The Fisheries Research Board of Canada

What it is and what it does

THE FISHERIES RESEARCH BOARD OF CANADA
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FISHERIES RESEARCH BOARD OF CANADA
Ottawa
1968

FOREWORD

The Fisheries Research Board of Canada was created by an Act of Parliament specifically to carry out government-sponsored research in aquatic biology.

FRB research results are utilized extensively by the Minister of Fisheries in regulatory actions and in arriving at international agreements.

Other Federal government agencies, Provincial governments, and universities carry out limited programs of fisheries research. Virtually no fisheries research is carried out by private industry – FRB dominates the Canadian fisheries research scene.

Present FRB research activities have been grouped into the categories shown below. Numbers of scientists and percentages of total research expenditure (for the 1967 – 68 financial year) are shown in parentheses for each category.

- **The Environment** – achieving an understanding of what causes differences in aquatic productivity; investigating pollution. (50 - 19%)
- **The Resource** – examining the body chemistry, life history, populations and production of economically valuable species. (73 - 29%)
- **Increasing the Resource** – increasing the supply of salmon and shellfish by improved propagation techniques; reducing losses of live-held lobsters; control of competitors or predators. (34 - 16%)
- **Harvesting and Management** – locating new stocks; accessibility and behaviour of fish in relation to existing or new types of gear; obtaining information needed for management; forecasting stocks and catches. (44 - 24%)
- **Commercial Products** – collaborating with industry to upgrade existing fishery products; developing or improving handling and preservation processes; determining factors that affect quality; developing new products from fish, invertebrates and microorganisms. (46 - 12%)

The FRB is concentrating university support on enrichment of specific departments where arousal of student interest will benefit the FRB and other marine agencies in future recruitment. FRB water laboratories and shipboard facilities are used to facilitate appropriate university research programs.

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The FRB research vessel "A.T. Cameron" leaving harbour on a cruise of offshore waters

INTRODUCTION

"The Board has charge of all Dominion fishery research stations in Canada, and has the conduct and control of investigations of practical and economic problems connected with marine and fresh water fisheries, flora and fauna, and such other work as may be assigned to it by the Minister."

(From the Fisheries Research Board Act)

The sea is a common property resource whose non-proprietary users have no commercial incentive to invest in the husbandry of its wealth and potential. For this reason, and because of the fragmented nature of the industry, there is no real alternative to government sponsorship of fisheries research. Industry participation is limited to some product and equipment work by the larger companies. Universities do some basic research which varies according to staff interests. Provinces and International Commissions deal with stocks of certain species (e.g. Pacific Halibut, Fraser River Salmon). However, the Fisheries Research Board of Canada is uniquely the agent in Canada which has both the responsibility and technical background to develop the whole field. This often includes collaborating, as circumstances warrant, with other agencies. The deployment by the FRB of limited resources has brought notable returns in specific areas where definite problems in aquatic resources demanded solutions. In large part these problems resulted from the rapid change of Canadian fisheries from fairly primitive harvesting operations to vertically integrated food industries. In solving them a relatively small staff of talented scientists has brought the FRB to a position commanding respect from its international peers.

We are now in an era of unprecedented scientific activity; unprecedented both in magnitude and scope. It is widely recognized that this has resulted in the narrowing of personal interests to the point where scientists find it difficult to communicate with each other as well as with the public. The FRB is an interdisciplinary organization which unites experience and motivation in diverse sciences for the benefit of fisheries and aquatic resources generally.

It is often said that a vast area of the earth's surface, represented by the ocean bottom, is less well known that the surface of the moon. To this should be added the opaque layer of water, up to several miles thick, in which occur mysterious chain reactions, subject to drastic modifications triggered by minor physicochemical changes. Fisheries research and aquatic science offer as much challenge, and can be as complex, as the currently glamourous sciences of space research and nuclear physics.

ORIGIN AND ORGANIZATION OF THE FRB

The Fisheries Research Board is the oldest government supported independent scientific board in North America. It was in 1898 that the British Association for the Advancement of Science recommended a Board of Management for *the* Marine Biological Station. (The first station was a floating laboratory which operated in the Gulf of St. Lawrence from 1899 to 1907.) The Board, created in the same year has, through changes in name, become the FRB of today. In 1924 the Board's responsibilities were broadened with the opening of its first technological laboratory at Halifax. In 1928 the first physical oceanographer was employed; when war came FRB oceanographers were taken over by the Navy as a unit. A freshwater laboratory was opened in 1944 and a headquarters for Arctic research in 1947. The Newfoundland Government Laboratory at St. John's was transferred to the FRB in 1949.

The FRB includes a full-time Chairman and 18 honorary members, appointed by the Minister for 5-year terms, of whom a majority are university scientists, with representation from the fishing industry and the Department of Fisheries. The membership is divided into Eastern, Central-Arctic and Western Regional Advisory Committees which meet once or twice annually with directors of FRB establishments and regional directors of the Department to review proposals and budgets and to set up priorities. Subsequently the Executive Committee, of which the Deputy Minister of Fisheries is an *ex officio* member, sets up national priorities. The full Board at its Annual Meeting, receives committee reports and develops national policies. While proposals for FRB research originate in many ways, the operational practices are usually initiated by the FRB directors.

The close liaison between the FRB and the Department of Fisheries is paralleled by interagency working groups. Many projects initiated by the FRB pass out of research and into practice and are handed over by mutual consent to Department of Fisheries services such as Resource Development, Inspection Service or Industrial Development. The transfer of the sea lamprey control experiment on the Great Lakes to Resource Development is a recent example.

The FRB is unusual among comparable agencies in not having laboratories in Ottawa. The staff of the Office of the Chairman has been kept small, currently at 25 persons, with substantial authority and accountability delegated to laboratory directors. Decentralization is considered essential for a proper research environment, which in turn determines whether the FRB can attract and hold good scientists.

The Office of the Editor, also located in Ottawa, publishes a monthly scientific *Journal* and *Bulletins* on specialized topics at irregular intervals. It serves as an FRB central documentation agency for scientific and technical information.

THE FRB AND OTHER BODIES

Some scientific boards, such as the Defence Research Board, operate only at the direction of their ministries. Others, like the Medical Research Council, are totally separated from ministries. The major part of the FRB budget is for programs initiated by FRB but it also services fairly wide co-operation with other bodies which should be mentioned.

Department of Fisheries. Sixteen or more nations fish the Western North Atlantic and at least four fish the Eastern North Pacific. To provide management and conservation there have been several treaties under which International Commissions have been set up. The FRB provides research and scientific advice for the Canadian delegations to most of these bodies. Within Canadian waters the conservation regulations for such forms as lobsters, oysters, herring and salmon are based partly on information supplied by FRB research. In fact FRB research plays a role, directly or indirectly, in the management of all marine commercial fisheries in Canada as well as sport fisheries in the Atlantic region.

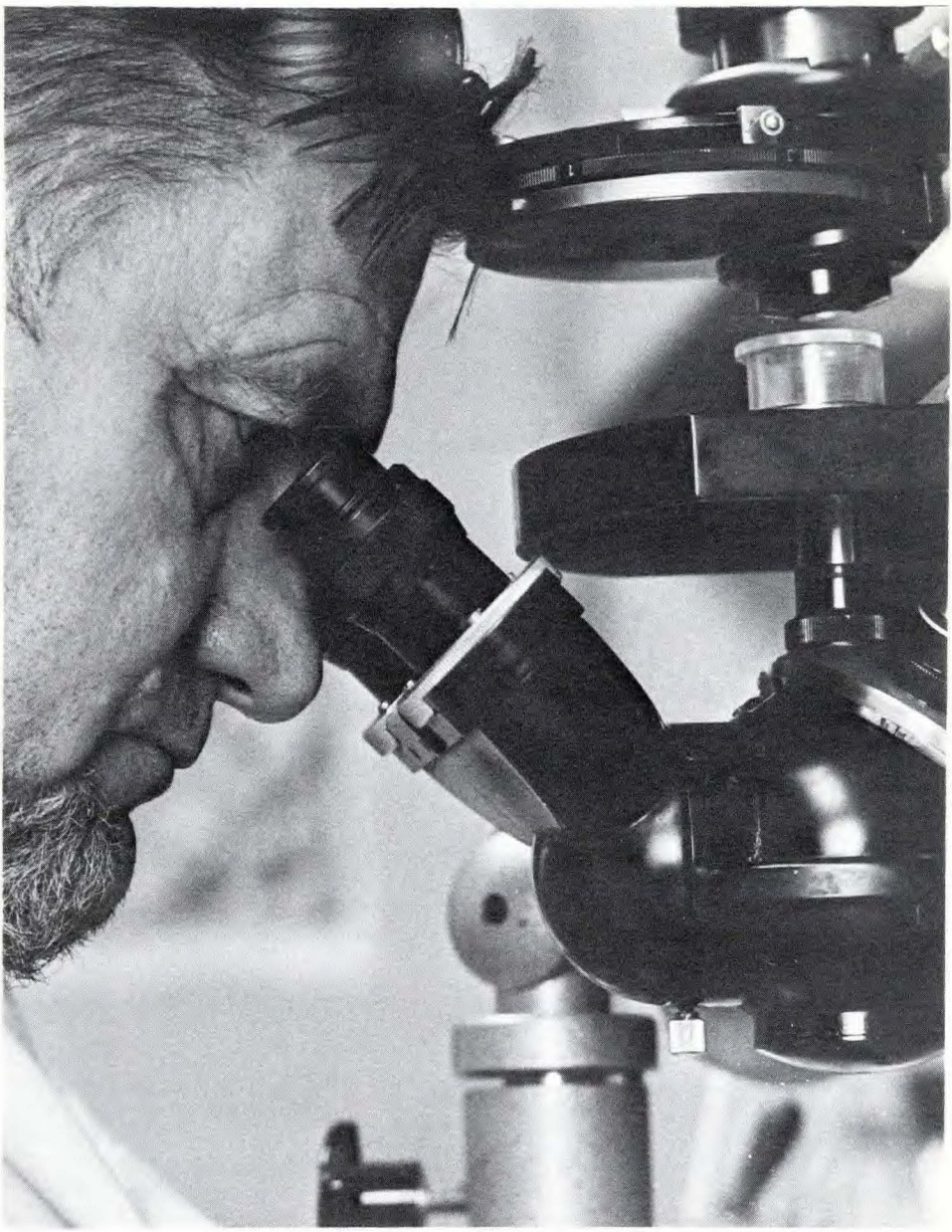
The Fishing Industry. Since 1924 industry representatives have been members of the FRB. Laboratories were concurrently established for the development, in close collaboration with industry, of improvements in the preservation and processing of fish, and of new products from fish. The biological search for new stocks of fish to be exploited, and for means of increasing stocks of lobsters, salmon, and other marine animals, is also of direct use to industry.

National Defence Department. The FRB has a strong interest in oceanography which defines the environment of the fisheries. Oceanographic research has produced information on among other topics, the boundary conditions of water masses, which are equally relevant to fish behaviour and to submarine warfare.

Indian Affairs and Northern Development. A 1953 Bill gave this department responsibility for co-ordinating all government activities in the northern territories. The FRB offers research and advice on the productivity of northern waters and the sustaining capacity of lake fish stocks for Eskimo and Indian settlements.

International Joint Commission. Biological aspects of such questions as the Passamaquoddy Tidal Power Project and Great Lakes Pollution are investigated by the FRB.

Universities. The FRB makes its ships, laboratories and field stations available for research by academics. It also operates a modest grant program designed to assist certain university departments to improve the opportunities for graduate students to undertake research in aquatic science.



An FRB biological oceanographer examines plankton in a study of marine productivity

The Provinces. West of New Brunswick and south of the Territories the stocks of freshwater fish are provincially managed, but FRB has always done considerable freshwater research on basic problems that are applicable to management. The provinces do no research on fisheries products. Development of provincial fisheries resources, freshwater and marine, is assisted by both the FRB and the Department of Fisheries.

Canadian Committee on Oceanography. The FRB was one of the founding members and provides the executive secretary.

THE PRESENT FRB PROGRAM

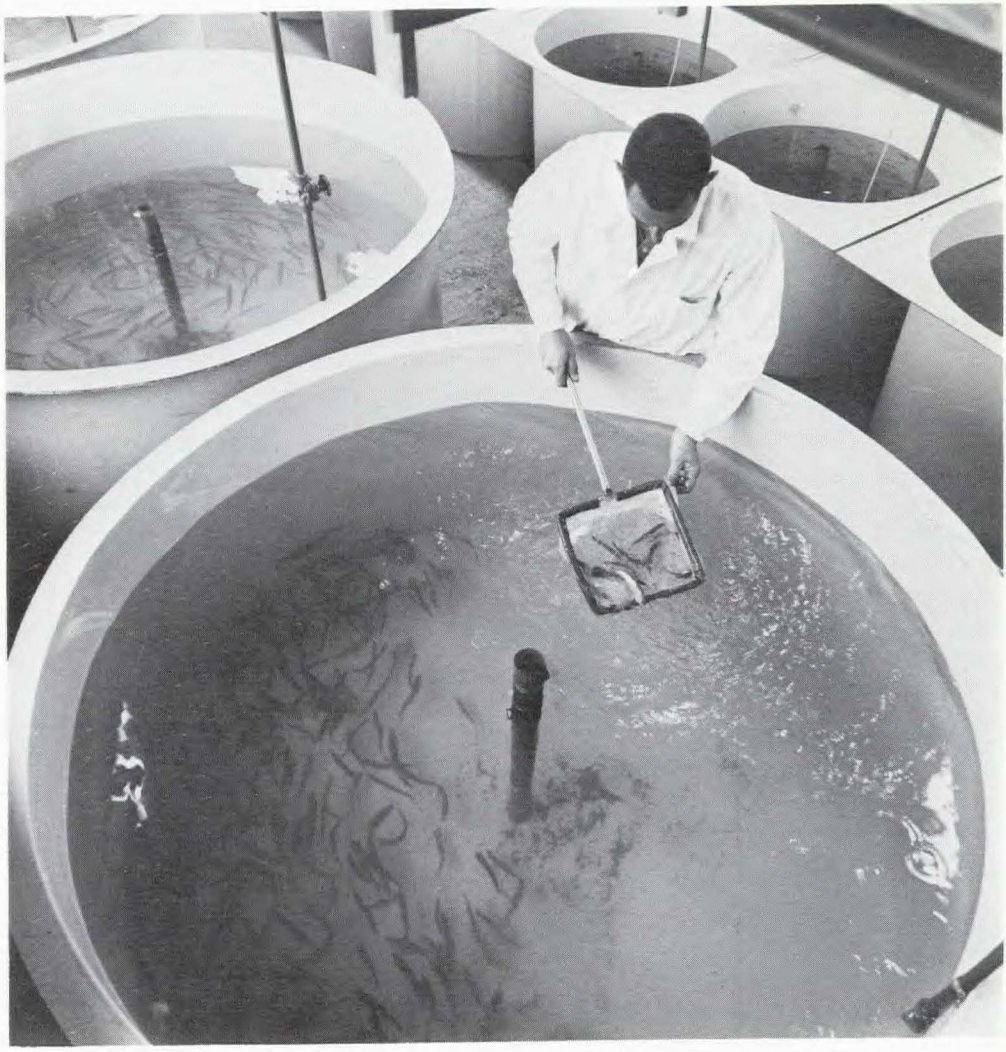
The Fisheries Research Board Act is available as reference material, and its key paragraph is quoted on page 1 of this booklet. Under this Act the FRB is given responsibility to develop the biological aspects of aquatic science in Canada as well as to investigate practical fisheries problems. The FRB research program is in five main areas as shown on page 15; these will be discussed in turn. The current distribution of FRB effort is shown on page 16.

The Environment is approximately equivalent to oceanography and its freshwater counterpart, limnology. It includes the properties, structure and behaviour of waters, phyto- and zoo-plankton, plant and animal production processes and energy relations in the food chain, effects of artificial alteration of the milieu (stream channel alterations, dams, insecticides, sewage, industrial wastes).

Contamination of the Great Lakes and other inland waters is a pressing problem of the times. Under a charge from the International Joint Commission, a multidisciplinary effort has been launched to investigate (and eventually alleviate) this pollution. In addition to the Province of Ontario, the federal agencies concerned are: Energy, Mines and Resources (water quality, circulation, chemistry), National Health and Welfare (fitness for human use) and the Fisheries Research Board.

The FRB task is to understand the mechanism and the biological effects of man-made increases in the nutrient level of lakes and to seek efficient means of controlling the process. The research will include field studies on the Great Lakes, laboratory studies, and pilot plant operations on smaller lakes. The outcome of the Great Lakes work, which is basically a rescue operation, will affect nearly half of Canada's population.

The Resource is concerned with commercially useful organisms of all sorts: their form and structure, physiology, biochemistry, life history, behaviour under different conditions, reproduction, diseases and parasites. At the level of stocks or populations information is needed on reproductive success, mortality rate, food, growth rate, stock size, and effects of competition and of environmental conditions.



Holding tanks for live fish used in laboratory studies

The future expansion of the Atlantic industry appears to depend upon the harvesting of additional species and smaller sizes by new methods. Additional animal protein is there, available for use by a hungry world, but the places of concentration of new stocks remain to be located and their sustainable annual yields worked out. The energy relations are complex since some of the potential unused fish resources (e.g. capelin) are the food of species now being captured. The FRB has projected plans to study thoroughly the population dynamics of migratory pelagic fish, especially the herring.

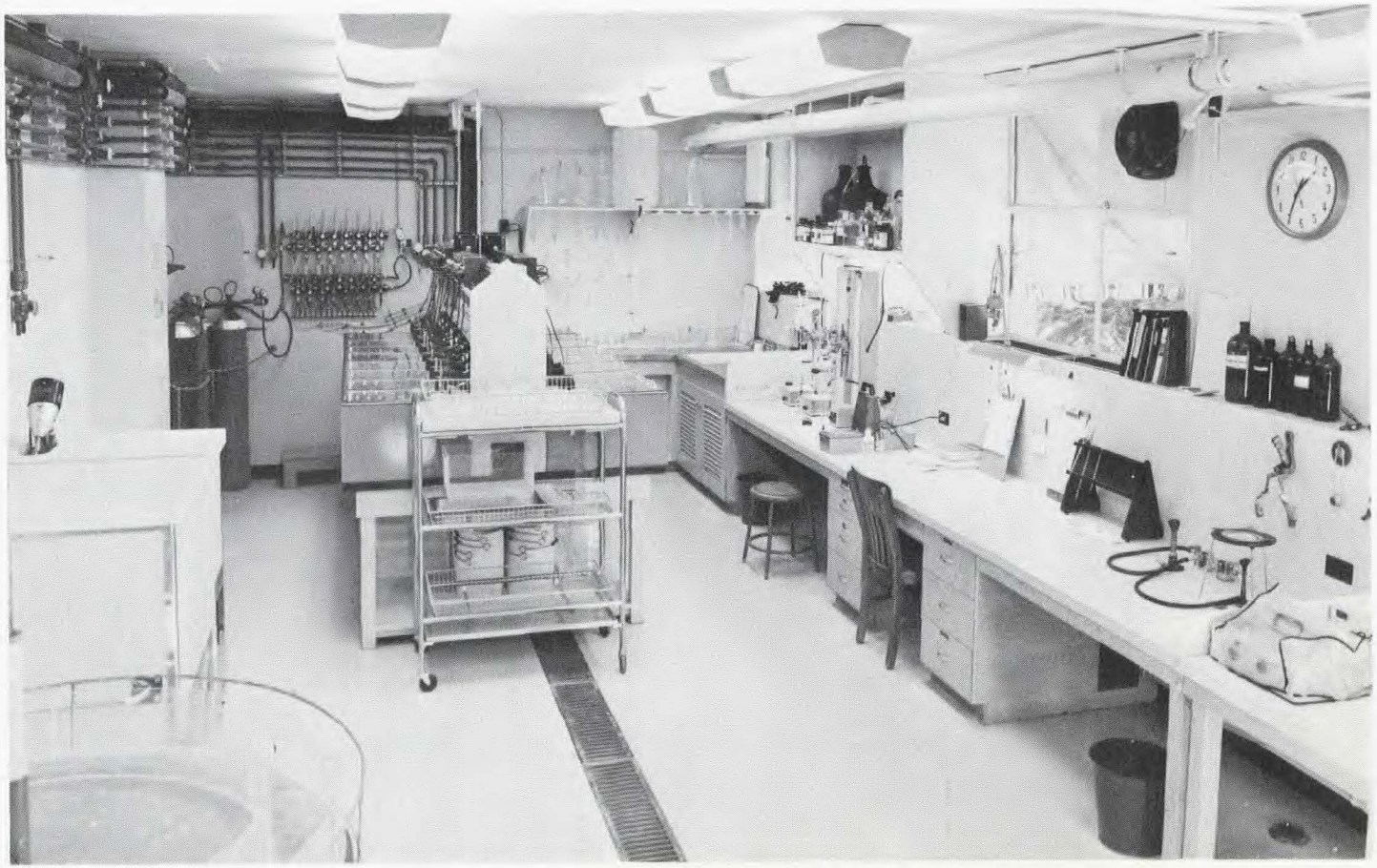
Increasing the Resource includes the current encouraging development of controlled-flow spawning channels and improved hatchery procedures for propagating Pacific salmon. The Fisheries Resource Development Branch and the FRB have common interests in this area. On the Atlantic coast oyster hatchery practice has been improved and lobster holding and feeding in pounds has been greatly assisted by recent FRB developments.

Transplantations have a tantalizing history. On the credit side is the transplantation of Japanese oysters and Manila clams to British Columbia. Still in the experimental stage are transfers of sockeye and coho salmon to the Great Lakes and pink salmon to the Atlantic, and of lobsters to British Columbia. Future possibilities include other species of salmon, European oysters and sturgeons.

FRB research has indicated that lobsters can survive on our Pacific coast – the experiment is still in progress. Pacific pink salmon have been introduced outside their geographic range to a Newfoundland river and some have bred there. They have also been transplanted to off-year streams in British Columbia, but in spite of numerous efforts over some 60 years no self-supporting pink salmon populations of any magnitude have as yet been established in Canada or elsewhere unless possibly in northern USSR.

If progress is to be made with most species it will be necessary to develop additional fundamental studies on food-cycle dynamics. The FRB basic researches into primary productivity are designed to open up this area.

Harvesting and Management research includes three types of work. Exploration for new stocks, or concentrations of commercial density, is carried out, often in collaboration with the Department of Fisheries. Understanding why a fishing method is successful or not depends on knowledge of the behaviour of fish in relation to gear, their sensory capacities, swimming ability, reactions to objects or chemicals, and the design of the fishing apparatus. Management studies involve determining the effect of fishing on stock size and productivity, means of forecasting catches, and estimating sustainable yield.



Laboratory for studying effects of environmental changes on fish and other marine organisms

The decisions of industry concerning expenditures for ships and plants depend upon estimates of the sustained yield of a species. The possibilities and limits of new and expanded fisheries such as that for Atlantic herring or Pacific bottom fish are defined by management research.

In addition to work on strictly domestic fisheries, this FRB research supplies background information for the nation's international commitments on such stock as seals and the perilously reduced baleen whale. Studies of fish distribution and fluctuations in abundance, and the prediction of fish concentrations, provide the information used in Canada's negotiations with other countries to determine the fisheries position of tomorrow. The trend in our industry is to utilizing new species and smaller sizes of fish than hitherto.

Harvesting research, together with the population aspects of resource research tend to be the most expensive of FRB program components. They involve field work and branch laboratories, technicians, ships and crews. In these areas the cost per scientist is about three times that of laboratory-based research. The overriding need to know more about living resources justifies this expenditure.

Commercial Products. It is likely that a great increase in demand for fish will occur in North America when the housewife can buy fish in the supermarket with as much confidence as she now buys eggs, ham or cheese. Considerable success in this direction has been achieved with lean fish like haddock. The prevention of rancidity in fat fish has been more troublesome but good progress is being made. Antibiotics have had a major impact on the Atlantic fresh fish industry. New methods of preservation, such as ionizing radiation and superchilling, are being introduced in advance of commerical needs, and new chemical preservatives, such as metal binding agents, are being exploited. New products, such as fish protein concentrate, have also been developed and at a recent conference with worldwide attendance the pioneering role of the FRB in this field was acknowledged.

In conjunction with the industry, methods of freezing fish at sea were introduced, as well as the use of chilled sea water (an FRB innovation of the 1920s which reached commercial use in the late 1950s). Bacterial and biochemical changes are thoroughly investigated in all of these processes.

The rapidly expanding fish meal industry has benefited substantially, through higher prices, from nutritional studies on these products carried out by the FRB on the West Coast and now in progress on the East Coast.

Campus of the University of British Columbia with FRB Vancouver Laboratory in left centre (encircled)

The ocean teems with a variety of living organisms of types not found on land. In addition to food these plants and animals can provide us with natural products, knowledge of biosynthetic processes, and a better understanding of the basic life mechanisms. Some natural products such as seaweeds, are being harvested now, but the full exploitation of this type of resource has scarcely begun. A knowledge of substances present in marine forms is being acquired through FRB fundamental research as a prerequisite to intelligent utilization of this resource. There is a continuing investigation of means of utilizing species and life forms which are at present unexploited, and in some instances, troublesome.

UNIVERSITY RESEARCH AND THE FRB

There is an inevitable relation between the fields of emphasis in graduate work and the supply of research recruits. In the years since the war the renewable-resource areas of study have lagged far behind the physical sciences in providing university support both absolutely and relatively. Fisheries shares its unenviable position at the bottom of the support list with Agriculture and Forestry.

As well as giving the universities scientific co-operation and the use of its equipment, the FRB is now expanding its direct academic grants. Duplication of the NRC support plan is not intended; the aim would rather be to back a half-dozen universities in appropriate areas of graduate work. The selected universities would be supported in a manner comparable to that provided by the MRC to medical researchers and graduate students. Thus there would be a production of recruits somewhere in Canada with a bias towards this branch of renewable natural resources.

The field of natural resource research has seemed since the war a little old-fashioned and outside the vanguard of science, which is depicted in terms of particle accelerators, rockets, radio telescopes and similar hardware. Nevertheless, the techniques of physical oceanography have become highly automated with shipboard space and gear needs such that equipment is no longer portable and must now be provided in "built-in" installations. Biological oceanography has also greatly altered in late years and now requires sophisticated electronic equipment and laboratory facilities, while the sea-going biologist is no longer content to pickle specimens in formaldehyde for study ten years hence, but wishes to transport live animals ashore for immediate detailed study.

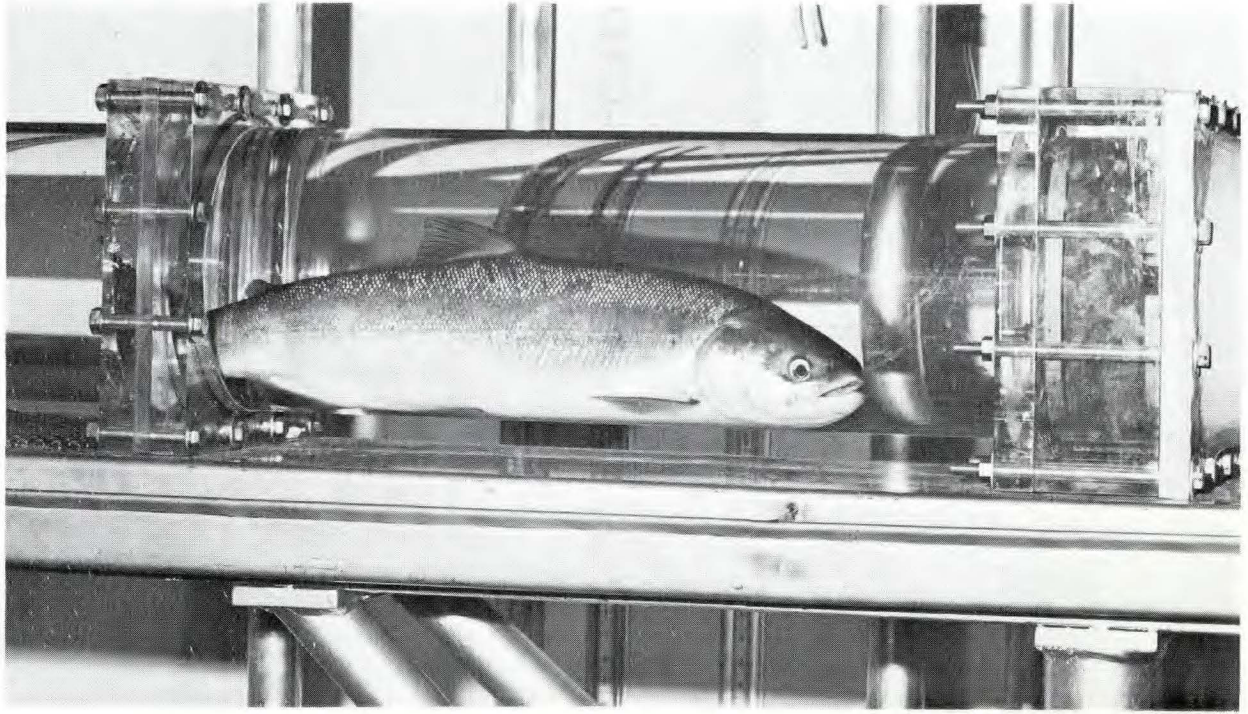
The physical requirement in respect to research on specific fish is that provision must be made for scientists to observe fish in their native habitat with enough surrounding space to freely exhibit reactions to each other and to specific external objects. Biologists have had some success in the control of stimuli for those sense organs which are well developed

Reading the magnified projection of a fish scale to determine the age of the fish from which it was taken

in man, but have had great trouble with experimental design in areas where humans are weak, such as odours. The constancy and adequacy of water supplies requires close attention and good water laboratories. The FRB already has special competence in the operation of water laboratories. Recent FRB studies using water laboratories for controlled experiments have shown that the physiological condition when caught of valuable species such as cod, lobster and oysters, can affect the commercial value of the ultimate product. Also, that the physiological state of marine organisms during their reproductive lives affects their reproduction and the subsequent survival of juvenile forms to sizes of interest to commerical fisheries.

FRB scientists have, on each coast, the use of an otter-trawler type of research vessel intended primarily for exploratory fishing. There are also a number of smaller inshore vessels. A modest amount of time for oceanographic research is provided through the courtesy of other Government agencies.

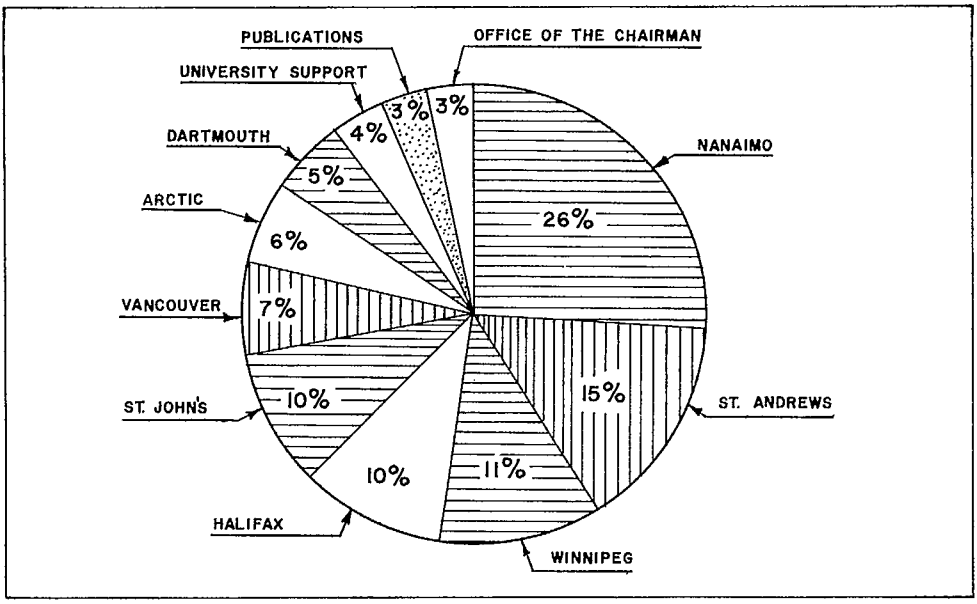
It is recognized that the greatest cost of increasing the population of post-graduate students at our universities is that of providing the students and those who teach them with opportunities for research. The FRB water laboratories and research vessels offer a strong and nation-wide enlargement of academic opportunity to train recruits for an important area of science. Sharing facilities with universities enables the FRB to stimulate the whole scientific community.



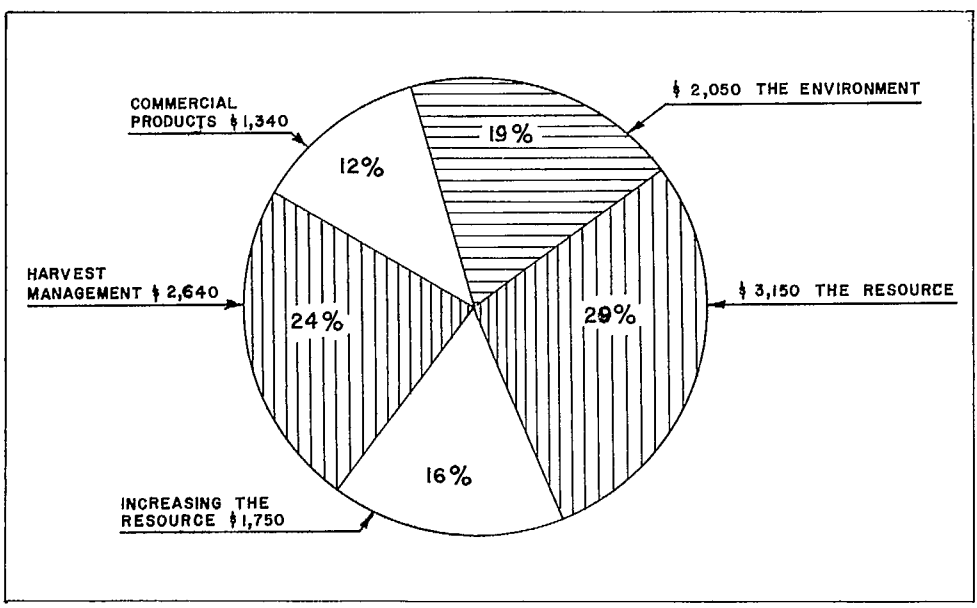
Relation of swimming speed of fish to water temperature being determined in a respirometer

CLASSIFIED SUMMARY OF THE FRB RESEARCH PROGRAM

- **The Environment** (Oceans, lakes, rivers)
  - * *The water and the basin* (temperature, gases, light, salts, waves, currents, sediments, etc.)
  - * *Biological environment and productivity* (nutrients, plankton and bottom life, transformation of matter and energy)
  - * *Pollution and eutrophication* (man-made changes)
- **The Resource** (fish, shellfish, mammals, plants, etc.)
  - * *The organism* (physiology, biochemistry, performance, behaviour, genetics, anatomy, classification, diseases and parasites)
  - * *Populations* (reproductive success, mortality, food, growth, stock density, competition, effects of environmental conditions)
- **Increasing the Resource**
  - * *Natural stocks* (rearing and survival of young salmon, hybrids, selection, lobster "reefs", improvement of oyster grounds, etc.)
  - * *Transplantation* (e.g. European oyster, Atlantic lobster, Pacific salmon)
  - * *Farming* (rearing to marketable size: e.g. trout, oysters, black cod)
- **Harvesting and Management**
  - * *Exploration* (new areas, new stocks)
  - * *Stock characteristics related to capturing techniques* (schooling, distribution on the grounds, sensory capacities, swimming ability, reaction to fixed or moving objects, attractants, herding methods, improvement of fishing gear)
  - * *Management* (effects of different levels of fishing on stocks, forecasting catches, sustained yield estimates, data for international negotiations)
- **Commercial Products**
  - * *Handling the catch* (removal from nets, gutting, unloading, mechanization)
  - * *Storage in vessels and ashore* (refrigeration, irradiation, preservatives)
  - * *Processing* (salting, smoking, canning, reduction to oil and meal, dehydration)
  - * *Acceptability* (nutrient value, quality, flavours, odours, colour, parasite detection and removal, seasonal changes, regional variation)
  - * *New products* (plankton, pharmacological products, etc.)



Distribution of effort for 1967 among FRB establishments and operations expressed as percentage of total operating costs



Operating costs for FRB areas of research in 1967-68 (in thousands of dollars)

FRB ESTABLISHMENTS

Fisheries Research Board of Canada,
Biological Station,
P.O. Box 100,
NANAIMO, B.C.

Fisheries Research Board of Canada,
Biological Station,
ST. ANDREWS, N.B.

Fisheries Research Board of Canada,
Biological Station,
ST. JOHN'S, Newfoundland.

Fisheries Research Board of Canada,
Marine Ecology Laboratory,
Bedford Institute,
P.O. Box 1006,
DARTMOUTH, N.S.

* Fisheries Research Board of Canada,
Technological Station,
GRANDE-RIVIÈRE, P.Q.

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Technological Unit,
Cable Building,
ST. JOHN'S, Newfoundland.

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Fisheries Research Board of Canada,
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‡ Correspondence for the Oyster Unit at Ellerslie should be sent to the Marine Ecology Laboratory, Dartmouth.

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