They also occur occasionally in Cumberland Sound, Frobisher Bay and Hudson Strait. In winter they probably frequent the open water of Baffin Bay but not much is known about this phase of their distribution.

Narwhal feed on, among other things, pelagic squid, polar cod, turbot and shrimp. Yet, scientists have much to discover about these animals; for example, how often they give birth and how many calves are born at a time.



There has been some concern in recent years about the well-being of these unique creatures, very important in some areas in a social and economic sense to the Inuit. Muktuk, the thin layer of blubber underneath the skin, is an important food and the tusk is a valuable article of trade.

Intensive hunting for some stocks of narwhal, primarily for their ivory tusks, may have reduced numbers to a low level and large-scale industrial development may have a severe effect in the future. Department of Fisheries and Oceans personnel are currently attempting to learn more about the biology and life history of the narwhal to alleviate these concerns.

Solar Energy

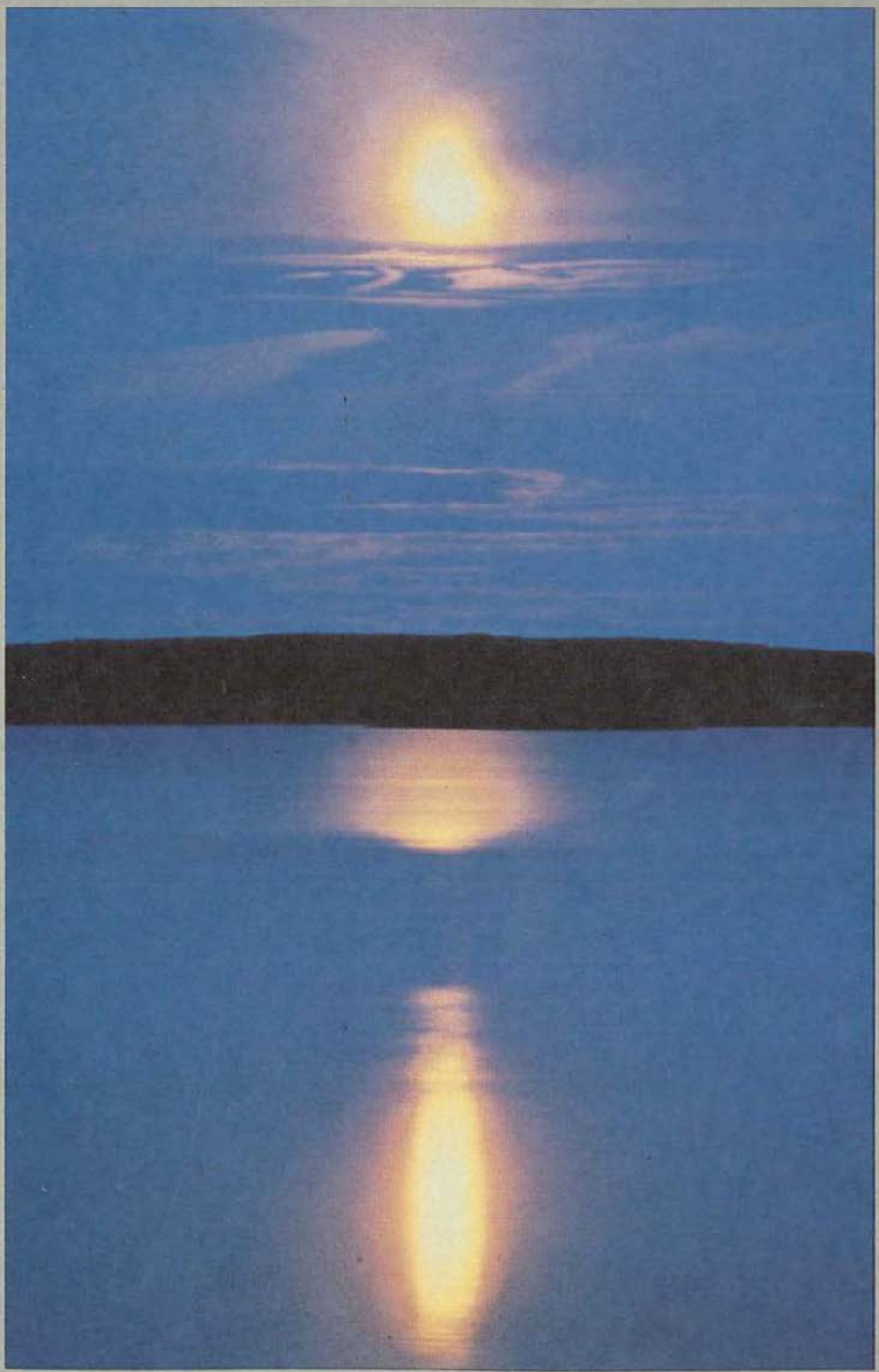
Canada's first practical application of harnessing heat from the sun to save energy in the operation of a fish hatchery is at the Department of Fisheries and Oceans' Experimental Fish Hatchery at Gunton, Manitoba, about 30 kilometres north of Winnipeg. From this successful pilot project has come the funding for the extensive use of solar energy to supply heating for the entire hatchery operation.

At the Gunton facility, solar energy is currently being used to supply 70 per cent of the heated water for the production of rainbow trout and Arctic charr housed in a separate broodstock building adjacent to the main hatchery. This pilot commercial operation uses a water recycling system which cuts the normal requirement of 3.6 tonnes of heated water per hour for the twelve 1400-litre tanks by 90 per cent.

The experimental hatchery is used primarily by groups involved in aquaculture or fish farming studies, but also provides fish for research into the effects of pollutants and environmental contaminants on aquatic life.

Most of the fish held at the hatchery are the offspring of its own brood stocks selectively bred in experiments to improve trout stocks for the commercial market.

The hatchery also serves to test experimental fish diets, developed by scientists at the Freshwater Institute, using agricultural by-products from the Canadian prairies.



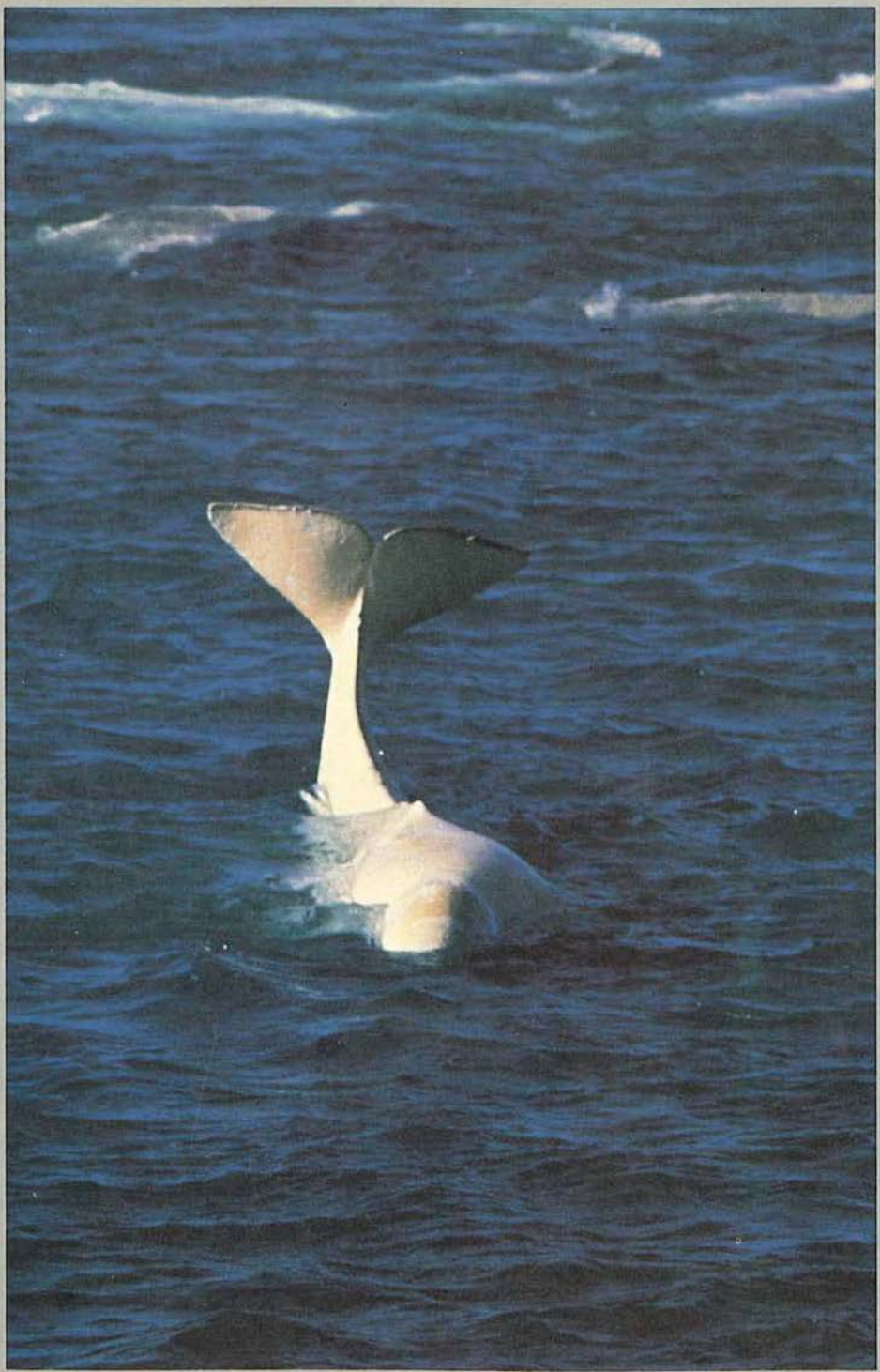
A Vulnerable Resource

Over the next 25 years significant development throughout the Arctic will include projects such as oil exploration in the Beaufort Sea, in Lancaster Sound, and the Davis Strait. Natural gas development in the Arctic Islands, year-round tanker traffic through the Northwest Passage, and various high-Arctic mining operations are also expected. In addition, there will be large-scale hydro development taking place on major tributaries of the Mackenzie River.

There is little doubt that this industrialization will proceed, but along with this activity, steps are being taken to ensure that the biological integrity of the region's ecosystem will be maintained.

Freshwater Institute biologists have been active in this area for several years and are striving to learn more about the fish and marine mammals that inhabit the Arctic.

Some of the immediate concerns of researchers are the unanswered questions surrounding the location of over-wintering and spawning areas of fish populations such as whitefish and cisco. There is concern about the status of the beluga or white whale because almost all of the Beaufort-Bering Sea population (about four to six thousand animals) can be found in one place at one time — in the Mackenzie River estuary. With the planned hydrocarbon development of the Beaufort Sea, scientists are anxious to learn how and why these animals concentrate in the area, so that the effects of development can be predicted and incorporated in the management of the whale populations before remedial actions become necessary.



All major lakes in the region support a winter fishing industry.

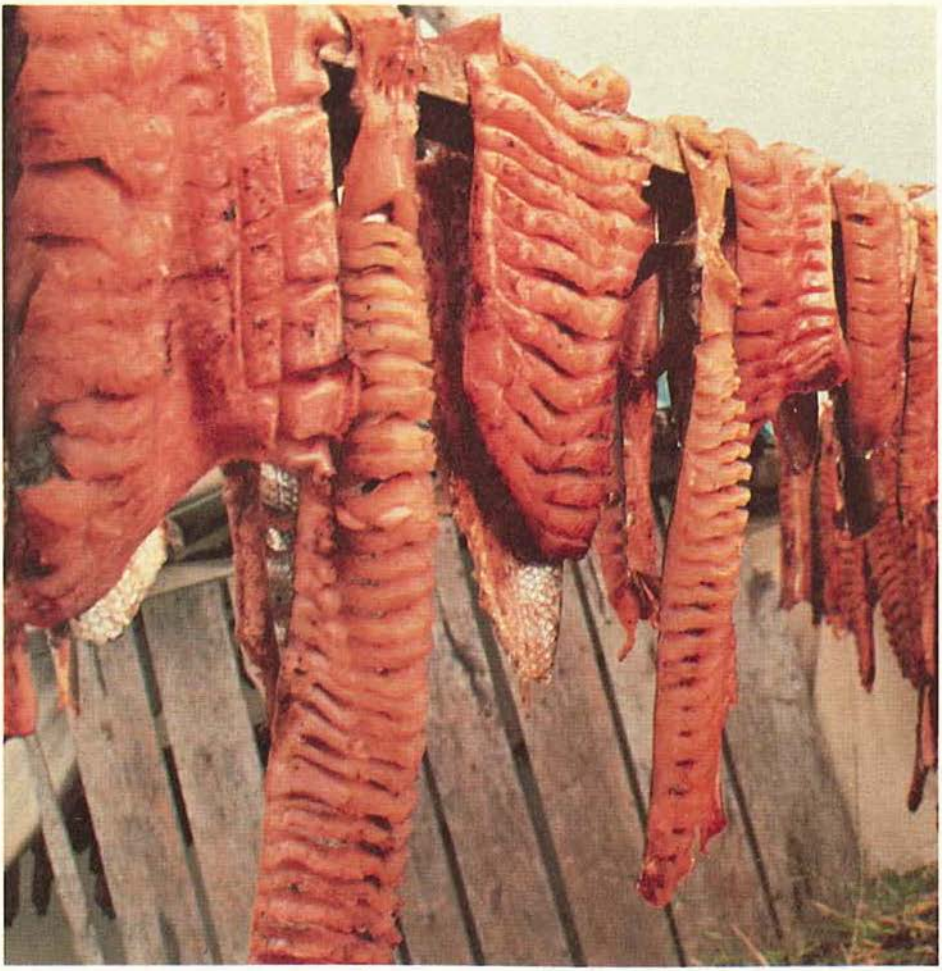
Industrial activity is increasing throughout the North, especially at Tuktoyaktuk and along the coast of the Beaufort Sea.

Operations

Operational programs of the western region are based at the Freshwater Institute but many of the key personnel are located throughout the three prairie provinces and in the Northwest Territories.

In the NWT, biologists survey and monitor the various fish and marine mammal populations. A record is kept of their commercial, recreational and domestic harvests in order to determine the biological factors which must form the basis for the successful management of all Canada's fisheries. Information gathered

An Inuit catch of Arctic charr dries naturally in the open air.



from these assessments is used to formulate realistic regulations and guidelines for the safe harvest of these resources — resources that are fundamental to the economic and social well-being of the North.

Scientists and managers are involved in both research and assessment of the processes causing disturbances to aquatic environments in the Arctic. These activities aid in preventing or minimizing the adverse effects of such disturbances, particularly those caused by industrial development.

Inuit hunters land a narwhal — its meat valued as a food and its ivory tusk as an article of trade.

Ongoing resource impact studies assess fish passage and habitat disruptions that result from hydro development, oil and gas development, and highway and pipeline stream-crossings. Information gathered from these studies will help provide solutions to the problems as they arise.

Ongoing baseline studies in the Arctic — as in the Mackenzie Delta and along the coast of the Beaufort Sea — are establishing an information base on fish and marine mammal resources, habitat use and sensitivity. Regional staff then can review thoroughly environmental impact statements for proposed developments and serve as expert witnesses at public hearings associated with the industrialization of the North. An understanding of the complexity and vulnerability of the fisheries resources in Canada's North is imperative. If they are to be used practically, they must be used wisely.

Federal fishery officers conduct surveillance and enforcement activities across the Northwest Territories with particular emphasis on the Great Slave Lake commercial whitefish fishery, the Cambridge Bay Arctic charr fishery, recreational fishing at

Federal officers carry out inspection and certification services at the various stages of fish handling and processing throughout the region.

the numerous lodges in the territories, and the subsistence charr, narwhal, beluga, walrus and seal harvests in the coastal areas. Conservation education and consultations with various associations and groups with respect to fishing regulations, to fish habitat protection and to other related regulations are conducted throughout the 3.4 million square kilometres of territory.

The department provides a number of services directly to the fishery. Regional personnel carry out the inspection of fish and fish products, processing plants and transporting vehicles by organoleptic, microbiological and chemical evaluations for the protection of the consumer and to ensure the continuity of products from the freshwater fisheries to both domestic and foreign markets.

The region has developed and operates a rapid analytical sampling laboratory to determine the levels of mercury, other heavy metals, and organic contaminants in fish. More than 20 different laboratories across North America use the mercury

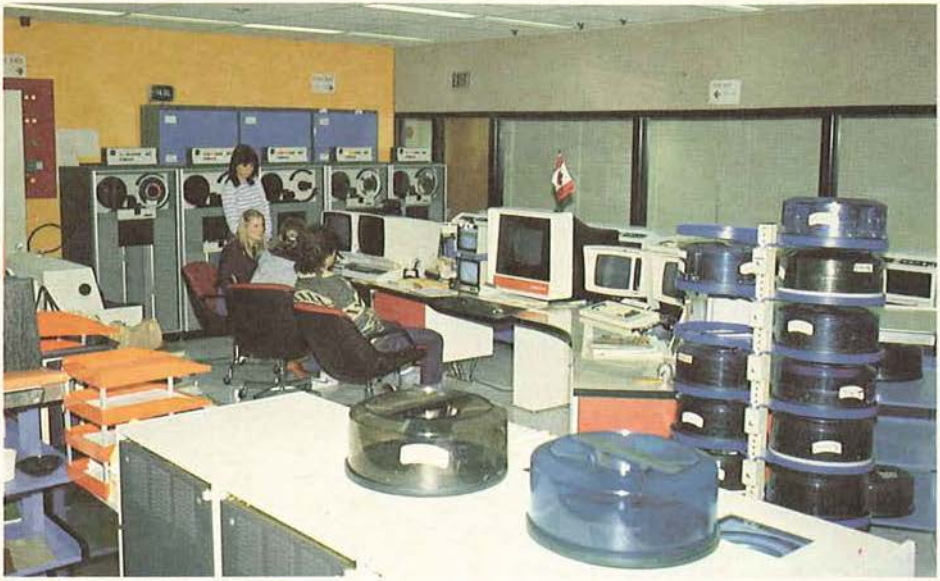
Microbiologists prepare bacterial cultures for further study.

Whitefish roe, or golden caviar, is processed and packaged for export by staff of the Freshwater Fish Marketing Corporation under the supervision of Institute technologists.

check-sample program established at the Freshwater Institute to standardize their own quality control procedures.

Fisheries development specialists provide guidance, training, technical and professional assistance to the primary and secondary fishing industry throughout the region. From a previously discarded by-product, Institute technologists developed a process to produce Canadian whitefish caviar. This development led to a substantial increase in the inland fisherman's income.

Computer technology is imperative to the fishing industry and to fisheries management and research to meet the demand for data analysis, storage and retrieval.



Fishermen's assistance plans are also administered. The federal Fishing Vessel Insurance Plan protects fishermen against accidents which may result in loss of, or damage to, their boats. And the federal Fishing Vessel Subsidy Plan provides financial assistance for the construction or the modification of fishing vessels, providing certain conditions are met.

An economic perspective for the management of public fisheries is provided as well. Through computerized statistical reporting systems and analyses of the structure and performance of commercial and recreational fishing industries, criteria are established for the economic efficiency of fisheries resource management. Site-specific analyses are carried out as well to assess the short and long-term economic returns to investments in fisheries research and development.

Since 1974 the region's Small Craft Harbours Branch has invested more than half-a-million dollars to improve and enlarge Gimli Harbour, on Lake Winnipeg, to service the commercial and recreational users of lake craft.

The region is responsible for the administration, construction and maintenance of federal small craft harbours and marina sites used by commercial fishermen and recreational boaters. The more than 70 marine facilities in the western region range in size and complexity from large multi-purpose harbours to small simple wharves and launch ramp installations.

Information

The Institute library, recognized as possessing one of the largest collections of limnological literature in North America, has more than 12,000 books, 1,000 current periodical titles, 30,000 back volumes of periodicals and 10,000 other publications related to the dynamics of freshwater biology.

Acrylic renderings of diatoms, as seen by Canadian artist Tony Tascona, hang in the stairway of the Institute's front lobby.

The Freshwater Institute provides fishermen, the fishing industry, schools, government departments and agencies, and the public with information about the activities, programs and policies of the Department of Fisheries and Oceans regionally, nationally and internationally through a variety of means.

Requests for information or assistance may be directed to the address below.

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