

Environment Canada

Fisheries and
Marine Service

Environnement Canada

Service des pêches
et des sciences de la mer

1974 Report

Resource Development Branch

Maritimes Region
Halifax, N.S.

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The above symbol which is incorporated on the cover of the 1974 Report represents a graphically stylized version of a "jumping salmon".

IMPORTANT

This report constitutes a summary of preliminary scientific and technical data for the information of colleagues, and should not be cited without prior approval of the Chief, Resource Development Branch.

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INTRODUCTION

The basic objectives of the Resource Development Branch have not changed in the past fifteen years, although the complexity of activities has grown considerably. Maritime economic and industrial growth were relatively slow prior to 1960, particularly when compared to the rest of Canada. Since that time, however, the region has experienced a marked increase in industrial development and economic growth. This expansion has necessitated a greatly increased effort by the Branch to monitor the effects and to insure the protection of regional fishery resources. At the same time, a rising standard of living has created more demand for recreational fishing opportunities. In 1974 it became extremely difficult to meet the growing responsibility of fisheries protection and enhancement with the limited resources that were available. As a direct result of inflation and reductions in casual manpower resources, 14 specific projects were curtailed. Although it is always useful to reassess what one is doing and to restructure priorities from time to time, the magnitude of this cutback was demoralizing. Despite diminished resources, the Branch continued to discharge its responsibility to protect and enhance freshwater and estuarine fisheries in all three Maritime Provinces.

In 1974 the problem of energy preoccupied most of the industrialized world. In New Brunswick, the search for new sources of electric energy was reflected in such projects as the Point Lepreau Nuclear Power Plant and the proposed Green River hydroelectric development. The Wreck Cove hydroelectric project on Cape Breton Island reflects a similar search for electric energy in Nova Scotia. All of these energy-producing projects may have detrimental effects on fisheries. A significant portion of our effort during the past year was expended on assessing the impact of these and other industrial developments on various fish stocks.

The federal government has initiated an Environmental Assessment, Review and Protection Process, designed to provide a more comprehensive examination of environmental issues of all federally funded projects that might have some significant impact on the environment. The "EARP" process manifests itself in the Region through a screening and coordinating committee which is chaired by Don Riley, head of our Fish Habitat Protection and Engineering Services Section. This committee reviews all federally funded projects of potential environmental significance for both the Maritimes and Newfoundland regions.

Greater demands were made in 1974 on the Resource Development Branch for the development and expansion of shellfish stocks and for knowledge required to artificially rear salmonids in the marine

environment. Research and development in these fields are required if the unique environmental opportunities available in the Maritimes are to be fully exploited. This new momentum in aquaculture aroused concern that an aquaculture industry could pose a threat to native aquatic plants and animals. Thus, in 1974 some Branch effort was directed toward developing regional guidelines that would control but not retard the aquaculture industry.

Resource Development Branch assistance to shellfisheries has been traditional in the Maritime Provinces. Current programs include oyster leasing, stock inventory surveys, location and timing for oyster spat collections, depuration of contaminated stocks, quality control, developing harvesting methods, control of fouling organisms and assessment of off-bottom rearing equipment. Development and refinement of this information must include the transfer of this knowledge to those people who can use it in commercial enterprises. To accomplish this goal, our oyster extension team was particularly active in 1974, conducting courses in oyster culture technology and lease management, interpreting federal government policy, and providing local biological and technical assistance to commercial operations.

Experiments in the seawater cage-culture of Atlantic salmon were continued in order to refine environmental, dietary and equipment requirements for this type of aquaculture operation. The tests at Polly Cove, Nova Scotia, although receiving setbacks from vandals and weather, demonstrated considerable success. This program was directed by R. E. H. Macdonald, who retired in December after thirty-four years of service in Maritime fish culture operations. Ray's contributions to improvements in fish culture were varied and significant. His optimism and enthusiasm have always generated good results, his recent success with mariculture being exemplary. Ray leaves with our best wishes for happiness in retirement and our expectation that he will always be associated with furthering the aquaculture of salmonids in the Maritimes.

In order to overcome difficulties imposed by rising costs, industrial expansion and an increased demand for recreational fishing, our fish culture stations must operate at peak efficiencies. To achieve this, we must improve the physical rearing facilities, as well as develop and more fully apply our knowledge of nutrition, disease control and selective breeding. During 1974, considerable progress was made in each of these areas by the concerted action of fish culturists, biologists and engineers. Mr. R. F. Hawkins, one of the key members of this multi-disciplinary team became seriously ill during 1974. We wish Ron a speedy and complete recovery.

Modified commercial salmon traps are being operated on a continuing basis in the estuaries of three major New Brunswick rivers in order to monitor returning runs of salmon. Trap catches on the Miramichi and Saint John rivers indicated that the 1974 salmon spawning escapement was about double that of 1973, whereas the spawning escapement to the Restigouche River had not changed significantly from 1973. On the Restigouche, the abundance of large salmon was actually 19% lower than in the previous year.

At Mactaquac on the Saint John River, where all ascending fish are intercepted, sorted at the Mactaquac Hatchery and subsequently distributed by tank truck to the upper river, 13,847 Atlantic salmon were collected in 1974. Of these, 6,695 were large salmon (2-sea-years or older) and 7,152 were grilse (1-sea-year). The spawning escapement into the upper Saint John in 1974 was the largest recorded since regular fishway counts were initiated in 1957. The increase is attributable to improved spawning escapements resulting from commercial fishery restrictions imposed in 1969-70, and also to increased returns of salmon from the Mactaquac Hatchery, which produced 38% of the run to the Mactaquac Dam in 1974.

In August, 1974, after only about one month of fishing, the Greenland salmon fishery was curtailed in order to abide by the ICNAF quota. At this time the combined high seas and inshore catch was approximately 1,800 metric tons, the lowest recorded over the past five years. This catch represents the first reduction since the phase-out agreement was reached in 1972. Reports indicate that salmon were abundant in Greenland waters at the time the closure was invoked. Even with the restrictions on the commercial fishery in Greenland beginning to take effect, biologists do not predict a commercially harvestable surplus of Atlantic salmon before 1977, in

New Brunswick rivers presently closed to commercial fishing. It is important to review Canada's salmon fishing strategy in advance of the reopening of these fisheries, so as to ensure maximum benefits from this valuable renewable resource.

A new area of responsibility for the Branch is in the field of marine plants. This program was transferred from the Industrial Development Branch in 1974. We plan to shift the emphasis of this program from industrial technology to biology, in order to provide a better biological basis for protecting and enhancing this valuable renewable resource. John Pringle, an algologist, joined the Branch in August to direct this important new phase of our operations.

It is a pleasure for me to again acknowledge the help received from my colleagues in the Conservation and Protection Branch, the Environmental Protection Service and the Research and Development Directorate. We also value the assistance that several provincial government departments and agencies provide. The help of Prince Edward Island, New Brunswick and Nova Scotia resource agencies is much appreciated and we look forward to continued cooperation with them in the protection and orderly development of the freshwater and estuarine based fishery resources of the region.

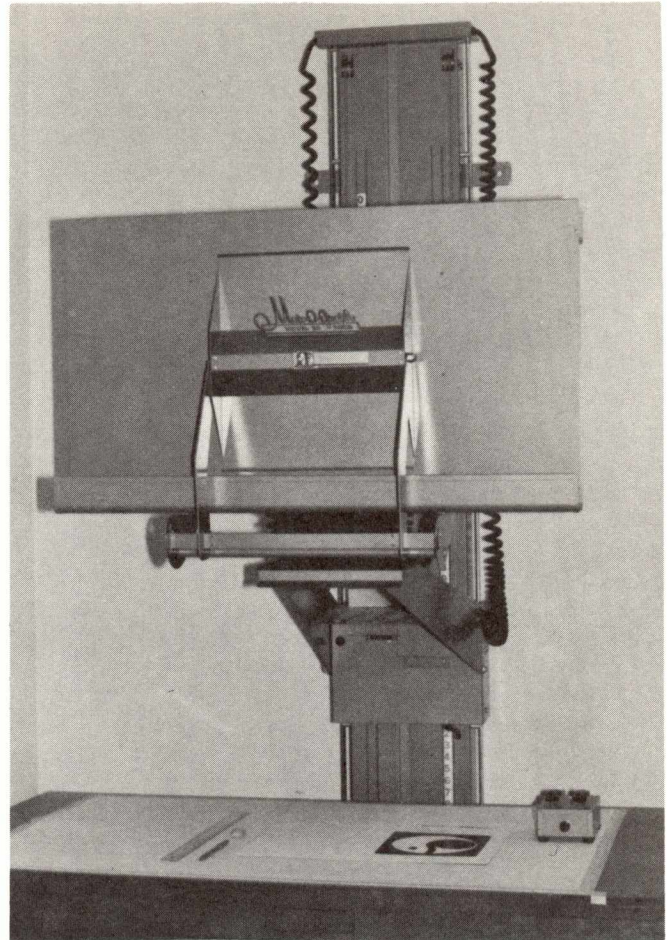
C. P. Ruggles, Branch Chief

SCIENTIFIC LIAISON AND SPECIAL PROJECTS

The Scientific Liaison and Special Projects Section provides support for the applied-science function of the Resource Development Branch. This small Section has now completed its first full year of operation, having been staffed late in 1973. The Section's support role relates mainly to communication and to developing information for use in appraising fishery management options.

The area of communication receiving emphasis is the external flow of scientific information. The editor has prepared a guide for the use of Branch writers in presenting their technical information in publications. Assistance and guidance are routinely provided to the scientific and technical staff to expedite publication of the many kinds of information generated by Branch activities. Scientific reports published by the Branch follow the Fisheries and Marine Service cover-series format. Technical Reports incorporate the results of scientific studies and are distributed widely to colleagues and other interested people. Data Record Reports, listing compilations and tabulations of background data, will be used to answer specific inquiries and generally will not be widely available. Internal Reports will contain consultant's reports, proceedings of major meetings, policy development papers and other material which is confidential or requires a restricted distribution. Information Reports are mainly for public consumption and will include brochures, semi-technical material, policy statements and similar items. The fifth type of report is that one publication of which this writing is a part.

Our graphic designer uses professional technical knowledge to incorporate illustrative materials into publications and audio-visual presentations. These special skills in design, drafting, and illustration are not infrequently performed for other operational units within Environment Canada. Our work has been expedited by acquiring additional equipment to permit speedier results at more modest cost and by



"Map-O-Graph" enlarging and reducing projector improves efficiency and accuracy for rescaling drawings.

term employment of a second graphic designer.

Fish resource management and development have become more complex. As a result, more assessment, appraisal and advice are required to develop the best programs. The Section Leader has been involved in this activity, for example, the preparation of development papers for salmon resource policy and for aquaculture policy, liaison with the Saint John River Basin Board office on a final report on fisheries management, and participation in a task force planning a water resource study proposal for the Shubenacadie River in Nova Scotia.

R. E. Cutting

MARINE FISHERY MANAGEMENT

The major activities of the Marine Fishery Management Section, since reorganization of the Resource Development Branch's operations in 1973, have been biological investigations related to management and development of the molluscan shellfish resource and the administration of an oyster-leasing program. This role was expanded in 1974, when a marine plant program was added to the Branch's responsibility and assigned to the Marine Fishery Management Section.

In 1974, the shellfish program continued in basically the same form as in previous years. Most of the investigations are ongoing ones, to develop an information base for management and expansion of the resource. Projects include shellfish resource inventories, oyster-spat monitoring and oyster-population assessments. A limited extension service, started in 1973, has provided considerable assistance to the oyster-farming industry in applying the results of our studies and, at the same time, has kept us informed of the specific problems facing the industry that required further biological investigations. Unfortunately, this extension service cannot keep pace with the demands of the expanding interest and investments in oyster farming throughout the Maritimes.

Investigations on the soft-shell clam (*Mya arenaria* L.) were continued, and stock-assessment studies were completed in the contaminated areas of Annapolis Basin, Nova Scotia and the coastal regions of Charlotte County, New Brunswick. A pilot-plant depuration study, to develop techniques for utilizing clam stocks in these contaminated areas, was undertaken in cooperation with other branches of the Fisheries and Marine Service, the Environmental Protection Service, the Nova Scotia Department of Fisheries and the processing industry.

The current year was a transitional one for the marine plant program. Since its inception in the mid-sixties, the marine plant program was the responsibility of the Industrial Development Branch, and program operations were centred at the Marine Plant Experimental Station, Miminegash, Prince Edward Island. The original purpose of the Station was directed at the development of techniques for drying, holding, and harvesting *Chondrus crispus* (Irish moss). As the Irish moss industry developed, these technical and engineering aspects were undertaken by the companies involved in processing, and the emphasis of the Fisheries and Marine Service program gradually shifted to the biological aspects of the resource. With the transfer of the program to the Resource Development Branch, future operations will concentrate on the biological investigations needed to manage this resource.

John Pringle, an algologist, joined the staff in August to head up the marine plant program. His late-summer arrival precluded the implementation of any major field studies but a start was made on a number of small field investigations. The major task undertaken in the latter part of 1974 was development of marine plant harvesting regulations for implementation in 1975.

N. E. MacEachern

SHELLFISH MANAGEMENT AND DEVELOPMENT

In 1974, the role of the Shellfish Resource Management and Development Unit continued to evolve in response to changes in the industry and in recognition of developmental potentials. Considerably more effort was placed on developing the biological and technical base needed for management and development of specific high-potential oyster stocks, on providing comprehensive on-site technical assistance to specific oyster producers, and on pilot clam-depuration studies aimed at the utilization of major stocks of bacteriologically contaminated soft-shell clams.

In shellfish management, the main emphasis continued to be the development of a sound biological and ecological base for the management and expansion of the shellfisheries, particularly the oyster fishery. Broad surveys were undertaken to determine both the oyster-growing potential and the extent of existing shellfish stocks in a number of bays and estuaries. As well, more specific oyster-population surveys and stock assessments were carried out on most of the major public fisheries. The oyster spatfall-inventory project, designed to define a number of commercially reliable oyster spat-collecting areas, was continued. This project is already providing valuable information for extension work in assisting industry with spat-collection activities. Over the next few years, it is anticipated that shellfish management activities will shift to the individual management of specific high-potential oyster-growing areas, through the application of resource-enhancement techniques. A small start was made this year towards the rejuvenation and expansion of the formerly productive oyster population of Shemogue Harbour, New Brunswick. Work in resource enhancement will be expanded considerably in 1975.

Shellfish development during the past year has been directed at expansion of soft-shell clam production through the use of presently unutilized stocks in contaminated areas. Two major population assessments were carried out, in Charlotte County, New Brunswick and Annapolis Basin, Nova Scotia; and Branch personnel participated in a pilot depuration study at Digby, Nova Scotia.

Shellfish farming and extension efforts in 1974 continued to place emphasis on on-site assistance to industry, in the form of biological and technical direction of commercial spat-collection operations, evaluation of rearing systems and culture techniques, operational planning, and provision of courses in all aspects of oyster culture and lease management. The primary objective of this program is to bring

about the implementation, by industry, of the vast amount of oyster-culture information presently available and to supplement this information, where necessary, by the further refinement or development of specific culture techniques suitable to Maritime oyster culture. During the past year, considerable on-site biological and technical assistance was given to the Buctouche Bay Oyster Cooperative, the Village Bay Oyster Company, the Grand Digue Cooperative, the Crane Cove Oyster Farm and other oyster producers. A number of courses in oyster spat collection, oyster culture and lease management were given to fishermen's groups or associations in all three provinces. A major function of this program is the continuous liaison it provides between the industry and the Fisheries and Marine Service.

Administration of the leasing of sea bottom for the cultivation of oysters, as prescribed by the 1972 leasing policy, was continued. Revisions were made in the policy document to clarify particular aspects for both the administrators and lessees. While a backlog of applications remains, crews are presently carrying out surveys at approximately the same rate as new applications are received.

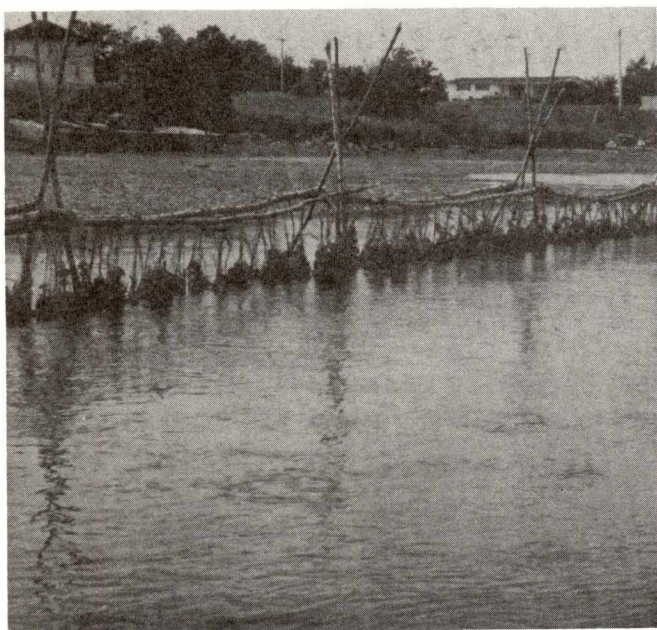
A significant amount of time during the year was also contributed to participation on, and in the preparation of submissions for, the Maritime Oyster Task Force.

T. W. Rowell

Oyster Spatfall Inventory

A five-year program, designed to determine commercially reliable oyster spat-collection sites, was continued in 1974. A number of sampling stations, which had proven unproductive or physically unsuitable over the past three years, were abandoned.

To date, spatfall data have been obtained for areas in Prince Edward Island and New Brunswick



Commercial collection of oyster spat in the Buctouche River system.

(Tables 1-3). These tables summarize the number of stations, the percentage of them which caught spat (percent success) and the percentage of the stations where more than 50 spat were recorded per scallop shell (percent commercial success). The average number of spat per station represents the relative oyster-reproduction success from year to year in each area.

Table 1. Summary of oyster spatfall-monitoring data, Prince Edward Island.

Year	Number of stations	Percent		Average no. spat/station
		Percent success	commercial success	
1971	40	90	30	138
1972	40	68	18	309
1973	40	95	60	574
1974	40	97	62	298
Average		87	43	330

Table 2. Summary of oyster spatfall-monitoring data, southern New Brunswick.

Year	Number of stations	Percent		Average no. spat/station
		Percent success	commercial success	
1971	38	66	26	173
1972	41	56	12	33
1973	44	61	39	93
1974	31	84	35	155
Average		67	28	114

Table 3. Summary of oyster spatfall-monitoring data, northern New Brunswick.

Year	Number of stations	Percent		Average no. spat/station
		Percent success	commercial success	
1971	36	85	22	66
1972	36	56	11	24
1973	40	85	52	181
1974	29	97	18	39
Average		81	26	78

In 1974, the oyster spatfall in Prince Edward Island was good. Although the average number of spat collected at each station was below the four-year average, the number of locations where spat were caught and the number of locations where a commercial set was recorded were both the highest in four years.

In New Brunswick, comparison with previous years' overall results is impossible because of the 1974 program modifications. A comparison can be made, however, for four important locations where sampling has been maintained since 1971 (Table 4).

Table 4. Average number of spat per station for four locations in New Brunswick, 1971-74.

Location	Number of spat per station				Average
	1971	1972	1973	1974	
Southern New Brunswick					
Main Buctouche River	515.8	73.5	361.7	538.8	372.5
Cocagne River	— ¹	14.0	71.3	149.3	78.2
Northern New Brunswick					
Baie Du Vin River	25.2	46.8	60.2	26.6	39.7
Caraquet Bay	135.7	1.4	269.0	75.9	120.5
Average	225.6	33.9	190.6	197.6	152.7

¹Station not monitored.

Analysis of the data indicates that the 1974 set was the best in four years for the two southern New Brunswick locations, while both northern New Brunswick locations had sets below the four-year average. The poor results for northern New Brunswick can probably be attributed to the cool spring weather, which delayed both spawning and spatfall in that area.

Dr. R. E. Lavoie and W. England

Estuarine Resource Inventory

Estuarine resource inventory projects are conducted to estimate oyster-growing potential and to evaluate the importance of present shellfish populations of bays and estuaries. During 1974, surveys were conducted in East River of Pictou, Caribou Harbour, Chance Harbour and Little Harbour in Pictou County, Nova Scotia, and in Little Shemogue Harbour in Westmorland County, New Brunswick.

East River of Pictou

A survey of this area was undertaken at the request of the Nova Scotia Department of Fisheries to determine if a worthwhile deposit of deep-water oysters, which might be suitable for relaying, existed in the area. If such a stock could be found, it could be used for restocking other areas of the estuary. The survey revealed that although oysters are present in some of the channels, the total amount is far short of that required for a large-scale relaying operation. However, several hundred boxes of good-quality oysters, suitable for hand picking, were found in the shallow-water areas of the river. The East River contains approximately 100 acres of bottom suitable for growing oysters but, because of the highly contaminated state of the river, any shellfish produced here would have to be relaid to pure water before being placed on the market. A number of soft-shell clam beds, totaling 8-10 acres, were found, as were several acres of mussels.

Caribou Harbour

Caribou Harbour has only partially recovered from the effects of Malpeque Disease. Oyster production

is limited mainly to the Caribou River system, where 2-3 acres of bottom are producing well. The oyster population in the remainder of the area is very limited,



Using a pole to determine bottom firmness, during assessment of area's suitability for oyster growing.

but there is evidence that a slow recovery is taking place. Approximately 150 acres of bottom suitable for oyster growing, together with an equal amount of marginally suitable bottom, were found. An additional 100 acres could be used for limited culture during the open-water season. A total of 4-5 acres of soft-shell clams and limited quantities of quahogs and mussels were also found.

Chance Harbour

Chance Harbour contains very few oysters, quahogs or soft-shell clams. A 2- to 3-acre bed of mussels is the only worthwhile concentration of shellfish in the area. Less than 5 acres of the harbour bottom are suitable for growing oysters.

Little Harbour

Very few oysters were found in Little Harbour and the amount of bottom suitable for growing oysters does not exceed 50 acres. The area contains several soft-shell clam beds, having a total area of 6-7 acres, as well as a few acres of mussels. The mussels are mainly small and of little commercial value. Quahogs, however, are quite plentiful and were found in commercial quantities at several locations, having a total area in excess of 50 acres.

Little Shemogue Harbour

Little Shemogue Harbour has approximately 2 acres of bottom producing oysters in commercial quantities. Another 30 acres are suitable for growing oysters and an additional 75 acres are marginal bottom, where growing oysters would be risky.

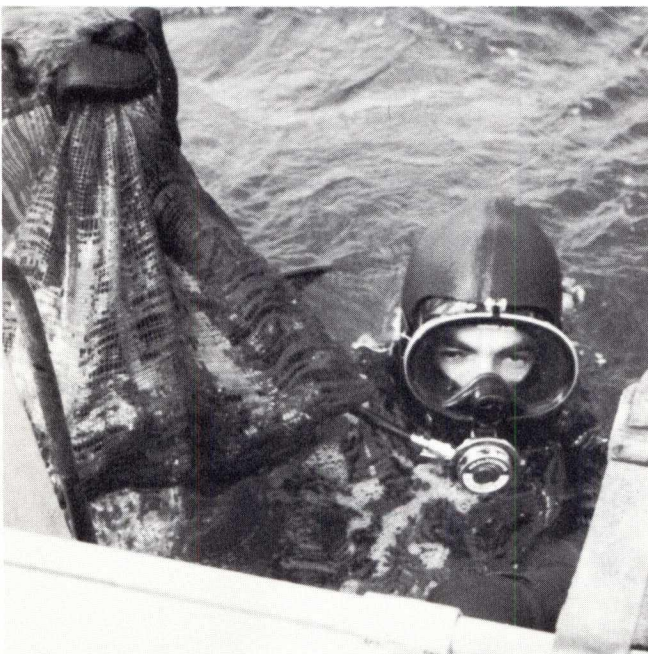
Several soft-shell clam beds, containing a total of 7-8 acres, were found, as were 1.5-2 acres of mussels. The harbour also contains quahogs in fairly good concentration at a number of places.

Dr. R. E. Lavoie and W. England

Oyster Population Surveys

These studies evaluate major parameters of important oyster populations such as their distribution, density, structure and recruitment. Knowledge of the evolution in time of these parameters allows for the assessment of exploitation impact on the population's ability to support continuing fisheries, and leads to specific recommendations on management procedures.

In 1974, such surveys were conducted in Caraquet Bay and North St. Simon River, New Brunswick and in the Dunk and the Hillsborough rivers, Prince Edward Island.



SCUBA diver bringing an oyster sample aboard the boat.

Caraquet Bay

A comprehensive survey was carried out on the public oyster ground in Caraquet Bay to determine oyster abundance and recruitment, as well as to assess the impact of recent exploitation. The data indicate that the size of the oyster beds and the standing crop of oysters have both changed since our first major survey in 1972. Over this period, the oyster bed has increased by 64 acres to a total of 593 acres. This can be attributed, at least in part, to the intensified fishing effort of the past few years, which has had the effect of cleaning the beds and exposing clean shell surfaces for increased spat settlement.

Due to a heavy spatfall in 1973 and a subsequent good survival, that year-class now dominates the population and has reduced the proportional representation of market-size oysters from 25% of the total population in 1973 to 18% in 1974 (Fig. 1).

Since the 1972 survey, the population has supported three fishing seasons with total landings of

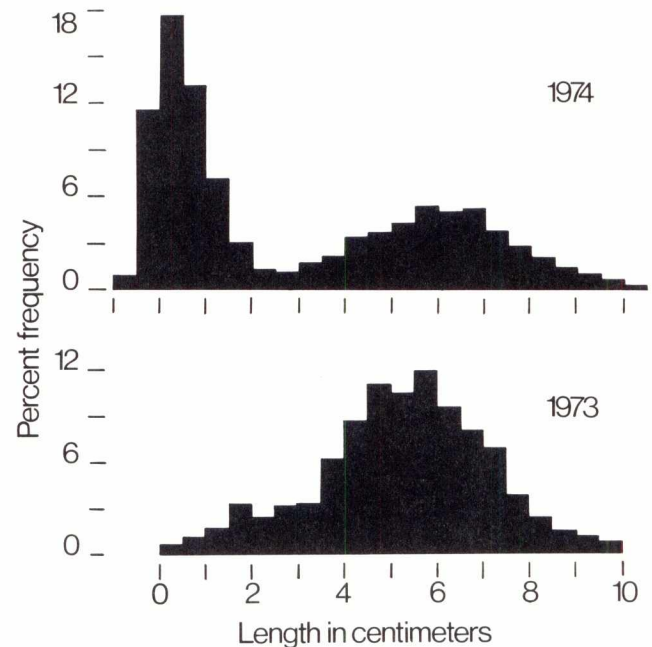


Fig. 1. Length-frequency distribution of oysters in Caraquet Bay, New Brunswick, 1973 and 1974.

about 25,000 boxes. The results of this year's survey showed, however, that the standing crop of market-size oysters has more than doubled since 1972 to approximately 50,000 boxes. Barring abnormal mortalities, the long-range possibilities for oyster production from this bed are very promising.

North St. Simon River

A survey was conducted in the North St. Simon River to determine the size and characteristics of the oyster population.

Four small oyster beds, totaling 9.5 acres, were found in the channel of the river. Although the population density is high in some areas, the proportion of market-size oysters is low (range 1.7-2.8%). The standing crop of market-size oysters is estimated to be about 400 boxes. Recruitment has

been fairly consistent over the last few years and, with the exception of 1972, all recent year-classes are well represented.

Dunk River

In the summer of 1972, a detailed population survey was carried out on the public oyster ground of the Dunk River. A similar survey, conducted in 1974, indicates that the oyster population in this area has declined.

The area occupied by oysters has decreased by 21%, 277 acres as compared to 349 acres in 1972, and the average density of oysters has dropped from 53.1/m² to 34.5/m². While there are still places on the bed where oyster density is high, their total combined size is relatively small and clustering does not appear to be as serious a problem as in the past.

During the last three years, there has been evidence of unusually high winter mortalities, which have been attributed mainly to severe ice conditions and heavy siltation. This mortality, along with high fishing pressure, has caused the standing crop of market-size oysters to decrease by about 60% since 1972.

Normally, the annual spatfall in the Dunk River is good but, because of an exceptionally poor year in 1972, only a very small part (6.5%) of the population is now in the 4- to 6-cm size class (Fig. 2). As it is this portion of the population that will replace the fishing stock over the next two years, production will likely decline further. The heavy 1973 spatfall should replenish the market stock within 3 or 4 years, provided there is no exceptional mortality.

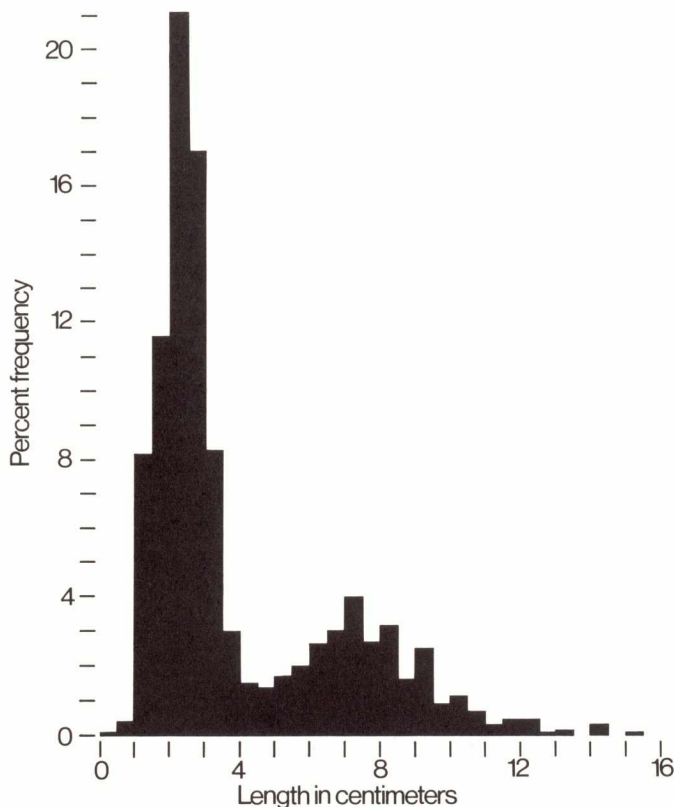


Fig. 2. Length-frequency distribution of oysters in Dunk River, Prince Edward Island, 1974.

Hillsborough River

An oyster-population survey was carried out in the channel of the Hillsborough (East) River, to determine the size of its oyster beds and their population characteristics.

Preliminary analysis of the data shows that the river supports a significant oyster population. The major bed is about 3.5 miles long, beginning one mile above Cranberry Wharf and continuing downriver almost to Duffy's Creek. This population has a patchy distribution, with the exception of the Cranberry Wharf area, where a solid bed of oysters covers the entire channel bottom. Recruitment is good, with all year-classes being well represented. In general, oyster quality is poor.

Oysters were found at various places in the channel for an additional 2 miles downriver, to a point just south of Glenfinnan Island. Oyster concentrations in this part of the river are confined mainly to the slopes of the channel, with several beds in the middle of the channel consisting mainly of old shells.

A solid bed of oysters was found between the bridges at Mount Stewart, as well as dense concentrations in the Pisquid and Johnstons rivers.

Dr. R. E. Lavoie and C. Bryan

Management of Natural Oyster Populations

This section reports on the action taken and the results obtained in oyster-producing areas where the Resource Development Branch conducted special studies and issued recommendations in anticipation of specific needs, as well as in response to requests and proposals received from the industry and the public. In 1974, such activities took place in Buctouche River, Richibucto River and Miramichi Bay, New Brunswick.

Buctouche River

For two years previous to 1974, the Buctouche Bay Oyster Cooperative was granted a permit to drag oysters from the section of the Buctouche River channel between the Irving tanker wharf and the old railroad bridge. After dragging operations were completed in 1973, a total two-year quota of 1,700 boxes of unsorted oysters and shells had been fished and relaid on the Cooperative's leases.

Since its beginning in 1972, the impact of this experimental project on the oyster population has been closely monitored. In the spring of 1974, a follow-up survey was carried out to assess the state of the oyster population and the effects of the dragging operations. The results of this survey show that the dragging operations have introduced some changes to the oyster habitat. In some cases, the path of the drag was quite evident and large rows of silt and mud piled up at either end, causing some oyster mortality. Generally, however, the drag had a cleaning effect and exposed a good deal of clean shell which would be conducive to good spat settlement. It appears that the oyster stock has not been seriously depleted and that the overall drag-

ging effect has been beneficial rather than damaging.

In May, 1974, the Buctouche Bay Oyster Cooperative was granted another permit to drag a maximum of 1,600 boxes of unsorted oysters (including spat and shells) from the same section of the river. This quota was reached by the end of June. It is estimated that the Cooperative relaid more than half a million oysters, of all sizes, to its leases during this operation.

Richibucto River

A brief survey was conducted in the Richibucto River to evaluate the size of the oyster resource in deep-channel areas. This survey was carried out in response to a request by the Village Bay Oyster Company to drag oysters from this area.

In the survey, divers found oysters living at depths varying between 30 and 35 feet. At this depth, they are virtually impossible to fish with tongs and rakes. The study indicated that this population suffers from clustering and that, before reaching market size, most of the oysters die from being forced into the muddy bottom.

To enable utilization of this population for lease stocking, the Company was granted a special permit to drag all sizes of oysters (including spat on shells) up to a maximum quota of 800 boxes. In six days of dragging, the Company obtained a total of 640 boxes of mixed oyster stock and shell which were planted on its lease at Richibucto Village.

Miramichi Bay

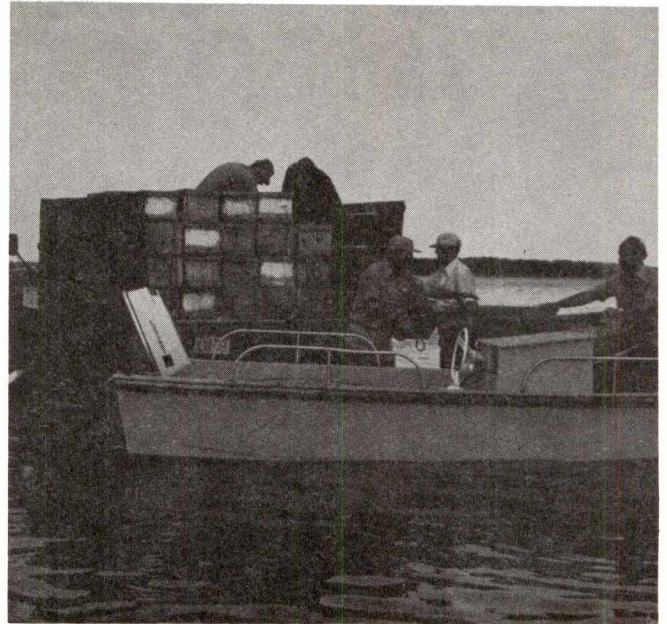
A short population assessment, conducted in June, failed to reveal any major change in the oyster population of this area. The population seems to be recovering slowly from the effects of Malpeque Disease and from the over-exploitation of the late 1960's. On the basis of the survey results, a three-week fishing season, from October 1 to 19, was recommended.

Landings for the south shore of Miramichi Bay were estimated at 945 boxes, a 56% increase over 1973. North shore landings were approximately 200 boxes.

Dr. R. E. Lavoie and C. Bryan

Resource Enhancement Project, Shemogue Harbour

An oyster-enhancement project, aimed at restoring oyster production in Shemogue Harbour, New Brunswick, was initiated in 1974. This area has a reputation for producing high-quality oysters. The project was undertaken because of encouraging results obtained from a preliminary experiment started in 1969. That year, a resource-inventory survey indicated favourable conditions existed for the production of oysters. In 1970, 50 boxes of oysters from the Richibucto River were transplanted to the area and portions of the old shell beds were cleaned in anticipation of the spatfall. A follow-up examination, conducted in 1973, revealed that, although the



Loading shells on a small boat for spreading on new oyster ground, Shemogue Harbour, New Brunswick.

transplant was small, an oyster set had taken place in 1970, 1971 and 1972.

During the 1974 season, approximately 120,000 oysters of all sizes from the Buctouche River channel were transplanted into Shemogue Harbour. These oysters adapted well and even spawned later in the season. Around the end of July, Branch personnel spread 100 boxes of mixed shells to be used as cultch by oyster larvae. A total of 8.5 acres of old natural shell deposits was cleaned by dragging to make them available to the oyster larvae. A total of 95,000 seed oysters from the Eilerslie, Prince Edward Island, oyster farm was also transplanted to the Harbour.

It is still too early to assess the impact of these measures on the oyster fishery. Success will depend greatly upon the resistance of the oysters to winter conditions, the collaboration of local residents for the protection of the broodstock, and on weather conditions during future reproduction periods.

Dr. R. E. Lavoie, C. Bryan and W. England

On-Site Technical Assistance to Industry

The Shellfish Extension Unit maintained close contact with the oyster-culture industry during the past year, with the main effort being concentrated on giving technical assistance to a limited number of on-going oyster-farming operations. Much time was spent establishing and directing an effective spatfall-monitoring system in the Kent County river systems. This required training six members of the Kent County Oyster Producers Association, and their project biologist, in spatfall monitoring and prediction techniques. The intensive training and monitoring systems contributed to a successful commercial spat collection by the Association, and resulted in a greatly expanded knowledge of spat distribution and survival and of the oyster-growing characteristics of the area.



Monitoring of water temperature and salinity in spat-collecting area.

In conjunction with the above project, weather conditions, salinity and water-temperature fluctuations were monitored, and the maturation of oysters was observed daily throughout the open-water season. By June 30, when surface-water temperatures had risen to 20°C, monitoring stations were

established to give a daily check on the commencement of spatfall. As well as the standard monitoring racks, strings of 3-in.-spaced scallop shells — similar to the standard commercial collectors — were set out in strategic areas of the rivers and bays to obtain an overall picture of spatfall and survival. Spawning was first observed on July 3 and spatfall commenced 21 days later, peaking between July 31 and August 5. Oyster producers were advised of the imminent spatfall, and 20,385 shellstrings, each comprising 30 scallop shells, were placed in the Buctouche River system. Spat growth and survival were excellent. By the end of November, the average size of the spat was approximately 1 cm, and the average survival was 30 oysters per shell in the Buctouche River and 20 oysters per shell in Buctouche Bay. The distribution of surviving spat on monitors two months after spatfall in the Buctouche River system was summarized (Fig. 3).

The Shediac River system and Richibucto Village Bay were also monitored, but there were no commercial sets in these areas.

Samples were collected to monitor larvae abundance during the setting period, but few were found in the later stages of development. A study of larval distribution, relative to tide, current, time of day and position in the water column, is being considered for next year.

A. R. McIver and P. Woo

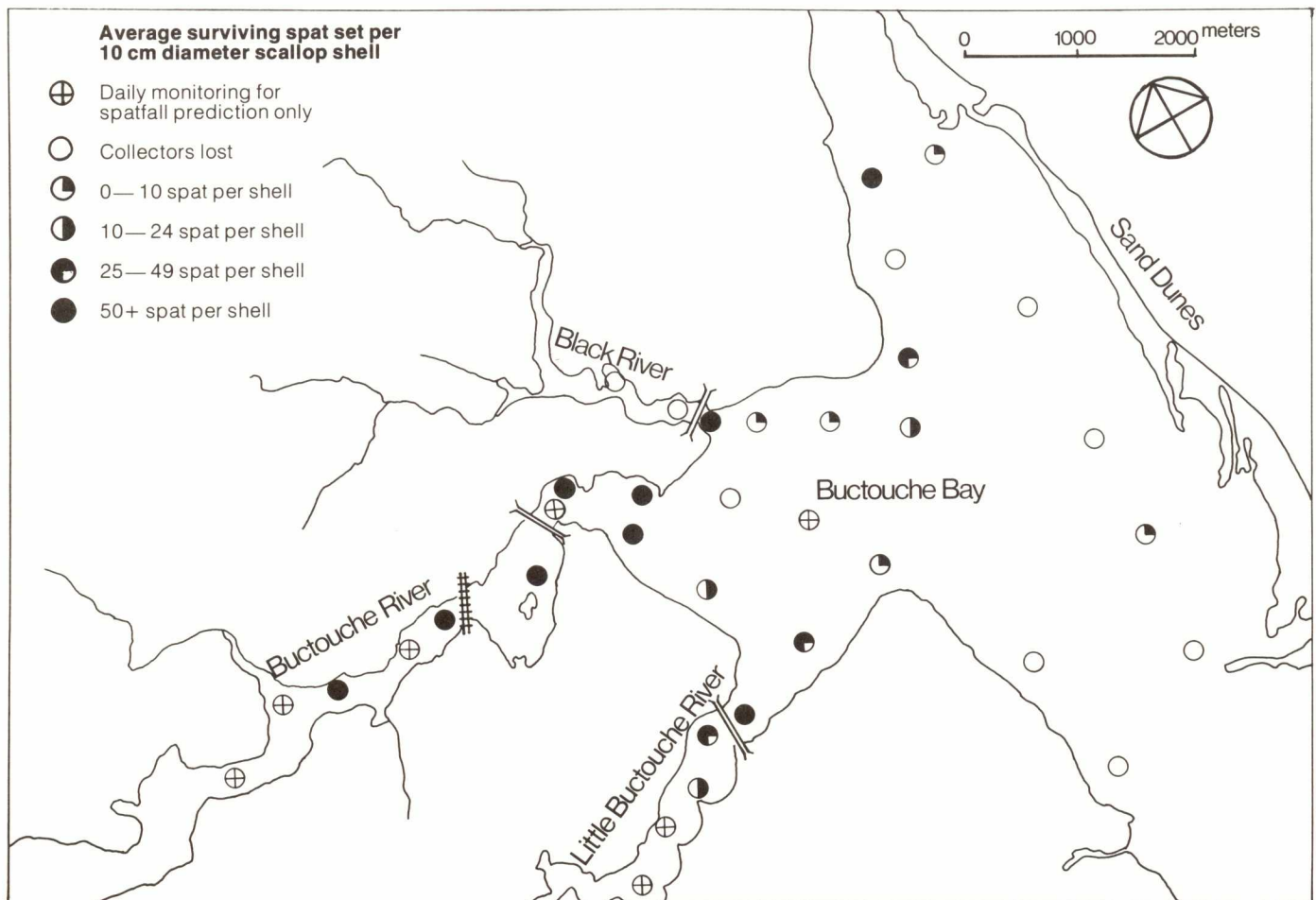


Fig. 3. Spat distribution and survival on monitor shellstrings, 1974.

Technical Investigations

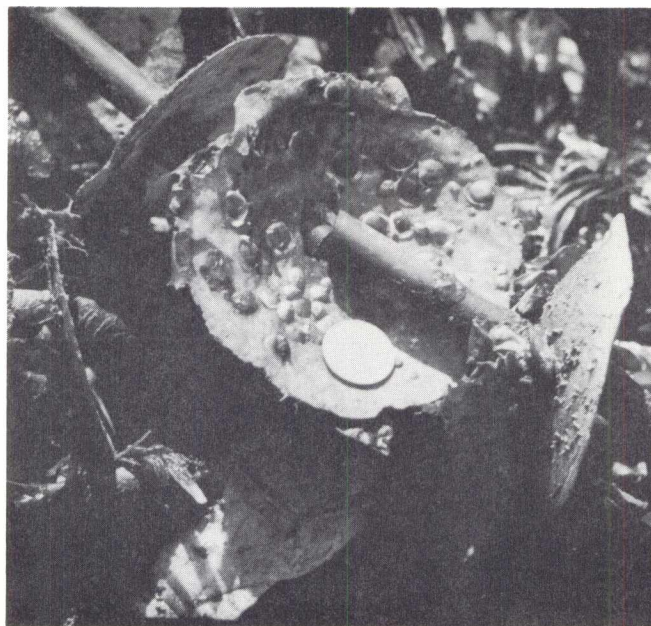
Industry-oriented studies, to develop and compare particular rearing methods, were continued in 1974. These studies have provided an accurate measure of the growth and survival of oysters at all stages of development, under various conditions and by different techniques. They have provided the basis for many of the recommendations given to industry, and for estimates of potential harvest size of oyster stocks. These experiments were generally carried out at the Gillis Cove Field Station near Orangedale, Cape Breton; but, in some instances, work was carried out in conjunction with oyster producers.

Studies on comparative growth and survival of shellstring oysters reared at various densities were begun in 1972 (Table 5). Shellstrings of 1971 oysters, with densities of 50, 40, 30, 20, and 10 per shell, were initially cleaned of fouling organisms (mainly mussels) and measured. Uncleaned strings, bearing approximately 40 oysters per shell, were also measured as controls. These measurements were repeated each fall in 1972, 1973 and 1974.

The data indicate that fouling by mussels and crowding resulted in the loss of a high percentage of oysters from the more densely set strings. Growth was retarded on densely set collectors and there was a wider variation in oyster sizes than on the ones less densely set. There was also a higher percentage of poorly shaped oysters on the more densely set collectors, even though the number per collector after three years was not significantly different in many cases.

The cost of cleaning must be balanced against losses in numbers and quality, when designing a culture program; but, it would appear a surviving set of 20-25 spat per shell by the first fall is most desirable and, with reasonable maintenance, should yield a dozen or so well-shaped marketable oysters.

Experiments to develop better techniques for bottom rearing of oysters removed from shellstrings are underway at Gillis Cove. In the spring of 1972, stock oysters of 1969, 1970 and 1971 were threshed



Three-month-old spat on scallop-shell collectors.

from scallop-shell collectors and spread on the bottom in a range of densities from 10 to 60 per ft². Results this fall indicate that crowding had little apparent effect on oyster shape, there being a general improvement in all year-classes; however, those held under crowded conditions had a considerably higher mortality than those held at a lower density.

Growth and survival studies on 1973 oyster spat were begun in 1973 and continued in 1974 at locations throughout the River Denys Basin of the Bras d'Or Lake, Cape Breton. In both 1973 and 1974, stock in Portage Cove (Estmere) showed the highest growth rate, reaching an average length of 6.5 cm, with a mean count of 15 oysters per collector-shell by November, 1974. Those at Gillis Cove reached an average length of 5 cm and, as in the previous year, had the highest mortality rate of all areas monitored.

A. R. McIver and P. Woo

Spatfall Monitoring (Bras d'Or Lakes)

Spatfall was very light in all areas monitored during 1974 (Table 6). Orangedale Cove had the highest initial spat count, but spat survival after three months showed that Morrison Cove was the best commercial collecting area. This differed from the previous year, when Gillis Cove proved to be the most successful.

It is thought that the failure of many Cape Breton areas as spat-collecting localities this year was due to environmental conditions, the presence of growing stock from the previous year and over-crowding of the spat-collecting areas. A shortage of food for both larvae and adults could be a major factor in this year's poor spatfall and survival.

The need to control the number of commercial collectors in a particular area must therefore be recognized, and a means of regulating spat collection must be developed.

Table 5. Survival over a 3-year period of 1971 year-class oysters growing on shellstrings at different densities.

Initial density (June 1972)	Number of oysters per shell ¹			Percent survival after 3 years
	Nov. 1972	Nov. 1973	Nov. 1974	
40 (uncleaned, control)	37	13	8	20
50	43	30	13	26
40	34	25	16	40
30	29	23	12	40
20	18	16	13	65
10	8	8	8	80
Average	32	28	19	45

¹Shells were approximately 10 cm in diameter. All oysters, on both top and bottom of the shells, were counted.

Table 6. Summary of 1974 spatfall distribution in River Denys Basin, Cape Breton, Nova Scotia.

Area	Number of spat per shell ¹			Av. size surviving spat (cm)
	Spatfall peak 2-wk period	Total spatfall	survival (Nov., 1974)	
Gillis Cove	84	241	10.4	0.56
Orangedale	200	492	10.5	0.57
Morrison Cove	302	481	34.9	0.92
Portage Creek (outside)	27	58	17.7	0.84
Portage Creek (inside)	17	22	6.8	0.65
Long Island Cove	125	279	— ²	— ²
Malagawatch	35	67	— ²	— ²

¹Shells were approximately 10 cm in diameter, with spat counted on the underside only.

²Areas not monitored.

A. R. McIver and P. Woo

Oyster Farming Courses

Interest in off-bottom oyster culture has continued to grow in the Maritimes, due to continued investment by government agencies and industry and the growth of subsidized cooperatives. To complement the field programs, instructional courses on shellfish culture and management and spatfall prediction were given during the winter months. General courses on oyster farming were given in Prince Edward Island at the Marine and Fisheries Training Centre in Summerside, and at Charlottetown, and in New Brunswick at Buctouche. In addition to basic shellfish biology and farming techniques, speakers were invited to discuss other aspects, such as hatchery operation, cooperatives and the roles of the various branches of the



Identification and counting of oyster spat on scallop-shell collectors.

Fisheries and Marine Service, such as the Inspection, and Conservation and Protection branches.

In recognition of the technical and managerial deficiency of the east-coast oyster industry, efforts were made to establish managerial and technical training courses. A preliminary course was given at Buctouche on the interpretation of growth and survival data, estimation of inventory, and harvest prediction. A three-day spatfall-prediction and larvae-identification course was also held at the Biological Station in Ellerslie, Prince Edward Island. These courses were given in cooperation with the respective provincial governments and agencies such as the Marine and Fisheries Training Centre Summerside, New Brunswick Newstart and the Federal Department of Manpower and Immigration. Further courses are planned for 1975, with an emphasis on the development of skilled personnel in the oyster industry.

A. R. McIver and P. Woo

Soft-Shell Clam Surveys

In preliminary consideration of the potential for clam depuration, it was determined that two major areas, Charlotte County, New Brunswick and the Annapolis Basin, Nova Scotia, were likely to have shellfish resources of sufficient size to support commercial operations. During the year, full-scale population surveys were conducted in both of these areas. A total of 900 acres of beach, closed due to bacterial contamination, was surveyed in the Annapolis Basin and 1,010 acres in Charlotte County. Although the data are not fully analysed, it appears that both areas have sufficient stock to support commercial depuration.

W. D. Smith

Soft-Shell Clam Depuration

The possibility of utilizing soft-shell clams from moderately polluted waters, through the use of a depuration plant, has been a topic of interest among clam producers in both Nova Scotia and New Brunswick for a number of years. In early 1974, population surveys of contaminated clam stocks in the Annapolis Basin indicated that sufficient volume existed to support such an operation. Agreement was then reached between the Fisheries and Marine Service and the Nova Scotia Department of Fisheries to carry out a pilot depuration operation in cooperation with Alan Fisheries of Digby. Other groups involved in the pilot operation were the Inspection Branch, the Conservation and Protection Branch and the Environmental Protection Service.

In planning the pilot operation, it was decided to copy as nearly as possible presently operating depuration plants and to limit experimentation to the minimum. Because of pumping and engineering problems related to the extreme tides at the Digby site, the plant was operable for only a portion of the one month scheduled. Operations began on August 13 and terminated September 14, with nine lots of clams being processed.

Success in degree of depuration of the nine lots processed was highly variable, but examination of the data appear to indicate that clams from particular areas of the Basin, such as The Joggins and the Annapolis River, might be reliably depurated under a more highly regulated process. Operations in 1975 will be concentrated on these two areas.

In carrying out the pilot operations, a great deal was learned about the inadequacy of existing guidelines as they relate to the soft-shell clam and to the Maritime environment.

W. D. Smith

Oyster-Lease Administration

The oyster leasing policy, introduced in 1972, continued to have the desired effects of reducing the number of non-serious lease applicants and increasing the average size of the areas being leased to individuals, companies and cooperatives. A total of 90 new leases was surveyed and 12 re-surveys of existing leases were carried out during the year. With the effects of consolidation of leases and cancellation of non-active leases, there was an overall increase of 45 leases and 735 acres (Table 7), an average of over 16 acres per additional lease.

A backlog of 301 applications for leases existed as of December, 1974. The breakdown on these outstanding applications was: Prince Edward Island, 85; New Brunswick, 123; and Nova Scotia, 93. This backlog exists despite the fact that lease surveys and provision of leases are presently keeping pace with

Table 7. Summary of the numbers of oyster leases and acreages of bottom leased in the Maritime Provinces.

Province	Leases		Acres	
	1973	1974	1973	1974
Prince Edward Island	1,078	1,089	4,256	4,448
New Brunswick	783	804	2,202	2,375
Nova Scotia	260	273	1,310	1,680
Totals	2,121	2,166	7,768	8,503

the rate at which applications are received. The backlog is a carryover from the moratorium period and the period immediately following implementation of the new policy. It is anticipated that this backlog will be eradicated over the next few years.

A total of 59 original master-leasing sheets was prepared for both oyster-leasing activities in new areas and for soft-shell clam survey studies. Revisions of 510 maps were completed and 1,742 copies were prepared and circulated to various branches of the Department of the Environment.

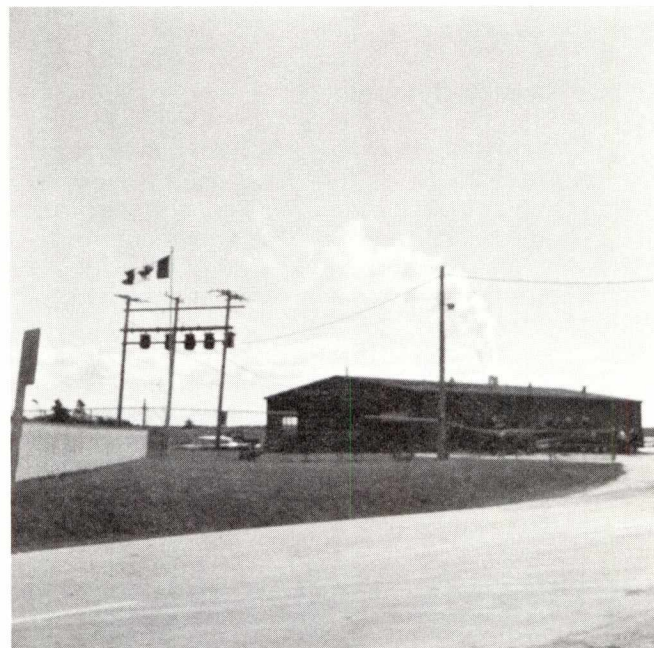
Oyster-lease administration staff also assisted the shellfish farming and extension group in the provision of extension courses to industry, and the shellfish-management and shellfish-development staff in the implementation of their projects.

L. A. England and O. Daigle

MARINE PLANT PROGRAM

The coastal waters of the Maritime region support a diverse flora of benthic marine algae, but at present, only six have economic importance. Listed in descending order of their economic worth they are; *Chondrus crispus*, *Ascophyllum nodosum*, *Furcellaria fastigiata*, *Rhodymenia palmata*, *Gigartina stellata* and *Laminaria* sp. All but *Rhodymenia palmata* are processed for colloidal extraction; the latter is processed for direct human consumption. Marine plants have been harvested commercially in Nova Scotia for over fifty years, and in the other two Maritime provinces for the last twenty years (Fig. 4). Their annual worth to the harvesters in the last decade has reached four million dollars.

Since the mid-sixties, the Federal Fisheries and Marine Service, through the Industrial Development Branch, has played a lead role in the development of the industry. This Branch was involved mainly with the engineering and technical aspects of drying and



Marine Plants Experimental Station, at Miminegash, Prince Edward Island.

harvesting the commercially valuable algae, although in recent years some work was directed towards biological investigations of particular species. With the continued expansion of the industry, the need for more biological investigations on which to develop management regimes was recognized. In 1974, the program was transferred to the Resource Development Branch, and emphasis was placed on development of biological information needed to manage the resource.

In August, funds and operating staff of the Miminegash Marine Plant Station were transferred to the Resource Development Branch, and the former station manager's position was staffed with a marine plant biologist. Projects started by this Marine Plant Unit during the fall of 1974 are outlined below. As *Chondrus crispus* (Irish moss) is the most exploited of the marine algae, and the most valuable in terms of

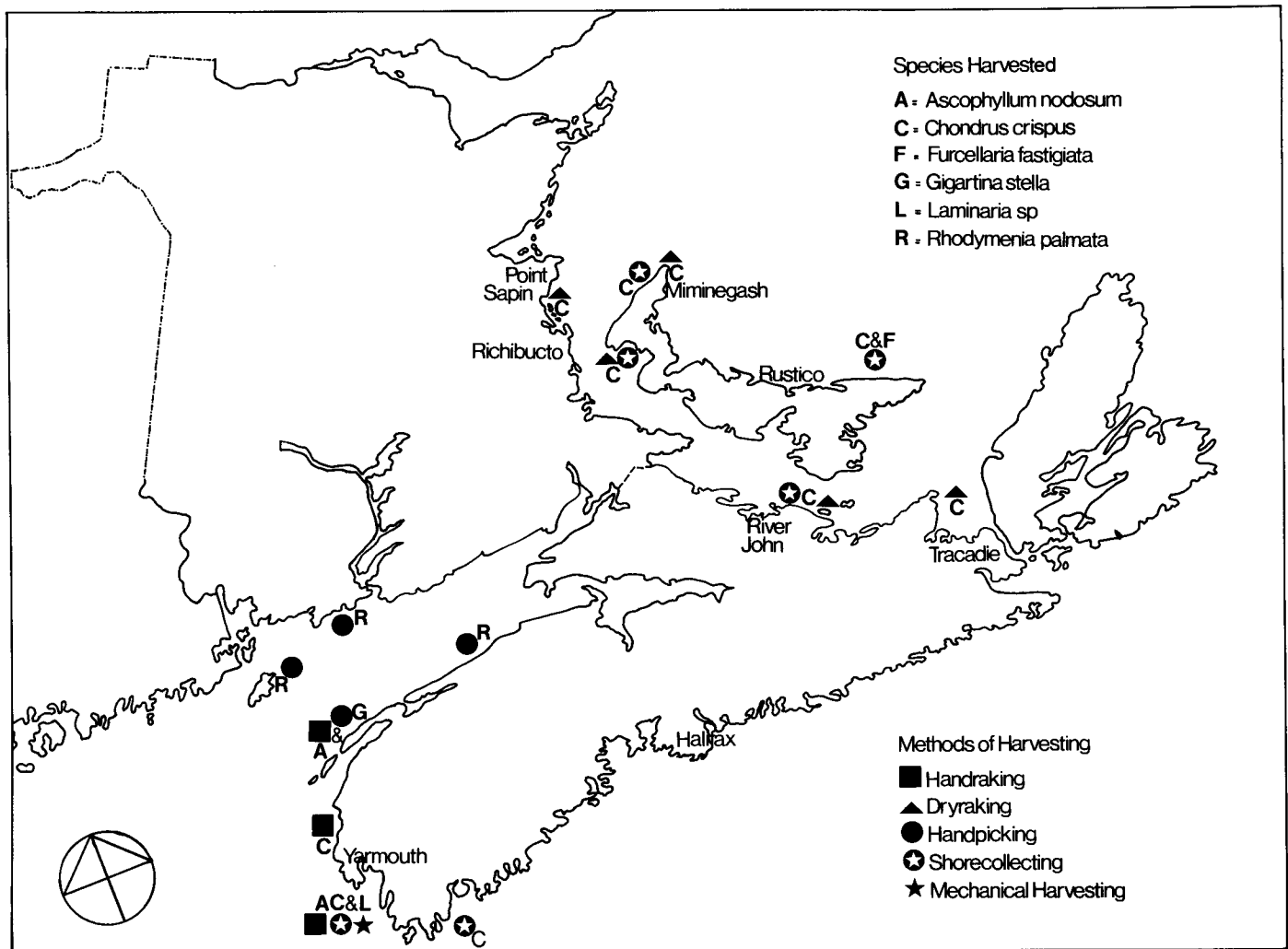


Fig. 4. Locations of major marine algal harvesting sites in the Maritimes, species harvested at each site and method employed in harvesting.

dollar returns to the fishermen, it is this species that will receive priority in the Unit's work program.

***Chondrus* Harvesting Techniques and Productivity**

Tours were made of each of the communities where *Chondrus* is harvested; and talks were held with harvesters, buyers and fishery officers to become familiar with the industry and, in particular, to determine the methods of harvesting and the approximate daily productivity of the harvesters (Table 8).

Chondrus is harvested in the three provinces primarily by lobster fishermen, who may employ one of three methods: handraking, dragraking and shore collecting. The typical handrake is similar to a garden rake but has a longer handle and tines less than 1/4 inch apart. The harvester stands in a specially built, short but wide, square-ended punt, and manually drags the rake through the beds. This operation can take place only during low tide; consequently, during a neap-tide cycle only three to four hours daily can be worked. Often during spring tides, two tides can be worked.

A dragrake is towed behind a lobster boat. It is fabricated from steel, with dimensions of approximately four feet by two feet, and has 10-inch long tines. Normally, two or three men are employed per

Table 8. Preliminary data on the methods employed in harvesting *Chondrus crispus*, the approximate number of harvesters in certain districts and their approximate daily productivity.

Statistical district	Handraking		Dragraking	
	Number of harvesters	Productivity per tide (1b)	Number of boats	Productivity per day (1b)
11	0	0	55	2,000
13	0	0	30	2,500
32	200	2,000	0	0
33	800	600	25	Unknown
34	75	1,500	0	0
36	50	400	0	0
75	0	0	6	3,000
76	0	0	45	2,500
82A & B	0	0	120	2,200
83A & B	0	0	50	2,500

vessel, one to operate the boat and the other(s) to tend the rakes.

Shore collectors gather those plants which have been deposited on the shore, often in large windrows, following high tide or a storm. They are normally dislodged from the substratum through water turbulence. However, where dragrakes are employed, the plants may be removed but not recovered by the



Typical lobster boat, rigged with twin booms for *Chondrus* harvesting off Skinner's Pond, Prince Edward Island, showing drag rakes on the roof and along the gunwale.

rake, thereby being set adrift.

The method employed to harvest *Chondrus* depends on the morphology of the bottom and the organisms associated with the plants. To successfully employ a dragrake, a bottom free of large boulders is required. The Northumberland Strait area, including St. Georges Bay and the northwestern side of Prince Edward Island, has a suitable bottom for this technique.

There are two areas on the north side of Prince Edward Island in which dragraking is banned, although the bottom is suitable. Apparently the bottom around Rustico (Fig. 4) is rockier than farther west, and the lobster fishermen were concerned that dragraking destroyed the lobster habitat. Farther east, *Chondrus* is associated with commercially sizeable quantities of *Furcellaria*. Unlike *Chondrus*, this plant has holdfasts which are removed by raking and, once removed, regeneration does not occur. Along this coast, harvest by shore collection takes place, and 10-20 million pounds of mixed *Chondrus* and *Furcellaria* are gathered annually. The majority of this is sold to a firm which has developed a technique for employing a mixture of the two colloids.

The south coast of Nova Scotia consists of a boulder-strewn bottom, which, for the most part, prevents dragraking. Here, however, the clarity of water, the large tidal amplitude and the calm water — provided by an island-studded coast — permit the use of handrakes.

The harvested plants are purchased by one of six companies: Argosy Seaweeds; A. D. Cunningham and Sons, Limited; Genu Products, Canada, Limited; Marine Colloids of Canada, Limited; Prince Edward Island Seaweeds, Limited and Prince Edward Island Seaweeds Cooperative. All but the first company have large mechanical driers located in the region. The plants, following drying, are baled and shipped abroad, where extraction of the colloid *carrageenan* takes place.



Large *Chondrus*-covered outcrops, typical of the ocean floor off southwestern Nova Scotia.

There has been a worldwide shortage of natural colloids during 1973 and 1974, resulting in an increased demand for this Maritime natural resource. This caused a doubling of the price paid to the harvester, and resulted in many new harvesters entering the field. A similar increase is expected in 1975. In most of the communities visited, the regular harvesters expressed concern about the sustained yield of the resource and have requested limitations be put on the number of harvesters.

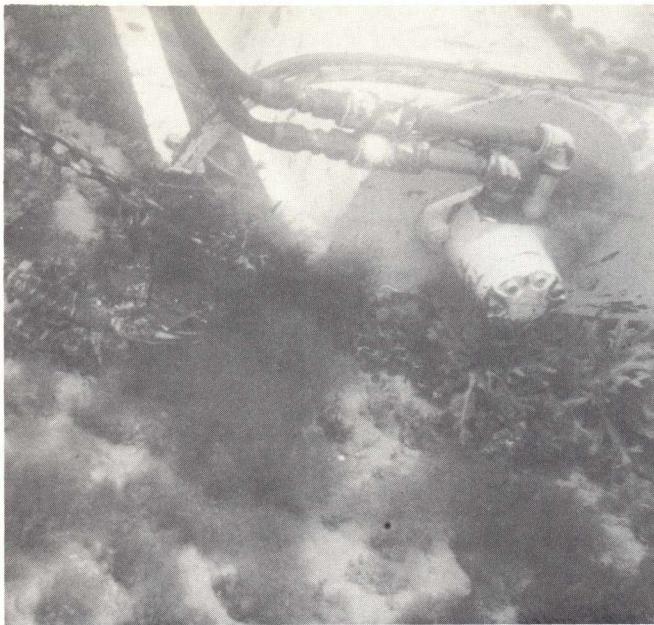
Marine Plant Harvesting Regulations

The development of the Atlantic Coast Marine Plant Regulations, for implementation during the 1975 season, was assigned as a top-priority task. Initial work on marine plant regulations was started by the Resource Management Branch, Ottawa, and a number of drafts were developed by the latter part of 1973. Proposed regulations cover the following areas: boat licensing, harvesting seasons, harvesting districts and provision for gear assessment.

In the fall of 1974, a series of meetings to discuss and review the 1973 draft were held with fishermen, processors and provincial government agencies involved with marine plants. All segments of the industry are concerned about conservation of the resource, and the majority are in favor of regulations. Considerable input and support was received from the industry at these meetings, and a final draft of the Atlantic Coast Marine Plant Regulations will be prepared for promulgation in 1975.

Mechanical Harvester Assessment

The Marine Plant Unit is presently assessing the affects on the ecosystem of a mechanical harvester, developed over the last three years by one of the companies involved in the industry. Trials were held during the fall in the waters off French River and Egmont Bay, Prince Edward Island, and Wedgeport,



Experimental, mechanical harvester, operating on the flat, ocean floor off French River, Prince Edward Island, showing lobster and clumps of *Chondrus* in front of the harvester.

Nova Scotia. Personnel were on board to both identify and quantify the animals and plants harvested. Periodic sampling of harvested *Chondrus* was conducted, and the individual plants were placed in one of four morphological categories. As well, the plants were assessed for holdfasts.

The analysis of the collections is not yet complete; however, the types of animals recovered by the harvester are as follows: lobsters, crabs, amphipods,

isopods, sculpins, flatfish, butterflyfish, blennies, perch, periwinkles, mussels, chitons, sea urchins, starfish, sandworms, sponges and tunicates. It is obvious the diversity of animals harvested is considerable; however, accurate assessment can only be made following quantity-per-time-of-harvest calculations. It can be safely stated, though, that this type of harvester will remove more animals from the bottom than the traditional dragrake. However, because it is towed more slowly than the latter rake, there is likely less damage inflicted on the biotic and abiotic structure on the bottom.

The effects of this harvester on the productivity of *Chondrus* are also of concern, as it was observed that 48% and 29% of the harvested plants are in morphological classes II and III respectively (Table 9). Some investigators suggest that morphological classes are indeed age-classes, so there is some concern that the harvester may be removing a large percentage of immature plants. Additional work is needed before a final conclusion can be reached on this aspect.

The other potential problem is holdfast removal. Sampling shows that approximately 10% of the plants carried holdfasts (Table 10). At present, similar data on holdfast removal by the traditional dragrake are not available, so no comparison is possible. In future assessments, attempts will be made to obtain data for comparison purposes.

Outplanting Studies

As little data are available on the phenology of *Chondrus*, it was decided to outplant isolates of it in the various Maritime regions where it is commercially harvested. The outplanting technique developed by

Table 9. The total number of *Chondrus* plants per morphological class removed by the experimental mechanical harvester off the north coast of Prince Edward Island.

Area sampled	Sample No.	Number of plants per sample in each morphological class				Total number
		I	II	III	IV	
French River	1	137	630	391	74	1,232
	2	221	752	376	84	1,433
	3	208	752	355	87	1,402
	4	144	643	288	69	1,144
	5	165	424	243	72	904
	6	125	355	217	79	776
	7	116	431	276	84	907
	8	146	270	302	118	836
Rustico	9	208	410	321	93	1,032
	10	192	509	287	73	1,061
	11	72	279	242	76	669
Totals		1,734	5,455	3,298	909	11,396
Percentage of plants harvested in each morphological class		15	48	29	8	

Table 10. The percentage of holdfasts observed per total number of *Chondrus* plants analyzed. (Plants collected via experimental mechanical harvester in two Prince Edward Island sampling areas.)

Sample area	Sample No.	Total No. of plants analyzed	Total No. holdfasts observed	% plants bearing holdfasts
French River	1	1,232	79	6.41
	2	1,433	243	16.97
	3	1,402	146	10.41
	4	1,144	110	9.62
	5	904	141	15.60
	6	776	51	6.57
	7	907	91	10.03
	8	836	106	12.68
Rustico	9	1,032	73	7.07
	10	1,061	71	6.69
	11	669	11	1.60
Mean percent				9.85

Dr. Louis Hanic of the University of Prince Edward Island was adopted for this project. This involves the securing on the ocean bottom of artificial-substrate holders (cement blocks with dimensions of two feet by four feet by six inches), which are constructed to permit the attachment of fired-clay, artificial substrates.

Ten blocks and 600 substrates have been constructed; the latter will be "seeded" in the laboratory with reproductive structures from *Chondrus* plants and attached to the blocks. Test sites for their location will be chosen in the early spring of 1975, and monitored throughout the remainder of the year.

J. D. Pringle

FISH HABITAT PROTECTION AND ENGINEERING SERVICES

The primary responsibilities of the Fish Habitat Protection and Engineering Services Section are (a) to maintain the aquatic environment in a state compatible with perpetuation of fish stocks and (b) to provide technical support for Branch capital-works programs. These responsibilities entail defining scientific and technical measures to minimize the deleterious effects of aquatic disruptions, and pre-engineering planning, design and construction supervision of fish culture and fisheries enhancement capital projects.

A significant increase in the number and complexity of man-made aquatic disruptions was evident during the year. This increase was attributed to the implementation of the federal government's new policy relating to the Environmental Assessment, Review and Protection process (EARP) and the Navigable Waters Protection Act (NWP) referral program.

In 1974, Section staff played a major role in the implementation and operation of the EARP process. This process is designed to provide a more comprehensive examination of environmental issues during the early stages of project development for all federally funded projects. Guidelines were developed, in collaboration with other services of the Department, for full-scale environmental impact studies, and several environmental assessment reports were reviewed.

The responsibility for assessing environmental consequences of proposed marine installations and estuarial dredging operations was assigned to the Section early in 1974. These projects relate to the NWP, administered by the Ministry of Transport. The additional responsibilities associated with the EARP process and the NWP program have expanded the role of the Section in environmental protection, and have resulted in a significant increase in the administrative workload.

As part of a continuing program aimed at developing new and improved methods for resolving juvenile fish passage problems at hydroelectric dams, assessment of existing fish passage works and new design concepts continued during the year. An evaluation of a combined powerhouse bypass and floating deflector screens was carried out at Tuskat Falls hydroelectric installation, Yarmouth County, Nova Scotia. A new spiral fishway design was also evaluated, to determine its effectiveness in passing adult fish. In collaboration with private consultants, studies got underway to determine the potential of electrical barriers in diverting juvenile fish away from powerhouse intakes.

Technical support for Branch capital-works programs was hampered by the transfer of professional

and technical staff as a result of promotional competitions. Greater reliance on outside consultants was necessary because of these transfers, and the continuing requirement for advanced planning and preliminary design work associated with fish culture and fisheries enhancement projects. Preliminary engineering design concepts were developed to alleviate total obstructions on the Tetagouche and Nepisiguit rivers, Gloucester County, New Brunswick and Liscomb River, Guysborough County, Nova Scotia. In collaboration with engineering consultants, investigations were initiated, aimed at alleviating a nitrogen supersaturation problem in the river-water supply to the Mactaquac Hatchery.

D. C. Riley

AQUATIC AND RELATED LAND ALTERATIONS

A total of 379 requests, involving a wide array of aquatic alterations, was investigated in 1974, an increase of 25% over the previous year. This increase was due in large measure to referrals under the Navigable Waters Protection Act, which were formerly processed by the Ministry of Transport without input from the Resource Development Branch.

Added to this new responsibility was a commitment to participate in the recently adopted Government of Canada Environmental Assessment, Review and Protection Process (EARP). The EARP process is designed to ensure that the environmental implications of proposed new development projects, involving federal funds and federal lands, are taken into consideration early in the project-planning stage. The complexity of some of the proposals dealt with in 1974, which included the development of a nuclear

Table 11. Qualitative, quantitative and geographical summary of stream-alteration requests investigated in 1974.

Type of stream alteration	Number of investigations			Total
	New Brunswick	Nova Scotia	Prince Edward Island	
Erosion & sedimentation	8	4	0	12
Gravel removal	2	5	0	7
Highway structures	95	14	0	109
Diversions	1	5	0	6
Channeling	2	7	0	9
Dredging	2	4	0	6
Obstructions	2	0	0	2
Dams	11	13	17	41
Flood control	1	3	0	4
Forest utilization	0	1	0	1
Public utilities	2	1	0	3
Fire/trout ponds	7	27	2	36
Water abstraction	3	9	0	12
Land fill	1	1	0	2
Scientific investigation	1	0	0	1
Salmon pools	9	0	0	9
Total	147	94	19	260

power plant and hydroelectric reservoir in New Brunswick and a hydroelectric scheme in the Cape Breton Highlands of Nova Scotia, demanded an unusually high degree of staff effort.

The most prevalent types of aquatic alterations dealt with during the year concerned the construction of highway structures, dams, ponds and salmon pools, and those resulting in erosion and sedimentation problems (Table 11). A decrease from 1973 in the number of applications for stream channeling, dredging and gravel removal can be partly explained by the more stringent controls being placed on ad hoc use of machinery in rivers. In this regard, interim policy guidelines have been formulated for stream channelizations in Nova Scotia.

Point Lepreau Nuclear Power Development

The New Brunswick Electric Power Commission has proposed the construction of a 1,200-megawatt nuclear power plant at Point Lepreau, on the Bay of Fundy. Major fishery concerns, as a result of possible thermal pollution in the receiving waters of the Bay of Fundy, are clams, lobsters and herring. There is also a possibility of a dam being constructed on the Lepreau River to provide a fresh-water supply for the power plant.

This project is now the subject of a formal environmental impact assessment (the first to be conducted in the Maritimes Region) under the EARP process. The Section played a lead role, in collabora-

tion with other services of the Department, in preparation of mandatory guidelines for the environmental impact study, and in assessing the adequacy of impact predictions.

Dr. W. D. Watt

Green River Hydroelectric Development

Additional investigations were carried out on the physical and chemical characteristics of water in First (Green) Lake (Fig. 5), which will be flooded by the creation of a new reservoir proposed by the New Brunswick Electric Power Commission. This information will supplement previous data, dealing with possible effects of the development on fish and ecology of the river, and permit a better estimate to be made of its likely consequences.

The proposed dam will be 61 m high and will create a 32-km-long reservoir on Green River, Madawaska County, in the upper reaches of the Saint John River system. The reservoir is to be used to provide peaking power.

Dr. W. D. Watt and W. J. White

Wreck Cove Hydroelectric Development

The Nova Scotia Power Corporation commissioned a technical feasibility study of the proposed Wreck Cove hydroelectric development in the east-

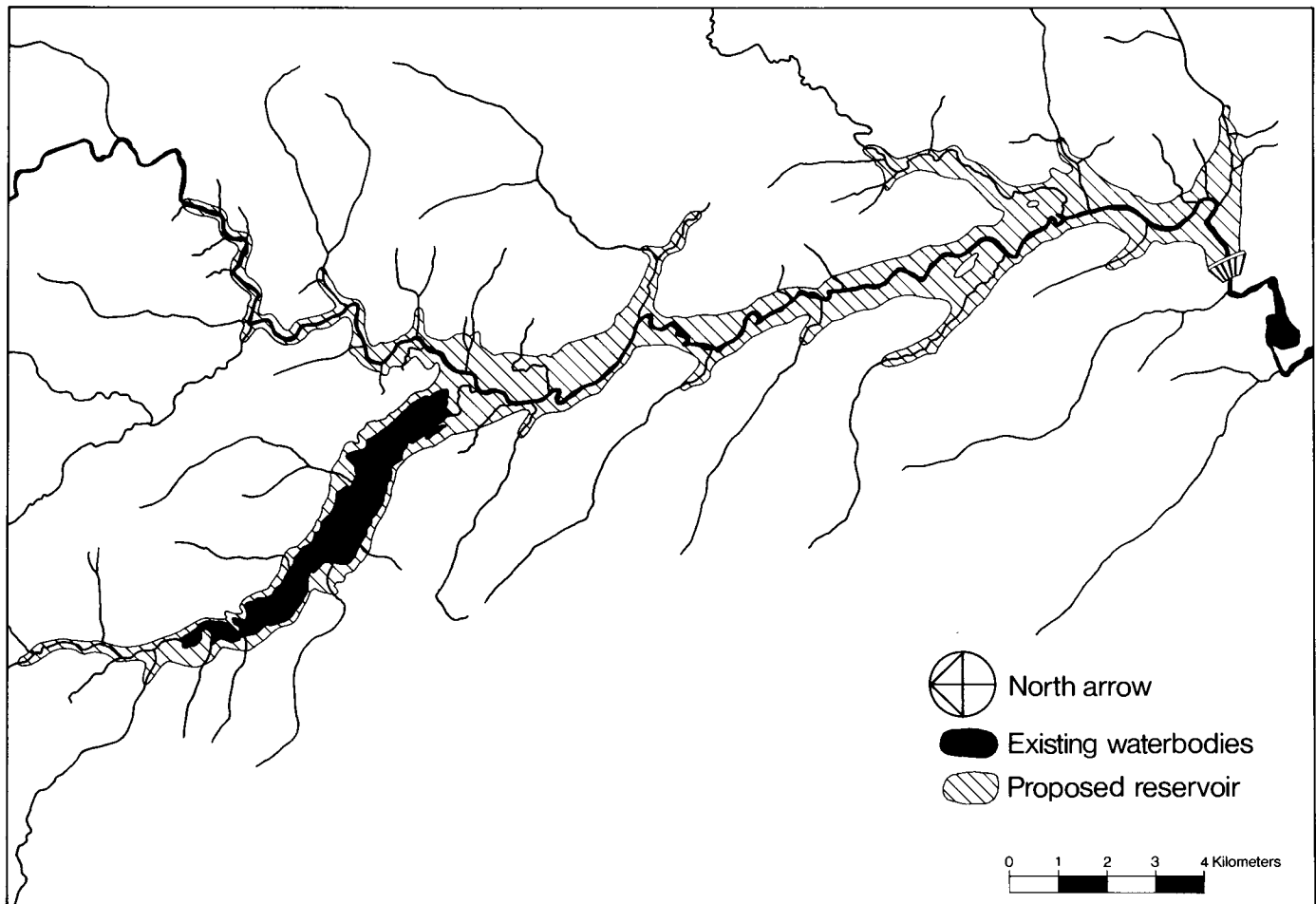


Fig. 5. Location map of Green River, New Brunswick, showing flood zone at proposed hydroelectric reservoir.

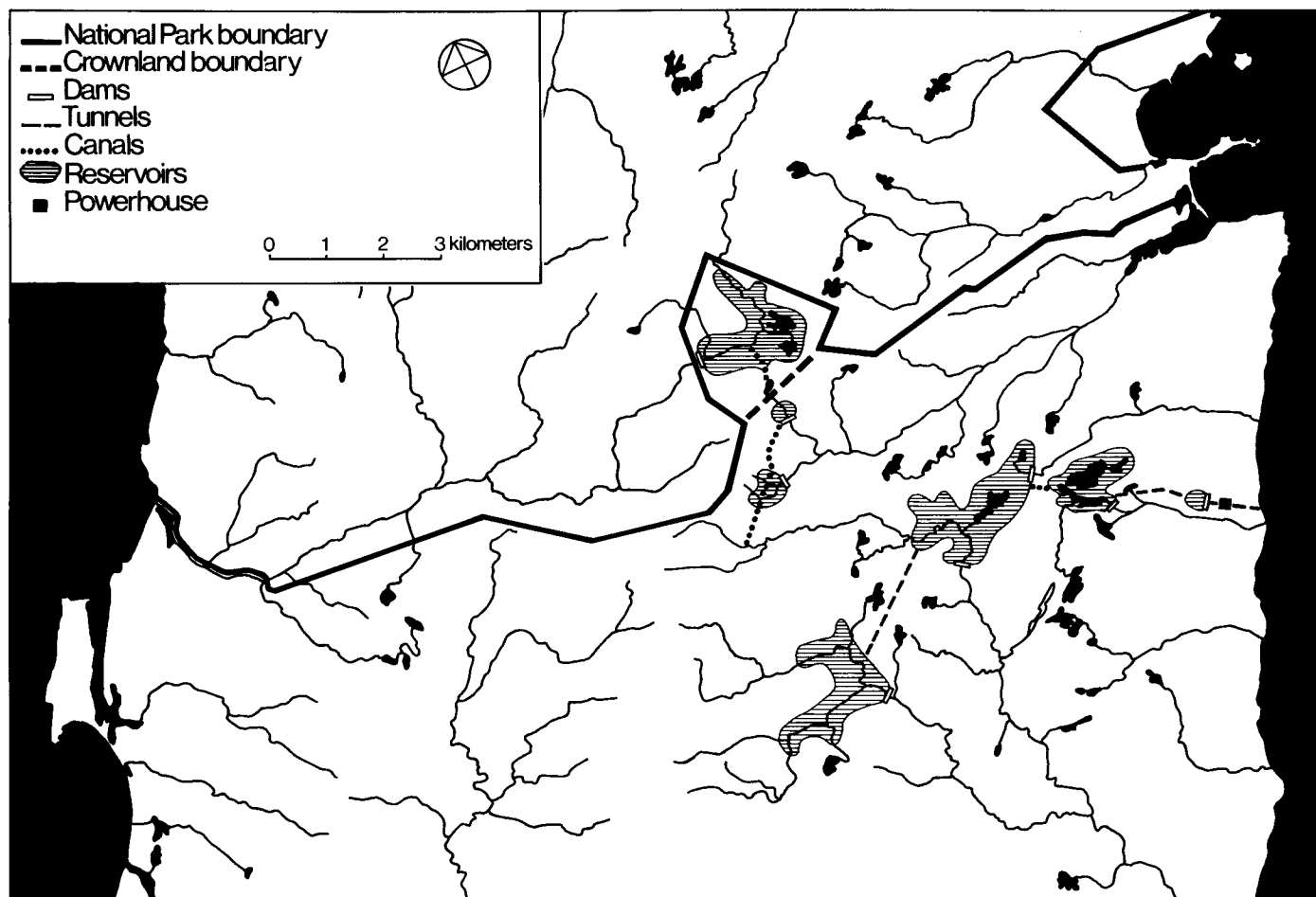


Fig. 6. Location map of proposed Wreck Cove hydroelectric development, Cape Breton, Nova Scotia.

ern Cape Breton Highlands (Fig. 6). The 200-megawatt development involves the diversion of seven headwater streams by a system of canals and tunnels to an underground powerhouse. The feasibility study was completed in April, 1974, and a decision was made by the Corporation to proceed with a preliminary environmental impact assessment of the project. The latter has been completed but, because of deficiencies in the report, additional environmental studies were recommended prior to commencement of the project.

Physical and biological stream surveys of the Wreck Cove area began in 1973 and continued in 1974. Measurements were also taken of the temperature structure, pH and dissolved oxygen in the waters of Gisborne and Wreck Cove lakes. These lakes will be substantially altered as a result of the enlarged impoundment being created on the watershed.

The lakes were thermally stratified from about mid-June to mid-July. By the first week in August, the thermal stratification had broken down. The lakes were slightly acidic, with an average pH of 6.3. Excessively low concentrations of dissolved oxygen were never observed. The lowest concentration recorded was 68% saturation. Brook trout (*Salvelinus fontinalis*) and eels (*Anguilla rostrata*) were the only fish species found in the lakes, and only the Wreck Cove lakes support a small trout fishery. Gisborne Lake and others in the drainage are at present virtually inaccessible.

Samples of fish, plankton and benthos were

collected to assist in predicting the likely effects of the Wreck Cove project on reproduction, survival and feeding of trout in the new reservoirs that will be formed.

Dr. W. D. Watt, H. E. Edwards, T. M. Humes and W. J. White

Erosion and Sedimentation Control

Most of the 24 erosion and sedimentation problems (Table 11) investigated in 1974 dealt with the degradation of agricultural land. Rip-rapping with heavy, quarried rock was stipulated as a solution to this continuing problem.

Investigation of an erosion and sedimentation problem, originating from a clear-cut area at a trailer court on the outskirts of Halifax, led to construction of a silt retention structure on a small stream carrying suspended matter into important trout waters.

Staff participated in a multi-disciplinary study of the effects of erosion and sedimentation on fish habitat and fish populations of Dunk River, Prince Edward Island (Fig. 7). Several agencies of Environment Canada, the Prince Edward Island Environmental Control Commission and the University of Prince Edward Island were involved in the study.

T. M. Humes and A. Cullen

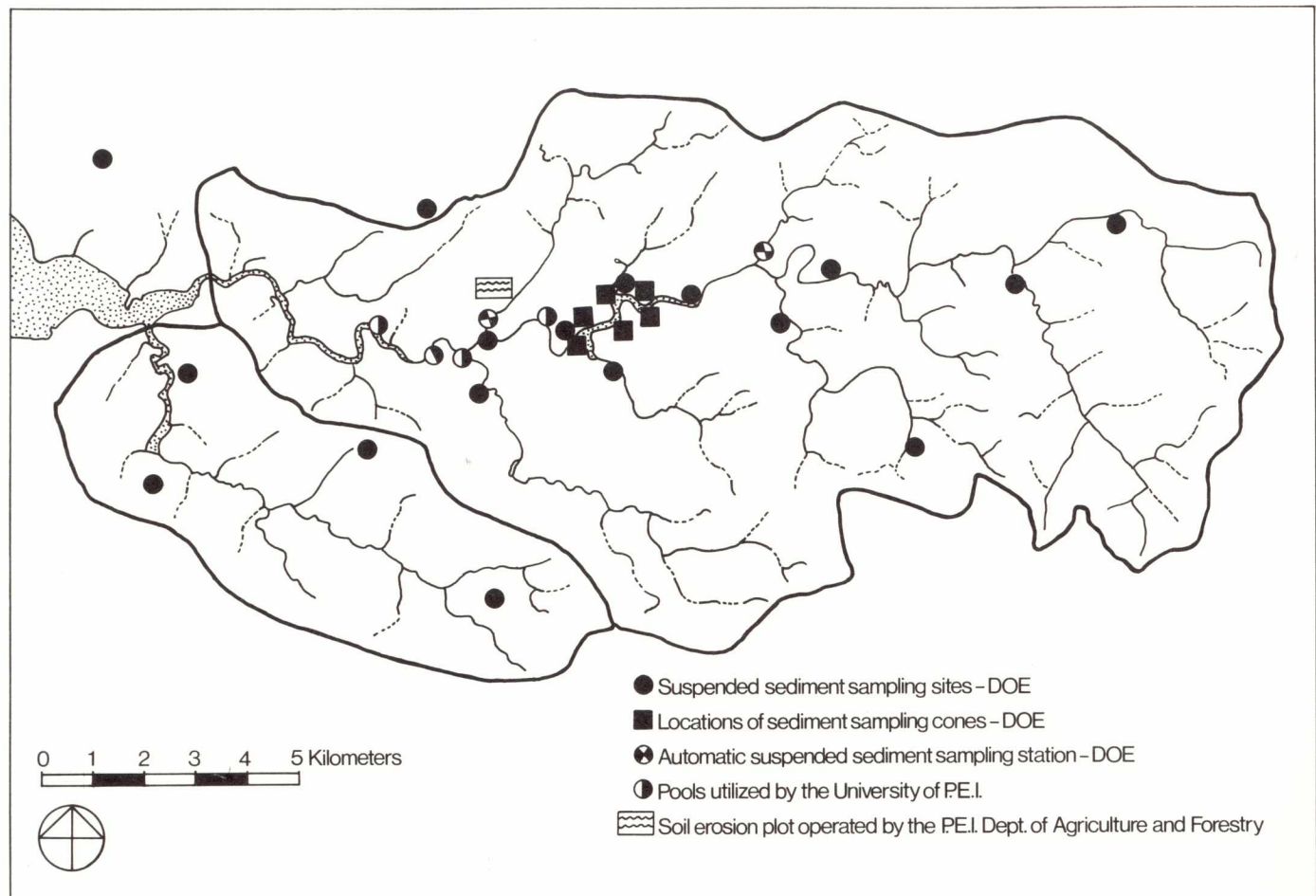


Fig. 7. Watershed map of Dunk River, Prince Edward Island showing sampling locations for the sedimentation study.

Stream Channelization

A total of 23 requests concerning the realignment or removal of stream substrates was investigated during the year (Table 11). Most of the requests were for the purpose of flood control, proposed by the Nova Scotia Department of Agriculture.

A request for channelization of a section of the South Branch of Kennebecasis River, New Brunswick, was rejected because the work would destroy important spawning areas for trout and salmon, and would make the stream bottom more unstable. Agreement was reached with the Nova Scotia Department of the Environment concerning fish habitat protection measures associated with dredging in the Sackville, Canard and Habitant rivers.

A request by the Nova Scotia Department of Agriculture to dredge 32 km of the Annapolis River and its tributaries was investigated. Under the terms of reference of the Canada-Nova Scotia Advisory Committee on Stream Alterations, a proposal for a preliminary environmental assessment of this project was prepared and presented to the Nova Scotia Department of the Environment. The assessment proposal consists of a technical feasibility study initially, followed by a preliminary environmental assessment report on the probable effects on the local environment.

A study was carried out on North River, Colchester County, Nova Scotia, where extensive channelization was carried out for flood protection. Periodic

engineering surveys were conducted, in order to monitor the changes in river morphology. These surveys will provide information on the adverse effects of such projects on fish habitat and river hydraulics.

H. E. Edwards and T. M. Humes



Stream channelization in North River, Nova Scotia.

Estuarial Dredging

Late in 1973, additional responsibilities were assumed for coordinating Fisheries and Marine Service input into the assessment of environmental effects of estuarial dredging. In 1974, this role was expanded to include all types of project referrals under the Navigable Waters Protection Act. During the year, 119 NWPAs referrals were received, including estuarial dredging requests to the extent of approximately 1.2 million cubic meters.

Two dredging proposals of a highly sensitive nature involved the removal and disposal of 76,000 m³ of material at Port Hawkesbury by Nova Scotia Forest Industries, and 275,000 m³ in Dalhousie Harbour, New Brunswick, by the Department of Public Works. Each of these proposals required considerable staff commitment, to assess the impact of possible contaminated dredge spoil on the marine environment and the potential disruption of commercial fishing operations.



Estuarial dredging, Middle River, Pictou County, Nova Scotia.

T. M. Humes

Marine Installations

Investigations under this heading were aimed at ascertaining the fisheries implications of marine developments, such as marinas, wharves, docks, submarine cables, pipelines, sewage outfalls and salt-water intakes.

One of the more significant developments concerned a proposal for installation of a submarine power cable under the Northumberland Strait, from Prince Edward Island to the mainland. A preliminary environmental impact study was carried out by Montreal Engineering Company and, since federal funding is involved, the project is being reviewed under the EARP process.

T. M. Humes



A site at the outlet of Grand Lake, Musquodoboit River, Nova Scotia, where stream clearance work is proposed.

Obstruction Removal

Removal or breaching of abandoned dams, in locations where the fisheries resource can be enhanced, is a continuing responsibility. Several watersheds were investigated during the year, and plans for stream improvement work were developed for East River Chester and Medway River, Nova Scotia. Fifteen streams in Antigonish County and Cape Breton profited from stream clearance work initiated early in 1974 under the Federal Government Labour Incentive Program. Approximately 161 km of stream clearance was carried out during 1974.

V. Conrad

Small Dams

A total of 41 applications to construct low-head dams was investigated during the year (Table 11).

The purpose of these dams was for trout rearing, domestic water supply and fire protection. Where justified, fish passage facilities were stipulated for individual structures.

During the year, three illegally constructed dams were investigated. One in Nova Scotia was subsequently removed by the owner. In Prince Edward Island, appropriate corrective action was undertaken by the owner of one dam; however, accord could not be reached with the owner of the second. Legal action is currently underway to implement remedial measures.

V. Conrad, H. E. Edwards and T. M. Humes

Highway Structures and Public Utilities

Over 100 requests for this type of work were investigated to determine their possible adverse effects on fisheries (Table 11). Nearly all of the road work originated from the highway departments of the

three Maritime Provinces. In a few instances, requests were received from logging companies and private individuals. Without exception, approval of these requests was recommended, subject to construction guidelines designed to protect indigenous fish stocks.

Other requests concerned the installation of domestic water-supply lines for several communities in northwestern New Brunswick and the construction of small causeways in freshwater lakes in Nova Scotia.

T. M. Humes

Water Abstraction

Investigations were conducted into 12 requests to withdraw water from lakes and streams for industrial and domestic consumption (Table 11).

These requests were approved, contingent on proper intake screening and the maintenance of residual flow releases below water-intake structures.

V. Conrad, T. M. Humes and H. E. Edwards

Salmon Pools

Nine applications were received from New Brunswick to construct or alter salmon angling pools. The majority of these requests was from private angling clubs on the Miramichi River system. Staff

continued to work closely with the New Brunswick Department of Fisheries and Environment to establish a firm policy regarding the control and administration of these requests.

H. E. Edwards and T. M. Humes

STREAM INVENTORY PROGRAM

In view of the continuing need to assess the impact of a wide array of physical alterations to rivers and streams, the requirement for a more comprehensive knowledge base to adequately evaluate these alterations was emphasized. The Stream Inventory Program is a step in this direction.

This program was initiated in 1973, and was designed to provide a catalogue of the physical features, hydrology, fisheries, pollution and man-made structures for individual watersheds. Although specifically aimed at fulfilling a need to protect fish habitat, it will also provide useful information for potential fisheries management and enhancement initiatives.

The inventory divides the Maritimes into 19 major watersheds (Fig. 8), which are further subdivided into major river basins. In 1974, emphasis was directed towards collecting and collating additional data for Nova Scotia watersheds. Existing information was compiled for 57 streams, engineering data were provided for 37 streams, and biological surveys and narratives were completed for 27 streams. In addi-

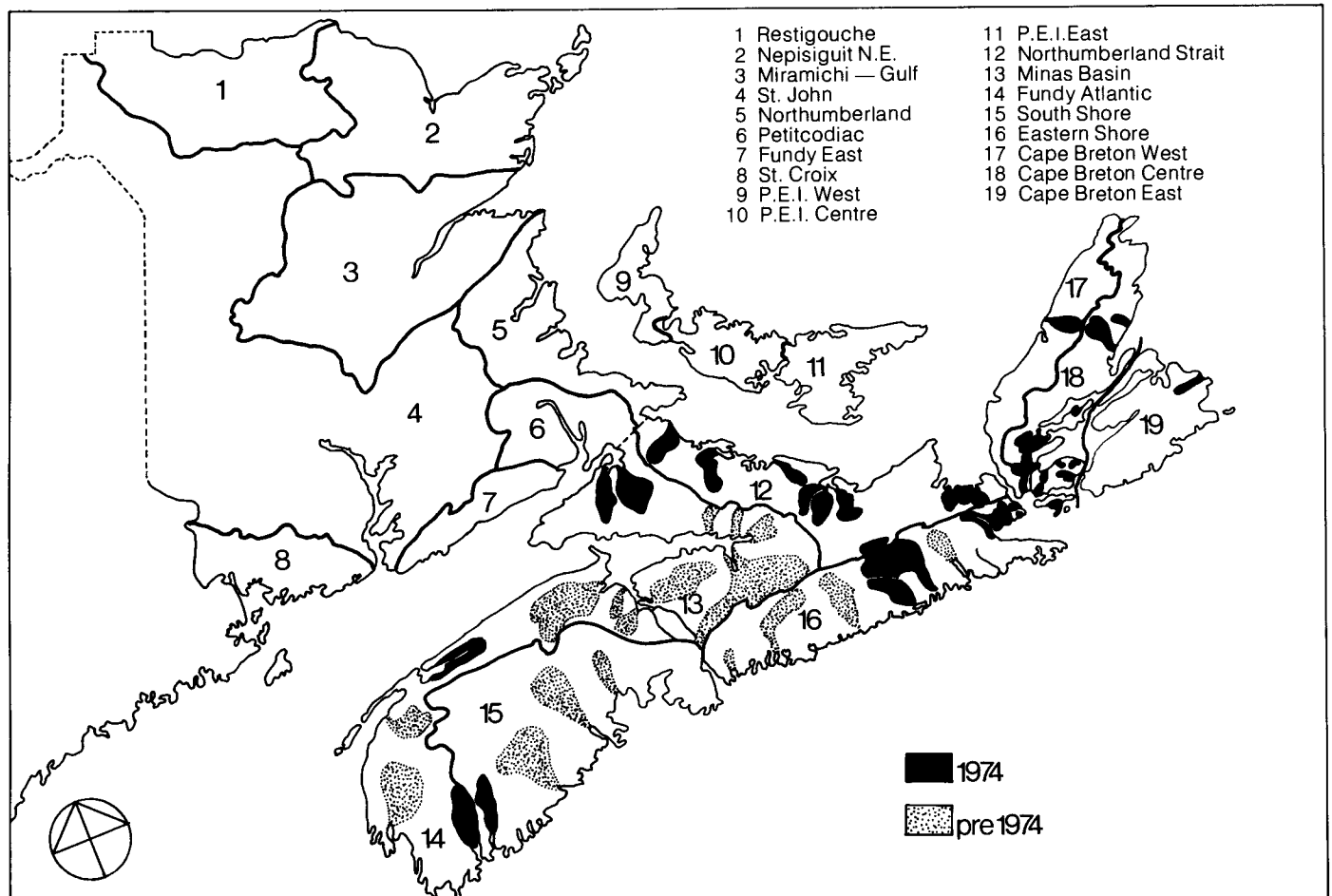


Fig. 8. Stream inventory map, showing areas where work has been initiated or completed up to and including 1974.

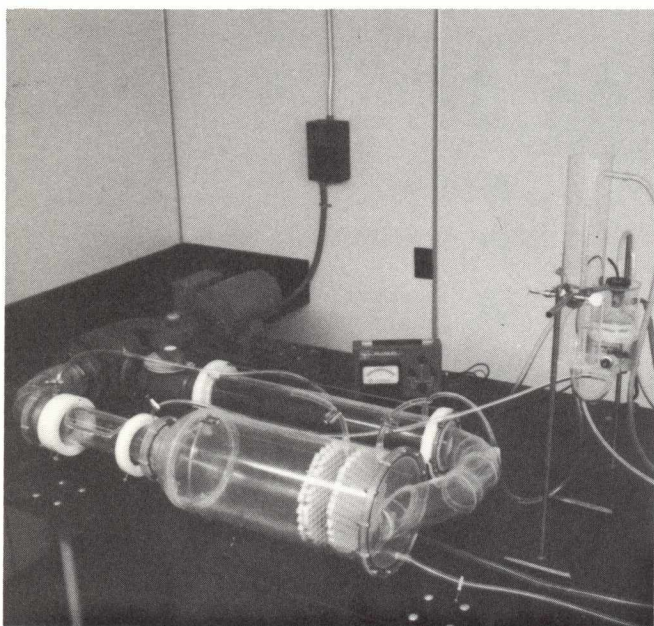
tion, information has been compiled on 15 Prince Edward Island streams.

H. E. Edwards and T. M. Humes

WATER QUALITY PROGRAM

The objective of the Water Quality Program is to define water quality parameters for optimum management of the fisheries resource. The program involves investigating physiological effects of sublethal concentrations of pollutants, with emphasis on fish and supporting ecosystems. It is orientated towards an ecological understanding of the effects of chemical contaminants and associated variables, through field and laboratory studies of an analytical, physiological and ecological nature. Conceived in 1973, the Water Quality Program became fully operational during 1974, with the final acquisition of necessary laboratory facilities and equipment.

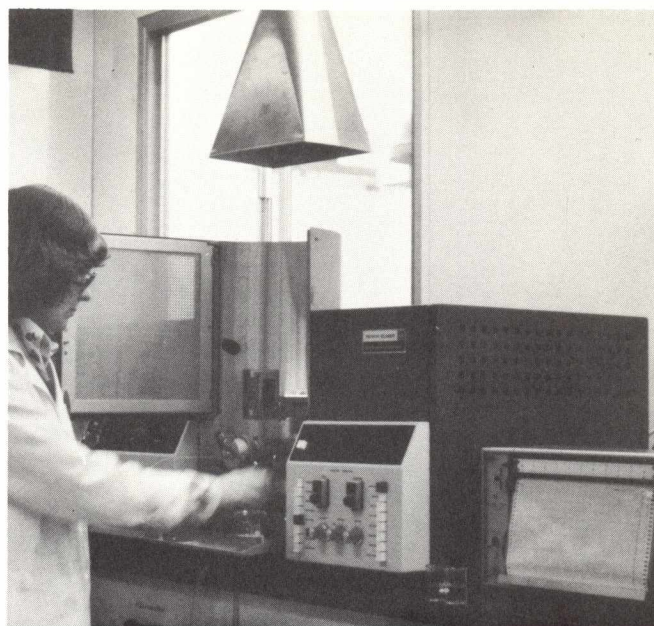
Physiological studies were initiated to determine



Fish respirometer in fish physiology laboratory.

the sublethal effects of zinc on Atlantic salmon. Projects completed or presently underway include the determination of zinc levels lethal to salmon parr, and measurement of the influence of sublethal concentrations on their voluntary food uptake, growth and changes in proximate body composition. Associated projects proposed for the immediate future involve determination of the relative toxicity of zinc to food insects of salmon parr, and its sublethal effects on hatchability of salmon eggs, and survival of alevins and fingerlings. Similar studies are planned to determine the influence of sublethal concentrations on respiration and swimming performance of Atlantic salmon.

In conjunction with physiological studies, analytical chemistry investigations were undertaken to determine background levels of copper and zinc in 15 different organs of Miramichi River salmon parr. This information will be used to ascertain future water-quality changes in the Miramichi system, and



Analytical equipment in water quality laboratory.

as a guide for selective accumulation and excretion of the metals in nature.

Analytical chemistry services were provided to various groups both inside and outside the Branch. These involved chemical analysis of water, mud, sediments, suspended matter and biological samples for various pollutants.

Personnel involved in the Water Quality program also prepared comments on various related matters, such as the adequacy of proposed national effluent standards for chlor-alkali and metal-finishing industries, and the International Joint Commission's water quality standards as they apply to the St. Croix River.

Dr. W. D. Watt, Dr. G. J. Farmer and Dr. S. Ray

FISH PASSAGE PROGRAM

The objective of the Fish Passage Program is to protect existing and potential fish runs, endangered by the construction of dams and other obstacles, by providing advice to proponents on the nature of fish protective works. To accomplish this objective, Section staff conduct hydrometric and topographic surveys, prepare design criteria for fish passage works, assess the efficiency of new and existing fish passes, and supervise the construction of new facilities. All of these tasks are necessary to ensure effective fish protective works are provided and maintained.

During the year, 21 fish pass designs were developed (Fig. 9). Three fish passage facilities were evaluated; two of these were experimental devices. Eight fish passes were constructed, and five fishways were repaired or improved.

Considerable staff effort was devoted to evaluating new and improved techniques for downstream passage of fish at hydroelectric installations. In collaboration with private consultants, a study was initiated to evaluate the potential of electrical deflectors for diverting adults and juveniles in hydroelectric impoundments. In addition, a thorough review was

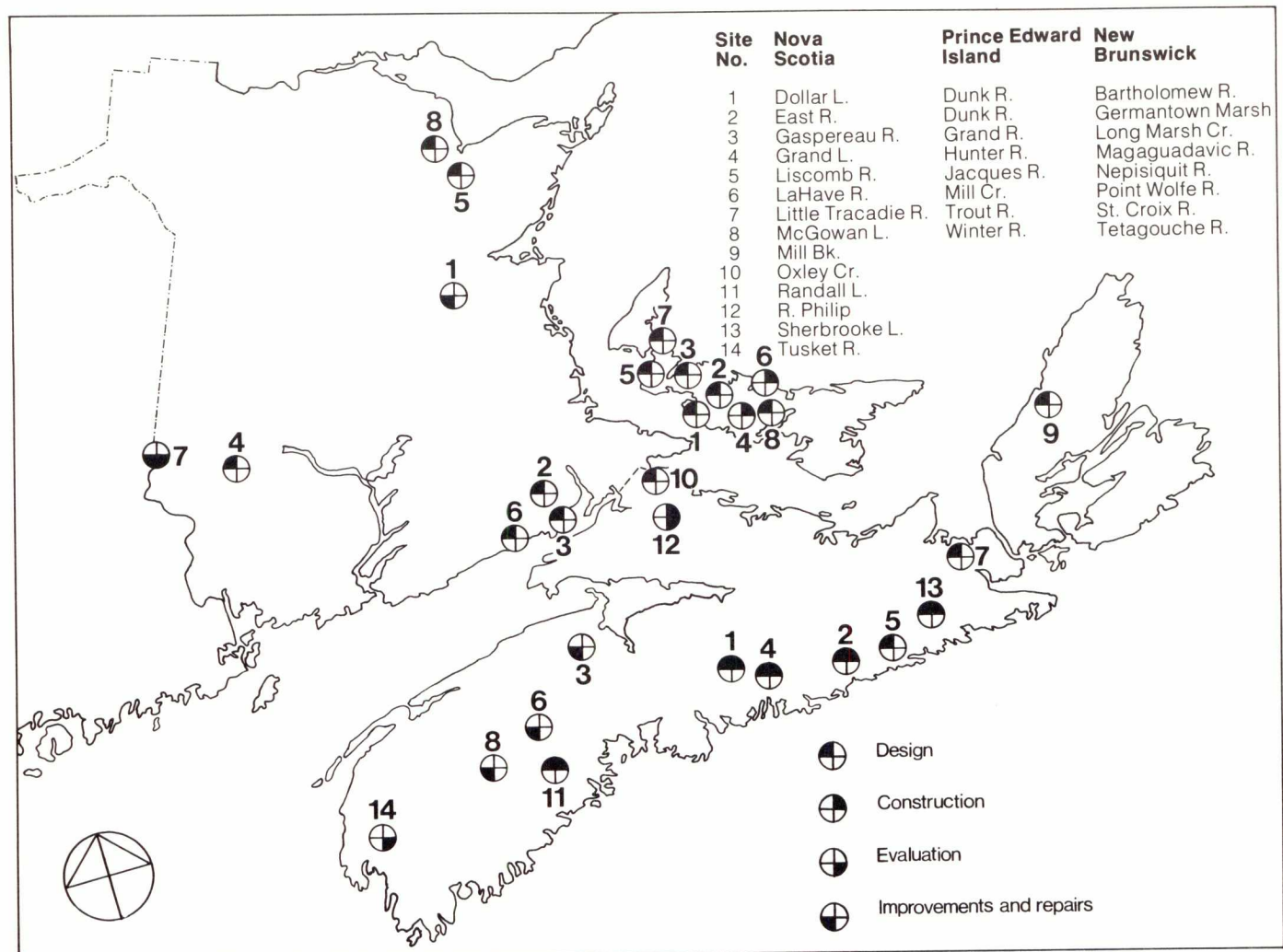


Fig. 9. Locations of fish passage work in the Maritimes Region, 1974.

initiated of all available information on the complex problem of downstream fish migration at hydro installations.

Design and Construction

In Nova Scotia, three conventional fishways were constructed during the year, based on design specifications developed by engineering staff. A timber, pool-and-weir fishway was built at the outlet of Sherbrooke Lake, St. Mary's River, and fish passage facilities were incorporated into a flow-control structure on the outlet of Dollar and Grand lakes, Musquodoboit River (Fig. 9).

Fishway design criteria were also developed for low-head dams on Oxley Creek, Cumberland County; Little Tracadie River, Antigonish County; and Mill Brook, Margaree River.

A fish bypass and automatic-weir control gate were designed and constructed at Malay Falls hydroelectric dam, East River Sheet Harbour, to facilitate safe downstream passage of salmon smolts and kelts. The bypass, consisting of a 0.6-m-wide, semicircular, fibreglas flume, was installed adjacent to the powerhouse intakes and designed to carry fish to the tailrace. A floating-screen deflector was designed and installed in the forebay of the dam to lead fish to the outlet. This device was not assessed

and was operated for only a short segment of the smolt run.

In New Brunswick, a conventional pool-and-weir fishway was designed and constructed at Long



Fiberglass flume, carrying smolts from deflector screen, around turbines and to the tailrace.



Construction of Bell's Pond fishway, Prince Edward Island.

Marsh Creek, Northumberland County; and fishway design criteria were developed for the Germantown Marsh wildlife enhancement project, funded by Ducks Unlimited (Canada).

In Prince Edward Island, an 11-pool, vertical-slot fishway was designed by Branch engineers and constructed at Bell's Pond, Hunter River (Fig. 9). A conventional fishway at Cass's Dam, Mill Creek, was also completed in 1974. Fishway design criteria were developed for Hardy's Dam, Winter River; Affleck's Dam, Dunk River; Robinson's Dam, Trout River; and Arsenault's Dam, Jacket River.

V. Conrad

Tusket River Evaluation

Since the construction of a new downstream fish bypass at the Tusket Falls hydroelectric station in 1973, a program has been carried out to determine its effectiveness. Most of the annual downstream migration consists of spent adult alewives (*Alosa pseudoharengus*), juvenile alewives and Atlantic salmon (*Salmo salar*) smolts. To assist and guide fish into the bypass, an experimental floating-screen deflector was installed in the powerhouse forebay.

Evaluation studies consisted of releasing marked, hatchery-reared Atlantic salmon smolts into the diversion channel above the power dam and recapturing them in trapping facilities inside the powerhouse. During the 1974 program, over 51% of the smolts were recaptured in the bypass. Tests conducted with the deflection screens in position showed that the angle of inclination of the deflector, relative to direction of flow, was critical. Although deeper deflector screens increased efficiency, provision of a sounding lip on the screens was of no significant value for salmon smolts.

Upstream spawning migrations were also studied. Between May 8 and June 21, an estimated total of 1.3 million alewives entered the powerhouse fishway. Comparison of rates of movement at the fishway

entrance and within the fishway indicated a slow-down through the structure, and a gradual buildup of fish within the lowermost portion. The significance of this buildup and possible reasons for delay are still being examined.

A report dealing with the downstream passage of salmon smolts at Tusket Falls hydroelectric facility has been prepared, and recommendations have been made for further minor improvements to the fish bypass.

J. R. Semple and C. L. McLeod

River Philip Evaluation

In the fall of 1974, a prototype spiral fishway, designed, constructed and funded by Aeroceanics Fishways Corporation, was installed at River Philip Dam, Oxford Junction, Nova Scotia. Assessment of this prototype was initiated to determine its suitability for passing Atlantic salmon. A conventional Denil fishway was operated simultaneously, to obtain a comparison of the effectiveness of the two structures.

Only one salmon, from a total of 157, used the spiral fishway during the test period. The main reason for this was attributed to poor entrance attraction features. Under normal operating conditions, discharge from the spiral fishway was approximately 0.17 m³/sec, compared to 0.50 m³/sec from the Denil fishway. River discharge during the test period was usually in excess of 7.08 m³/sec.

Blood samples for lactic acid determinations were collected from fish, in an attempt to detect any variation in effort required to negotiate the two fishways. Although a higher lactic acid concentration was found from the fish in the spiral fishway, no significance could be attributed to this value due to the small sample size.

Further tests, using other anadromous fish species, are planned for 1975.

J. R. Semple, C. L. McLeod and V. Conrad



Spiral fishway under high water conditions at Oxford Junction, River Philip, Nova Scotia.

St. Croix River Evaluation

The St. Croix River, which forms the international boundary between the Province of New Brunswick and the State of Maine, is presently being considered for a restoration project for Atlantic salmon and other anadromous species. The lower portion of this river system has been plagued for many years by industrial pollution.

As part of an assessment of basic survey information to determine the suitability of the system for rehabilitation, a critical review of existing fish passage facilities began in 1974. The lowermost fishway, situated at the Milltown hydroelectric dam, was examined with regard to its ability to attract and pass anadromous fish. This timber pool-and-weir structure was constructed in the mid-1950's and is virtually confined to the under portion of the powerhouse.

Most of the present annual fish migration on the St. Croix is composed of alewives (*Alosa pseudoharengus*), with the occasional speckled trout and Atlantic salmon. The alewife count at the fishway totalled 31,433 fish in 1974, with the run peaking in early June. This is nearly double the figure obtained for the last previous count in 1968. Only two Atlantic salmon entered the fishway.

Mark and recapture experiments indicate the present Milltown fishway is grossly ineffective in attracting alewives from the powerhouse tailrace. The results of these field investigations will be analyzed to identify specific fish migration problem areas. It is possible the deficiency in attracting and passing fish relates to a combination of fish passage and water quality problems.

J. R. Semple and C. L. McLeod

Repair and Improvement

Extensive repairs were made by the New Brunswick Electric Power Commission to a timber fishway located inside the Milltown powerhouse, St. Croix River. Leaking pools were relined, baffle elevations adjusted and improved ventilation was provided inside the powerhouse, to reduce further rotting of timber components. Also in New Brunswick, the two lowermost pools of the Bartholomew River fishway at Blackville were replaced, and the owner of the Magaguadavic Lake fishway (J. D. Irving Company) was advised to undertake extensive repairs before the 1975 spring migration.

The Nova Scotia Power Corporation undertook major repair work on the 70-pool White Rock timber fishway on Gaspereau River. The repair work began in 1974, and will be completed when the bottom eight pools of the fishway are rebuilt during the winter.

A fish passage problem at Indian Falls on the LaHave River was discovered during the year.

Excessive flow and turbulence were found in the fishway, and appropriate corrective action was taken.

The Nova Scotia Power Corporation has agreed to construct four new baffles in the Harmony Mills fishway on the Medway River, and to undertake repairs to deteriorated concrete portions of this structure. These measures are designed to improve fish passage and maintain the integrity of the existing facility.

An existing timber fishway on the outlet of Lake Major, Halifax County, was modified to improve its effectiveness for passing alewives. The work was performed by the owners, the City of Dartmouth.

V. Conrad and J. R. Semple

ENGINEERING SERVICES

The role of Engineering Services is to provide technical expertise for current and planned Branch capital projects associated with fish culture and fisheries enhancement programs. This entails conducting technical feasibility studies for major new capital projects, and design and construction of new and improved facilities and works.

In collaboration with private consultants, engineering feasibility studies were initiated for a proposed new hatchery in southwestern Nova Scotia and to resolve a serious nitrogen supersaturation problem in the river-water supply at Mactaquac Hatchery. Engineering design and construction of new adult salmon holding ponds and trout rearing facilities at Antigonish Hatchery continued during the year. Preliminary design work was completed for improving existing adult sorting facilities at Mactaquac and providing a permanent adult release site on the Tobique River.

Engineering field surveys continued during the year, to acquire additional topographical and hydrometric information to assist in refining preliminary design concepts and planning of major fisheries enhancement projects. Field work was concentrated on the Nepisiguit and Tetagouche rivers, Gloucester County, New Brunswick and on the Liscomb River, Guysborough County, Nova Scotia.

Further details regarding Engineering Services participation in individual projects during the year are provided in the Freshwater and Anadromous segment of this report.

The ability to provide engineering expertise for current and planned fish culture and fisheries enhancement projects was seriously hampered during the year by promotional transfer of professional and technical support personnel. As a result of these transfers, it was necessary to solicit assistance from outside consultants for several high-priority projects.

G. H. Jenkins, A. Anderson, V. Conrad, A. Cullen and W. Jones

FRESHWATER AND ANADROMOUS FISHERY MANAGEMENT

The past year has produced some extremely satisfying program accomplishments. Returns of salmon to the upper Saint John River in 1974 were greater than in any year since 1957, when escapement enumeration started. This result is directly attributable to the Branch's adult salmon transport and distribution operation — which has maintained natural production upstream of Mactaquac Dam — and to increased returns from the Mactaquac Hatchery operation. Returns of hatchery-reared salmon to the upper LaHave River, Nova Scotia, in 1974 increased more than two-fold over the 1973 level. We are well on the way to establishing a self-sustaining salmon run to the upper reaches of the LaHave, above Morgan Falls fishway. At the same time, declining financial support for the program has forced substantial reduction in many of our biological investigations and some hatchery operations. Four fence operations, which provided salmon escapement information and hatchery broodstock, had to be terminated in 1974 to reduce operating costs.

The three major segments of the freshwater and anadromous fisheries program were capably directed by T. G. Carey (Fish Culture Programs), M. R. Robertson (Southern Management Investigations) and G. E. Turner (Northern Management Investigations). In late 1974, these individuals, with support from other staff, started preparation of background documents concerning modernization of the Maritime hatchery system, and a long-term salmon rehabilitation and development program. These papers, to be completed in early 1975, will be an essential part of Branch program planning and budgeting over the next five years.

D. B. Lister

FISH CULTURE

In 1973, all fish-culture activities in the Resource Development Branch were melded into a single group. These activities included operation of 13 Maritime hatcheries, hatchery biological investigations and commercial fish-culture development projects. This year, there has been closer integration of these multidisciplinary activities to serve common goals, and better coordination with other Resource Development Branch staff, such as engineers and management biologists, on joint projects. Excellent cooperation has also been received from staff of the Conservation and Protection Branch and other agencies, such as the Halifax Laboratory and St. Andrews Biological Station of the Research and Development Directorate.

The most important factors affecting fish culture

programs this year have been the substantial decrease in casual manpower (33%) and the lack of increased budget allocation to compensate for inflationary cost increases. This resulted in a number of projects being eliminated or reduced in scope. However, these circumstances forced a critical review of all projects and programs, and resulted in redirection of some resources towards more productive areas.

One of the key activities in 1974 has been the continued planning for short- and long-term hatchery programs. This has followed the efficiency assessment of present fish-rearing facilities and identification of increased hatchery-stock requirements over the next ten years. Studies have shown that several new hatcheries should be constructed in the Maritimes Region to improve efficiency and expand fish production.

Closely correlated to the need for modernizing hatcheries is the requirement to increase staff training. In 1974, 15 people attended courses on accident prevention, management, report writing and classification procedures. Towards this end, fish culture staff have also been working closely with the New Brunswick Community Development College and the Salmon Research Centre at St. Andrews, New Brunswick, in preparing a curriculum for training fish culturists.

Unfortunately, one of the senior members of the fish culture staff was lost this year, with Mr. R. E. H. Macdonald retiring after thirty-four years of service. Also, Dr. C. Frantsi, fish disease biologist, resigned to accept a position with the Salmon Research Centre, and has been replaced by Dr. J. Weber (Queens University).

T. G. Carey

Hatchery Planning

Following the assessment of all hatcheries in 1973, and identification of a number of inefficient and costly operations, a document is being prepared which outlines the need for modernizing the Maritime hatchery program. This document will include estimates of all hatchery-stock requirements to 1984, current benefits obtained through stocking hatchery-reared fish, and techniques for improving efficiency and expanding production capability of the hatcheries.

Projected annual stock requirements from Maritime hatcheries by 1984 are expected to total almost seven million fish, compared with three million produced in existing facilities (Fig. 10). Increased stocks will be required over the next ten years to support the following: (a) new projects to enhance Atlantic salmon stocks in the Maritimes; (b) initiation of new intensive recreational trout and salmon fisheries; (c) use of rainbow trout to monitor industrial effluents, as part of new regulations to control pollution; and (d) provision of salmonid stocks to assist initially in development of commercial aquaculture.

Assessment of contributions of hatchery-reared Atlantic salmon and trout to fisheries has shown a substantial increase in both survival and exploitation

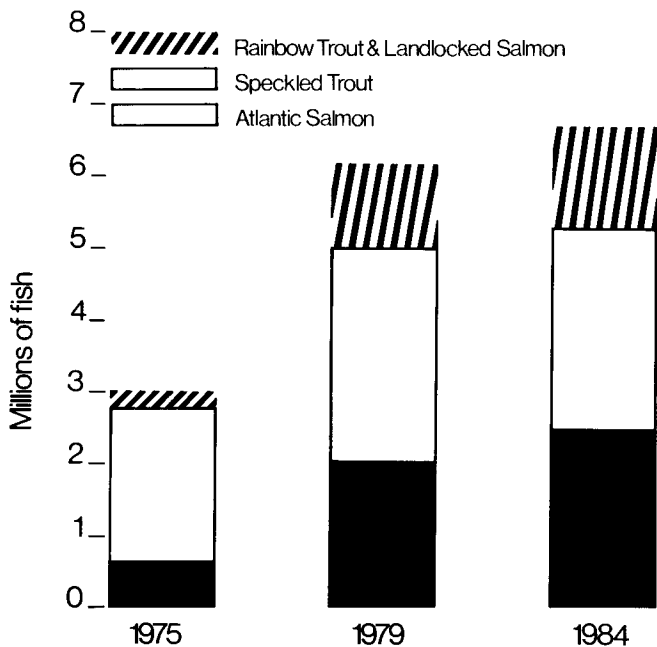


Fig. 10. Projected hatchery stock requirements for the Maritimes Region, 1975-84.

rates in the past two years. Recent figures indicate a survival rate for Atlantic salmon smolts, for example, of >2% from recent releases of hatchery fish, compared with <1% in previous years. Speckled- and rainbow-trout yearlings are also harvested at a rate of 75% or more in intensive fisheries, such as those in five lakes in Dartmouth, Nova Scotia. These promising results demonstrate that hatchery-reared stocks can be used effectively for increasing fisheries potential for selected species.

The plan to expand production and improve efficiency of Maritime hatchery facilities will take place in two stages. The first will include replacement of old facilities and modernization of existing ones which have the capability for increased production. This stage will essentially take place without any increase in manpower resources, and only small increases in budget allocations. The second stage will entail construction of new facilities to meet maximum expected production requirements, and will require new manpower and fiscal resources.

Progress is now being made in the first stage, through a feasibility study to locate a suitable site for

a new hatchery in southwestern Nova Scotia. This would replace three existing inefficient hatcheries, and would be expected to double their fish production and operating efficiency. It is anticipated that construction will begin in 1977, following environmental-impact studies and detailed design of the new facilities. Consideration is also being given now to construction of a new hatchery in Cape Breton, because of serious disease problems being experienced at the Margaree Hatchery.

T. G. Carey, R. F. Hawkins and G. B. Robbins

Hatchery Operations

The federal government hatchery program comprises five hatcheries in New Brunswick, seven in Nova Scotia, and one in Prince Edward Island. Fish reared in these hatcheries include Atlantic salmon, speckled trout and rainbow trout, which are used primarily for increasing and supplementing wild populations of these species. Biological investigations are also conducted in support of the hatchery program in fish health, and evaluation of contributions of hatchery-reared stocks to fisheries.

Fish Production

In 1974, manpower and financial limitations resulted in elimination of several operations and severe restrictions to others.

Manpower restrictions primarily affected peripheral operations, including the Atlantic salmon broodstock holding ponds at Charlo, New Brunswick, and the salmon broodstock collection fences on the St. Mary's and Margaree rivers. The Mersey Hatchery in Nova Scotia also operated at a substantially reduced level, and was used primarily as a seasonal rearing station for speckled trout. Continuing the trend of recent years, total production in 1974 from the 13 Maritime stations declined by 134,435 fish (2.5%) and 7,746 kg (6.5%) from that of 1973 (Table 12). This was the result of further reductions in pond densities to improve fish quality. However, the average individual weight for all species decreased by 2.3%. This was in contrast to the increase experienced over the past three years.

The decrease in average weight was attributed

Table 12. Production statistics for Maritime hatcheries, 1972-74.

Species	1972			1973			1974		
	Total number	Total weight (kg)	Average weight (g)	Total number	Total weight (kg)	Average weight (g)	Total number	Total weight (kg)	Average weight (g)
Atlantic salmon	3,703,000	54,745	14	2,257,000	37,195	17	2,097,391	46,224	22
Speckled trout	5,483,000	81,105	14	3,027,000	74,988	26	3,119,405	63,409	20
Rainbow trout	80,000	3,750	45	84,000	6,604	77	40,088	1,624	41
Brown trout	0	0	0	27,000	290	11	3,681	74	20
Landlocked salmon	100	10	100	0	0	0	0	0	0
Totals	9,266,100	139,610	15.1	5,395,000	119,077	22.1	5,260,565	111,331	21.6

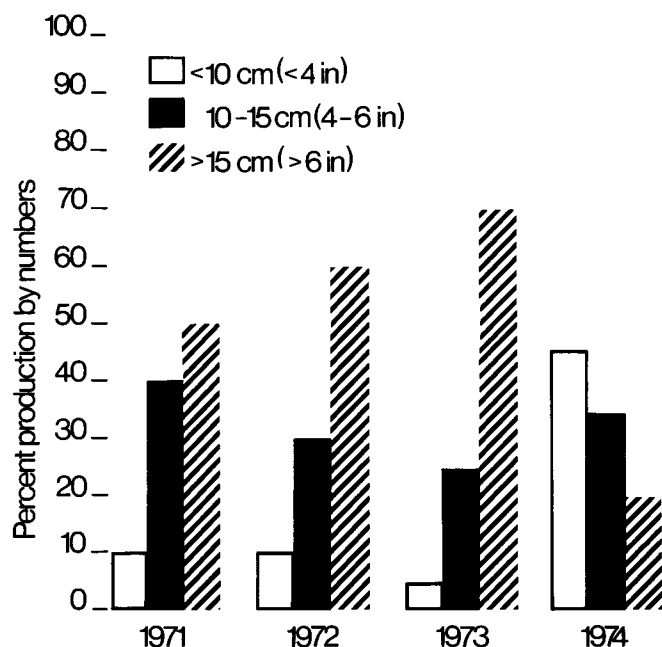


Fig. 11. Comparative production of different size-groups of speckled trout from Maritime hatcheries, 1971-74.

mainly to adjustment of the speckled trout production program. Although the number of speckled trout produced in 1974 increased by 3%, the total weight decreased by 15.4% from that of 1973. This loss in production was the result of trout being released earlier in the growing season, in an effort to reduce the total cost of food. A noticeable shift also occurred in the average length of trout produced, with fewer fish being reared to 15 cm or more (Fig. 11).

The trend for Atlantic salmon production in recent years continued, with the release of more fish at the smolt stage. Of the total Atlantic salmon production, 47% were >15 cm in length, which is considered to be the minimum desirable smolt size (Fig. 12). A total of 491,890 smolts was released into eight Maritime rivers in 1974.

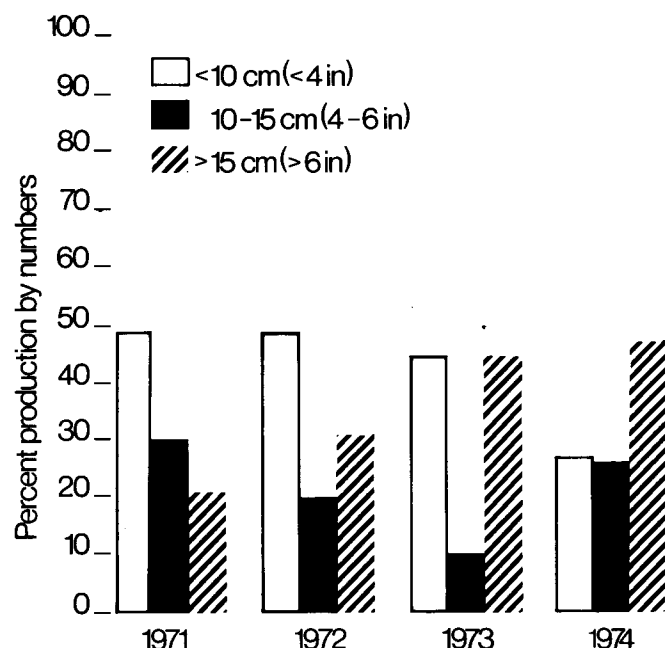


Fig. 12. Comparative production of different size-groups of Atlantic salmon from Maritime hatcheries, 1971-74.

While the total weight of Atlantic salmon produced in 1974 increased by 24.3% from that of 1973, total number decreased by 7.1% due to high mortalities at Mactaquac and Kejimkujik hatcheries (see section "Fish Health").

The production of River Philip stocks of Atlantic salmon has been eliminated due to its low priority, and replaced with Big Salmon River stocks, scheduled for release in Point Wolfe River in Fundy National Park, New Brunswick. Development of a salmon run in this system is being undertaken with Parks Canada.

In response to a request from the Prince Edward Island Government for Atlantic salmon smolt stocking of the Morell River, 6,000 yearlings were transferred from Charlo Hatchery to Cardigan Hatchery, for release in the spring of 1975. In addition, Atlantic salmon eggs of Miramichi River stock are being incubated at Cardigan Hatchery this winter, the first time Atlantic salmon have been reared in Prince Edward Island since 1967.

Rainbow trout broodstock of fall-spawning parent-age were held this year at Cobequid Hatchery, and the 1974 egg collection was taken from these two-year-plus fish. Sufficient eggs were taken to meet most requirements; however, to ensure that total commitments are fulfilled, additional eggs have been requested from the United States Bureau of Sport Fisheries hatchery at Nashua, New Hampshire.

In an effort to develop a strain of speckled trout which is tolerant to the acid waters of southwest Nova Scotia, broodstock are now being held at the Yarmouth Hatchery. All other trout broodstocks for the Maritimes are held at the Antigonish and Cobequid hatcheries in Nova Scotia.

The rearing of juvenile Atlantic salmon in Little Lake on the St. Mary's River, Nova Scotia, was discontinued because of budget constraints. In 1974, smolt production from this 3.5-acre lake equalled 39% (4,670 smolts) of the fish originally stocked as yearling parr in 1973. In the three years of operation, smolt production from Little Lake ranged from less than 1,000 to almost 10,000 (Table 13).

Although the survival rate of 76% recorded for the first year of operation was considered to be good, the lower survival rates observed in the following two years were unsatisfactory. Otter predation during the winter months is known to have contributed to the extremely low survival recorded in 1973. In all three years, low water flows through the lake delayed smolt

Table 13. A summary of Atlantic salmon smolt production from Little Lake on the St. Mary's River, Nova Scotia, 1972-74.

Year of emigration	Number stocked ¹	Number of smolts produced	Percent survival
1972	12,770	9,621	76
1973	12,000	870	7
1974	12,000	4,670	39

¹Number of yearling salmon originally stocked in lake.

emigrations and necessitated the removal by seining of approximately half the total production.

A technique has been developed whereby early-run large salmon, caught in the commercial fishery of the St. Mary's River estuary, are being purchased and utilized for hatchery broodstock. Important aspects of this technique include very careful handling, and the acclimation of broodstock from salt to freshwater, in which they are held until spawning. The 1974 program yielded 28 early-run large salmon of St. Mary's River stock. Of these, 23 survived until spawning and produced 102,400 eggs.

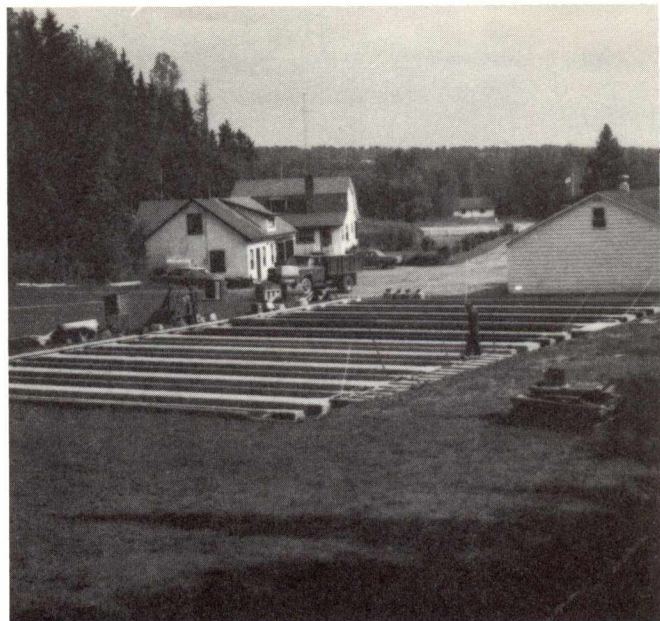
The problem of preliminary feeding of Atlantic salmon fry in cold 7°C (45°F) water at Mactaquac, causing high mortality due to starvation, was overcome this spring by installing a water-heating system. This system will provide water to the incubation facilities at 11-13°C (52-55°F), which is an acceptable level for Atlantic salmon. However, the system is not of sufficient capacity to heat water to initiate early hatching and to accelerate growth to produce one-year smolts at Mactaquac.

In addition to the numerous hatchery-reared stocks released into natural waters in the Maritimes, considerable assistance is provided to other agencies and the public for research and assessment projects, development of aquaculture and stocking private waters. In the latter, only excess hatchery-reared fish are used, and these are sold rather than given to persons applying for fish.

In 1974, 429,061 fish (8.1% of total production) were utilized to provide assistance to various government agencies or universities for research, or were sold to commercial fish culturists. These fish constituted 82% of total rainbow trout production and almost 2% of Atlantic salmon production (Table 14).

Assistance was also provided to the United States Bureau of Sport Fisheries and Wildlife, through the collection and spawning of Atlantic salmon broodstock. A total of 250,000 eggs was shipped to United States Federal hatcheries for the Connecticut River Salmon Restoration Program.

A new program was initiated this year to facilitate better hatchery production planning. All agencies and individuals who have received hatchery-reared stocks in the past were requested to submit estimates of their requirements over the next two years. With this information, priorities can be set for specific



Florenceville Hatchery, Carleton County, New Brunswick.

projects, adequate hatchery space can be allocated and fish can be reared to meet special criteria. Knowledge of future requirements will also result in better forecasting of resources required to meet production objectives.

Production Efficiency

Manpower efficiency in trout production decreased in 1974, due to the policy of releasing the majority of fish at smaller sizes (<10 cm), in an effort to reduce rearing costs (Table 15). These fish were

Table 15. Measures of production efficiency of Maritime hatcheries, 1973-74.

Year	Atlantic salmon		Trout species	
	Cost/kg (\$)	Kg/man-year	Cost/kg (\$)	Kg/man-year
1973	16.37	667	7.43	2,191
1974	11.89	945	8.45	1,994

Table 14. Hatchery-reared stocks provided to other agencies and the public in 1974.

Purpose or recipient	Atlantic salmon	Speckled trout	Rainbow trout	Brown trout	Total
Aquaculture	1,800	0	750	0	2,550
Research (Government agencies)	22,817	6,499	2,200	0	31,516
Special-project stocking	0	20,650	16,000	0	36,650
Universities	694	1,445	150	0	2,289
National parks	0	36,300	0	0	36,300
Private applications	0	181,250	0	0	181,250
Provincial agencies	5,000	111,230	13,776	500	130,506
Fish habitat protection	8,000	0	0	0	8,000
Totals	38,311	357,374	32,876	500	429,061

released before any substantial weight gains could be achieved, thereby reducing the efficiency of the production unit.

However, the salmon program, which is of higher priority than the trout program, was less affected by fiscal restraints; and continued its trends of recent years to produce larger fish and thereby increase efficiency of the production unit. However, the cost of producing Atlantic salmon is significantly greater than for trout, because salmon have to be reared at lower densities to produce high-quality fish.

Fish Health

Infectious Pancreatic Necrosis (IPN) continues to pose a problem at all stations rearing speckled trout in the Maritimes Region. During the past spring and summer, speckled trout from IPN-infected stock were transported to Guelph University for a study on the modes of transmission and infection of this viral disease.

In 1974, Mactaquac Hatchery experienced losses of 33% of its Atlantic salmon underyearling parr. Although investigated by fish-disease personnel from both the United States and Canada, an explanation for the losses wasn't found. Water supply samples were submitted to the Water Quality Laboratory of the Environmental Protection Service at Moncton for analysis of pesticides, which were found to be within acceptable limits.

The external gill parasite *Salmincola edwardsii* was discovered on speckled trout broodstock in semi-natural rearing ponds at Cobequid Hatchery. An attempt was made in the fall to eradicate the problem through isolation of infested stocks and through disinfection of facilities.

Bacteria, tentatively identified as *Pasteurella* sp., caused high mortalities in the yearling Atlantic salmon at Kejimikujik Hatchery. This is the first identification of these bacteria at any North American fish culture station. To combat the problem, both year-classes of salmon were destroyed, and the station will be thoroughly disinfected before becoming operational again in 1975.

A survey is continuing to determine the recruitment period of glochidia (larval clams) on Atlantic salmon at Antigonish Hatchery.

The drug, Furanace, was tested at two concentrations (1 ppm and 2 ppm) for the treatment of saddleback disease in Atlantic salmon fingerlings. Weekly one-hour treatments with the experimental drug proved unsuccessful, however, and similar treatments with 1:300,000 malachite green were more effective in controlling this disease.

During 1974, 60 disease cases were submitted to the Fish Health Laboratory at Mactaquac Hatchery for diagnosis. The cases involved Atlantic salmon (46 cases), speckled trout (12 cases) and rainbow trout (2 cases). Forty-five of these cases were from Maritime hatcheries, 13 were from other government operations and 2 were from wild populations. The cases included parasitic, bacterial and fungal infections and gas-bubble disease.

A new program was initiated in 1974, in which stocks at all stations will be examined twice a year on a routine basis by fish disease biologists, for disease

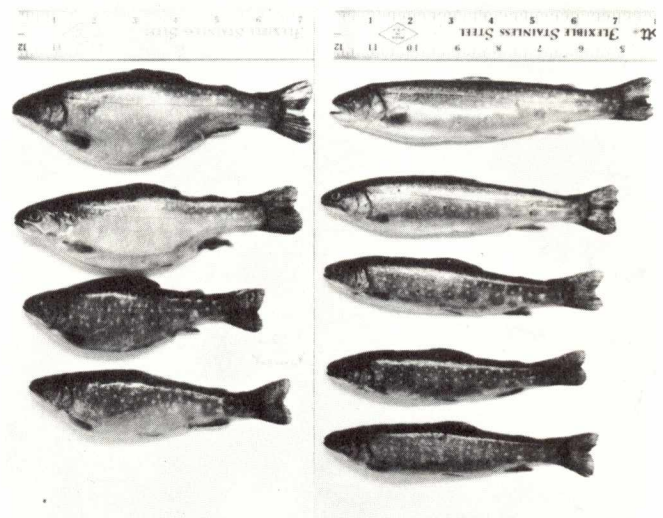
or general health problems. This year, the program was carried out at six hatcheries, with 58 groups of Atlantic salmon, speckled trout and rainbow trout being examined from various age-classes, rearing facilities and stocks. While the condition of fish examined was generally good, some problems were encountered and are being investigated further. The most significant problem identified was that of blind speckled trout at Cardigan Hatchery. The problem has been tentatively attributed to a nutritional disorder. Experimental diets were being tested at this station but, as a result of this problem, the tests were terminated.

The need for more detailed investigations related to salmonid nutrition in Maritime hatcheries has been identified for some time, and it was anticipated that a start would be made in this field in 1974. However, fiscal restraints precluded this possibility, and investigations were delayed until 1975. The nutrition biologist will eventually be responsible for monitoring quality of food used at hatcheries (either commercially or locally prepared), identifying specific nutritional problems, recommending dietary changes to correct these problems, and testing formulas for new diets.

The assessment of Ewos and Silver Cup salmon feeds on a production scale at three stations was continued during 1974, and will be terminated in 1975, with the release of smolts from the 1972 year-class. Although final results of this feed trial will not be known until a complete assessment has been made on adult return rates, initial results indicate that fish reared on Silver Cup are longer, heavier and have better fin condition than those reared on Ewos.

Feeding trials to the yearling stage were conducted in 1973-74 at three hatcheries, to compare Silver Cup and Martin Mills trout feeds. The conditions of the fish on both diets was monitored for the duration of the experiment. Physiological and biochemical analysis revealed insignificant differences between the two groups (Table 16).

However, mortalities at two stations, especially during the fry stage, were significantly lower for trout



Comparison of yearling speckled trout reared on the same diet at two Maritime hatcheries.

Table 16. Variation of selected parameters (mean values) recorded during speckled trout diet trials at three hatcheries, 1973-74.

Parameters measured	Antigonish		Florenceville		Yarmouth	
	Silver Cup	Martin Mills	Silver Cup	Martin Mills	Silver Cup	Martin Mills
Fork length (cm)	17.4	17.4	15.3	15.6	20.0	20.9
Weight (g)	63.3	62.9	47.3	52.4	146.4	183.0
Condition factor	1.21	1.19	1.25	1.31	1.83	2.01
Total blood protein (g%)	3.0	3.0	3.0	3.3	4.0	4.2
Mortality (%)						
(to end #1F stage)	3.0	5.2	66.5	21.5	39.9	25.4
(to yearling stage)	7.4	9.2	68.1	21.9	55.2	44.2
Convention factor ¹	1.03	0.99	2.7	2.4	1.3	1.1
Cost of food/kg of fish produced (\$)	0.89	0.90	1.32	1.42	0.67	0.72
Thermal units/year	5,433		3,962		6,877	

¹Conversion factor is the weight (kg) of food required to grow 1 kg of fish.

²A thermal unit is the sum of daily-average water temperatures above 0°C (32°F).

on Martin Mills feed than for those on Silver Cup. On the other hand, cost of food per unit weight of fish produced was slightly higher at two stations for Martin Mills than for Silver Cup. The significant differences recorded for some parameters between hatcheries (eg. length, weight and condition factor) are attributed to differences in temperature regimes. Yarmouth Hatchery experienced the longest growth period for fish (Table 16). Following detailed assessment of results of these trials, it was considered that the diets were very similar, and purchase of future supplies would depend mainly on feed costs.

In the spring of 1974, due to the increasing cost of dry fish-food ingredients, such as herring and soybean meal, the decision was made to experiment at one station with a moist diet composed of inexpensive local products. The diet trial commenced at Cardigan Hatchery in March, 1974, using as its main ingredient Silversides (*Menidia menidia*), a species very abundant in Prince Edward Island waters, as well as very inexpensive (8c/lb).

Four variations of the diet were fed, each being evaluated for growth, survival and condition of the fish. Unfortunately, the diet trial was terminated on November 22, 1974, after many fish developed "opaque" eyes, a condition currently under investigation by fish disease biologists. All diet-trial fish have

subsequently been converted to a commercially prepared diet.

Contributions to Fisheries

Assessment of contributions of Maritime hatchery-produced Atlantic salmon to fisheries and spawning escapement was continued in 1974, with the tagging and release of 48,000 smolts. Also, approximately 90% of the 491,890 smolts released were finclipped, to facilitate enumeration of adults returning to spawn.

The annual evaluation of smolt quality and condition, which includes examination of length, fin condition and physiological parameters, was again undertaken in 1974. The results of this year's assessment show a major improvement over those observed in each of the previous two years evaluated (Table 17).

Relationships of smolt size and age, with age at first maturity, as determined from an analysis of hatchery-reared smolt tagging data, were recently reviewed in a paper submitted to the International Council for the Exploration of the Sea. Data reviewed for groups of two-year hatchery-reared smolts indicate that the larger fish within a group produce proportionately fewer grilse than do the smaller fish.

Table 17. Quality comparison of Atlantic salmon smolts released from Maritime hatcheries, 1972-74.

Year	Number of smolts released	Percentage of smolts released				
		Fork length > 14.4 cm	Non-caudal fin index (<28.6%) ¹	Caudal fin index (<16.6%) ¹	Condition factor ≥ 0.9	Good quality smolts
1972	1,001,670	70.5	58.1	93.2	83.0	33.6
1973	643,700 ²	81.0	65.0	87.8	87.8	32.8
1974	491,890	85.1	81.0	93.4	92.3	56.5

¹Maximum percentage of missing fin material acceptable for "good" quality smolts.

²Only 288,070 smolts of this total were assessed for quality.

Similarly, the one-year smolts currently propagated in Maritime hatcheries produce markedly fewer grilse than do two-year smolts originating from the same stock. The conclusion of the review was that both these relationships reflect a common relationship between age at first maturity and variable growth rates within a salmon stock. This tends to suggest that selection practices in the hatchery, such as size grading, are influencing the age composition of spawning populations produced from hatchery stocks. Removal of the slower growing fish in a group, as is normally done through grading, is undoubtedly favoring the production of those smolts within a stock which are destined to mature at an older age. Natural selection occurring in wild populations may also be favoring either the slower or faster growing juveniles, and thus be contributing to yearly variations in age composition of individual adult populations.

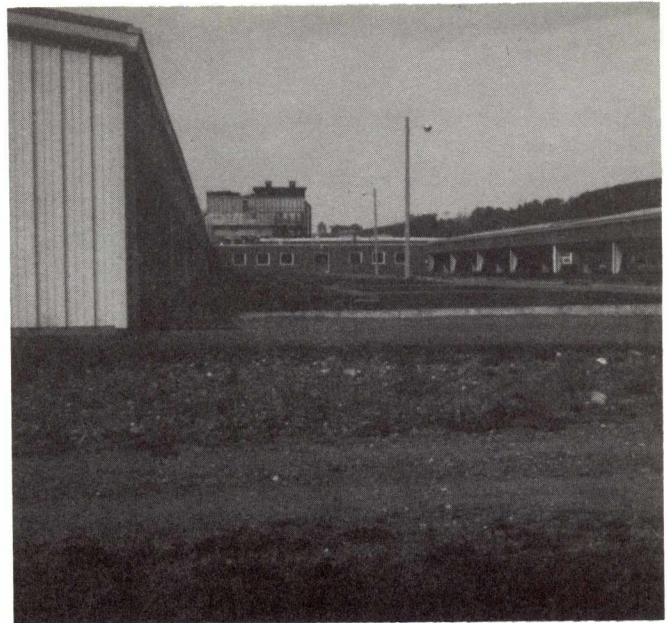
An analysis of tag-return data for one- and two-year hatchery-reared smolts suggests that the benefits derived from current one-year smolt stocking programs are low, compared to those derived from two-year smolt programs. One-year smolts released in the LaHave River, Nova Scotia, produce a low tag return to fisheries and spawning escapement (approximately one quarter that recorded for two-year smolts). Similarly, one-year smolts reared at Mactaquac Hatchery and released in the Saint John River, New Brunswick, returned at lower rates than did two-year smolts.

Despite the apparent low survival of yearling smolts currently produced in Maritime hatcheries, the results are inconclusive as to what benefits might be derived from a good yearling-smolt stocking program. Yearling smolts distributed by our hatcheries are small, and normally smoltify later than two-year smolts. Frequently, yearling smolts are liberated three or four weeks after two-year smolts have emigrated to sea. Thus, a comparison of tag-return rates for these two types is not a valid assessment of the true potential of yearling smolts that can be produced in Maritime hatcheries in the future. Following preliminary investigations which showed that Atlantic salmon could be reared to 17 cm in ten months after egg fertilization, small-scale tests are currently being undertaken to determine the most economical strategy for rearing high quality in one year.

Detailed information on contributions of specific hatchery-reared Atlantic salmon stocks are summarized in latter sections relating to the Restigouche, Miramichi, Saint John and LaHave rivers.

Public and Inter-Agency Relations

Hatcheries continue to be of high interest to visitors to the Maritime Provinces, as well as to local residents. This facet of operations provides a virtually unexploited opportunity to inform the general public of the functions of the Resource Development Branch. It is most unfortunate that tour guides have not been provided at those stations receiving large numbers of visitors. The 13 Maritime stations received 178,179 visitors in 1974, of which 23% were students, 15% were American citizens, 1% were foreign and the remaining 61% were from areas of



Mactaquac Hatchery, showing aeration tower in background.

Canada.

A general information pamphlet will be available in the spring of 1975 to assist the visiting public in understanding hatchery objectives. In addition, funds have been requested for a staffed information facility, to be located at Mactaquac Hatchery. Equipped with both live and static displays, the facility will depict the objectives of related management programs in the Saint John River basin. An information pamphlet, unique to this station, is also being prepared.

Assistance was provided to the United States Bureau of Sport Fisheries and Wildlife, through the collection of 250,000 Atlantic salmon eggs for their Connecticut River Salmon Restoration Program.

The Salmon Research Centre, St. Andrews, New Brunswick, held 89 Atlantic salmon broodstock in the adult holding ponds at the Mactaquac station in 1974, and utilized this station's spawning facilities in their egg collections.

An intensive investigation into the modes of transmission and infection of the Infectious Pancreatic Necrosis (IPN) viral disease is being conducted by the University of Guelph. To assist in this study, 600 speckled trout were transported by tank truck from Cobequid Hatchery to the University.

To assist in the commercial fish culture field, 200,000 speckled trout eyed eggs were sold to a commercial fish culturist in New Brunswick, and 300,000 rainbow and speckled trout eggs are being held for a new commercial fish culture venture in Nova Scotia.

The Cobequid Hatchery is currently rearing 57,000 Atlantic salmon, to be utilized by the St. Andrews Biological Station for sea-ranching experiments. These fish will be delivered as two-year smolts in the spring of 1976.

Cooperative tagging programs with the Province of New Brunswick have been continued this year, in an effort to assess contributions of hatchery-reared trout to fisheries in various lakes.

As in the past, large numbers of speckled trout

and Atlantic salmon were supplied to various universities, Parks Canada, provincial agencies and water quality and research units of Environment Canada. In 1974, a total of 209,000 speckled and rainbow trout and 38,311 Atlantic salmon, representing 6.6% and 1.8% respectively of the total numbers produced, were provided to these agencies.

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Hatchery Engineering and Construction

Apart from repairs and construction of new facilities at Mactaquac Hatchery, which is reported on in another section, Antigonish Hatchery was the only other station at which major construction was undertaken. The Atlantic salmon broodstock holding pond, which was started in 1973, was completed this year. The gravel-lined pond has a length of 88.1 m, a width of 10.7 m, and a depth of 2.1 m, with 2:1 side slopes. Water is pumped to the salmon broodstock



New salmon broodstock pond under construction at Antigonish Hatchery.

pond from a well, capable of supplying 680 liters per minute (150 gpm). A trout broodstock pond of similar dimensions will be constructed at Antigonish Hatchery early in the new year.

Awareness of safe working conditions within the 13 federal stations, and actions taken to correct potential safety hazards, were stressed during 1974. During the year, six employees of the junior and senior supervisory level attended a five-day government safety course. In addition, steps were taken to cover all of the wooden walkways near rearing ponds with non-skid paint. Problems with electrical short-circuits in several stations are under investigation and will be corrected when solutions are found. Handrails have been placed on all walkways in the area of station reservoirs, to prevent accidents which could result in drowning.

G. H. Jenkins, F. M. MacMillan and G. B. Robbins

Commercial Fish Culture

Commercial fish culture in the Maritimes Region is slowly gaining momentum, as indicated by the large number of requests for information and assistance in 1974. Six new farms were licensed by the federal Fisheries and Marine Service, including four freshwater and two saltwater establishments. However, most of the farms are relatively small operations, as private investors are still approaching this industry with caution.

Resource Development Branch staff provided input into development of a position paper on research and development needs for aquaculture in the Maritimes. The paper was prepared by the Halifax Laboratory, Research and Development Directorate, following a meeting with all provincial and federal government agencies involved with aquaculture in the Region.

The Resource Development Branch Marine Aquaculture Development Project with Atlantic salmon at Polly Cove, Nova Scotia, is attracting considerable attention, from both the public and professional sectors. This project has been visited by fisheries scientists from many parts of the world, including Japan, Germany, France, Scotland, England, the United States and many Canadian centers.

Studies at Polly Cove include the three basic factors that are most important in the field of marine aquaculture: (a) the biological and technical requirements for rearing salmonids in a confined saltwater environment, (b) design and testing of facilities and (c) observing environmental conditions within the rearing area.

Excellent professional support for this project has been provided by the scientific and technical staff of the Halifax Laboratory, who have been regularly monitoring physiology, pathology, biochemistry and hematology of fish, to assist in evaluation of health and determine progress in the experiment. The technical information accumulated from the monitoring program has provided invaluable data for development of fish-health and nutrition guidelines, and a more comprehensive understanding of the physiology of salmonids in a confined seawater environment.

Sixteen hundred Atlantic salmon from the 1973 program were carried over winter in the same nets and cages used for summer rearing. The growth rate and health of these fish have been excellent and, while the program received several severe setbacks, the trials definitely established that exceptional growth is possible in cage rearing of Atlantic salmon. The most serious loss occurred on August 7, 1974, when 326 of the largest fish that had been selected for broodstock were stolen. Average weight of these fish was 3.2 kg (7 lb) at that time. On March 4, 1974, 418 were also lost due to severe gill damage and suffocation, brought about by a prolific algal bloom that occurred during a severe winter storm. This is a common problem during late winter along the Atlantic coastline, and consideration will have to be given to using shore-based rearing facilities for over-wintering stocks to circumvent this problem. On December 3, 1974, one week before the salmon were to be killed for test marketing, a freak storm, that caused

extensive damage to fisherman's shore facilities in the St. Margaret's Bay area, also destroyed the two aluminum-frame wire-mesh cages, and one half (385) of the remaining salmon escaped. Three hundred salmon were killed in December and prepared for test marketing, to evaluate consumer response to the product. Fifty salmon will be carried through the second winter for further biological studies.

In April, 1974, 1,100 Atlantic salmon smolts (average weight 87 g) were selected from late-run River Philip stock and acclimated to salt water. These fish were transferred to Polly Cove in May and placed in seawater rearing pens. The growth of these fish has been excellent and surpassed the 1973 growth by approximately 20% (Fig. 13). Fish health and progress were monitored regularly throughout the growing season. In the final evaluation made in December, it was determined that 20% of these fish weighed 0.9 kg (2 lb), 60% weighed 0.9-1.3 kg (2-3 lb), 12% weighed 1.3-1.9 kg (3-4 lb), and 8% averaged 1.9-2.3 kg (4-5 lb). Total mortalities during

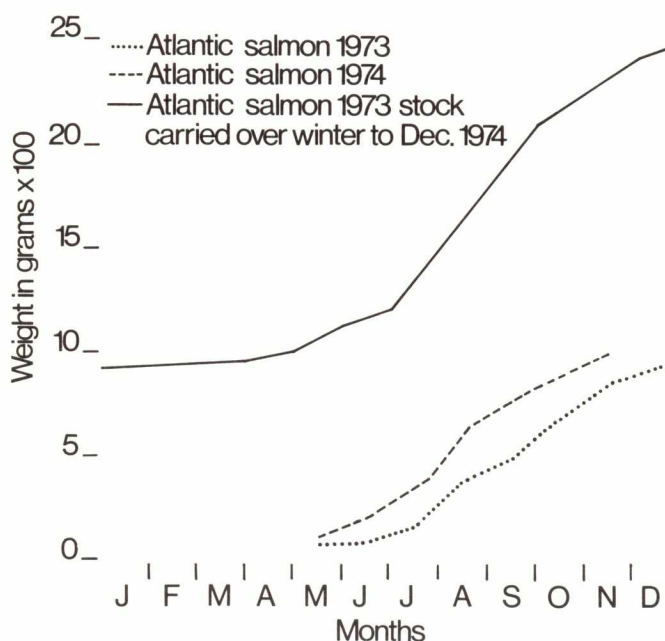


Fig. 13. Incremental growth rate of Atlantic salmon reared at Polly Cove, Halifax County, Nova Scotia.

transfer, acclimation and the summer growing cycle were 5.8%. One hundred and twenty fish were sacrificed for health evaluation, 150 were culled out in December (tagged and released at the site), 22 were sacrificed for bacteriological and parasitology checks and 145 were lost due to cage failure. Three hundred fish have been placed in saltwater shore-based facilities for wintering, and 300 will be wintered in net cages in the sea, to compare rearing success.

A very important part of the Polly Cove project has been the design and testing of rearing facilities and equipment. During the three years that the Resource Development Branch has been working in marine aquaculture, four types of holding facilities have been used at various times. These include: (a) P.V.C. frame and plastic-netting cages, (b) aluminum frame and vinyl-coated wire-mesh cages, (c) knotted nylon nets and (d) knotless nylon nets.

During a severe storm in Arichat Bay, the P.V.C.

plastic-netting cage disintegrated, and this type was discarded immediately. The aluminum frame vinyl-coated wire-mesh cages, while excellent units in which to hold fish, were all destroyed by heavy wave action in the second year of use. They are not recommended for areas where heavy currents or wave action in excess of six feet can be expected. The knotted nylon nets are very good, and can be substituted for the knotless units; however, the best unit is definitely the knotless nylon net. When these nets are hung with double-size floats and extra lead weights, they make an excellent rearing facility. No fish have been lost from the latter, even during storms with waves up to 12 feet.

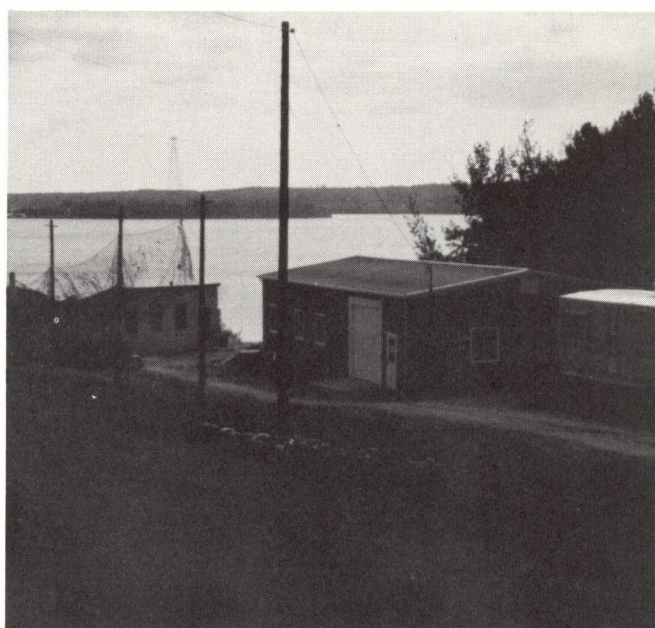
Consideration has been given to relocating facilities from Polly Cove to a new site, which would have better access, would be more suitable for onshore holding of salmon over winter, and would provide fresh water for acclimating stocks. A feasibility study will be undertaken during the winter of 1974-75 to locate a suitable site.

R. E. H. Macdonald

MIRAMICHI RIVER SALMON MANAGEMENT

During 1974, the Branch continued to expend a significant portion of its resources on managing the salmon stocks of the Miramichi River system. This river, draining approximately 14,170 km² (5,457 mi²) of east-central New Brunswick, has in past years supported the largest recorded commercial and sport fisheries for salmon in North America. Up until 1968, an average of 40,000 large salmon was taken by commercial fishermen each year and another 40,000 grilse and large salmon combined were taken by anglers.

Activities were again concentrated on assessing the effects of the commercial salmon-fishing ban and angling restrictions introduced in 1972. Data were collected on abundance, exploitation and migration



Resource Development Branch field station on Miramichi River estuary at Millbank.

of tagged adult salmon and wild smolt. Juvenile salmon abundance in the system was monitored and basic biological data, such as age, sex, average weight, length and condition, were also gathered.

G. E. Turner

Adult Abundance and Exploitation

The sampling trap on the Miramichi estuary (Millbank), operated each year since 1954, has provided an important index of adult salmon run strength each year. It was fished daily throughout the open-water season, or until upriver runs ceased each year in early to mid-November. In addition, the trap provided information on run timing, composition, exploitation (through tagging), and other stock characteristics (weight, length, sex). Data gathered at the Millbank sampling trap, as well as elsewhere, and analysed by Branch staff have had a significant

influence on formulation of commercial and sport salmon-fishing regulations.

The total catch of large salmon in 1974 (1,791) was the highest recorded since the commercial-fishing ban was instituted, but considerably below the average yearly catch of 2,677 for the period 1954-67 (Fig. 14). This represents the period from inception of trapping at Millbank to when the dramatic declines of late-run salmon were first noted. In 1974, the large-salmon component comprised 30.7% of the total catch at the sampling trap (Table 18).

The late-run catch (September-November) of large salmon in 1974 was 927, the highest recorded since 1968, but still well below the average for the 1954-67 period. The late run accounted for 52% of the total large-salmon catch in 1974, slightly lower than the 58% in 1973 and well below the 70% yearly average for the period 1954-67.

The 1974 grilse catch was 4,038 up 65% (1,588 fish) from 1973 (Table 18) and the best catch

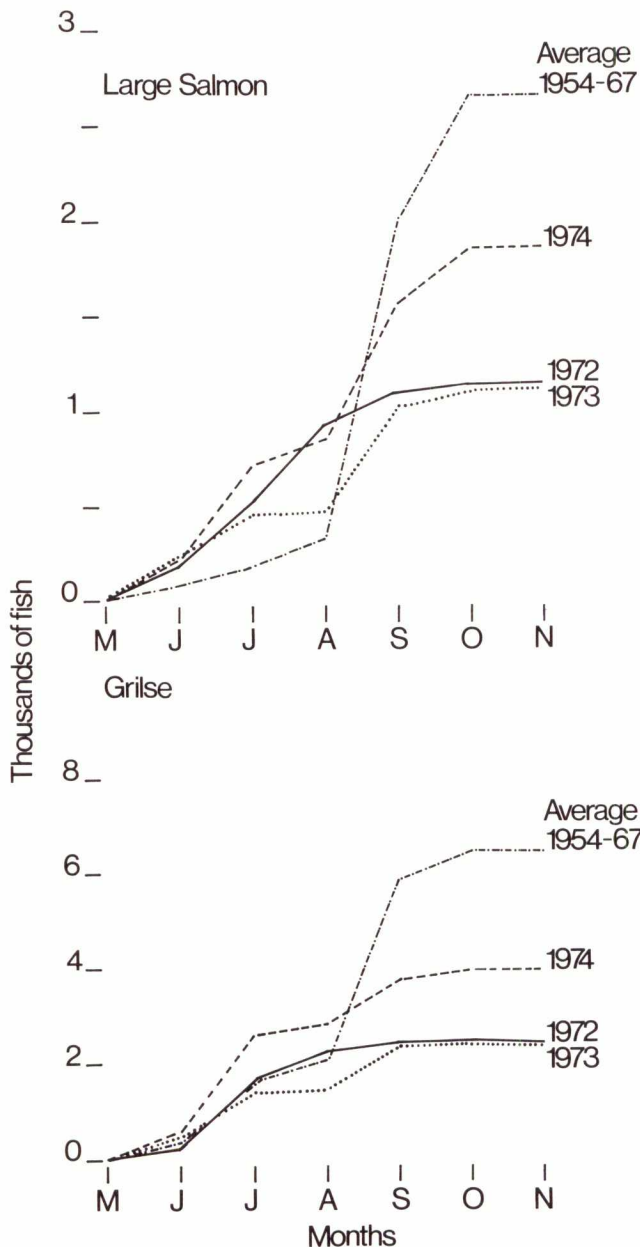
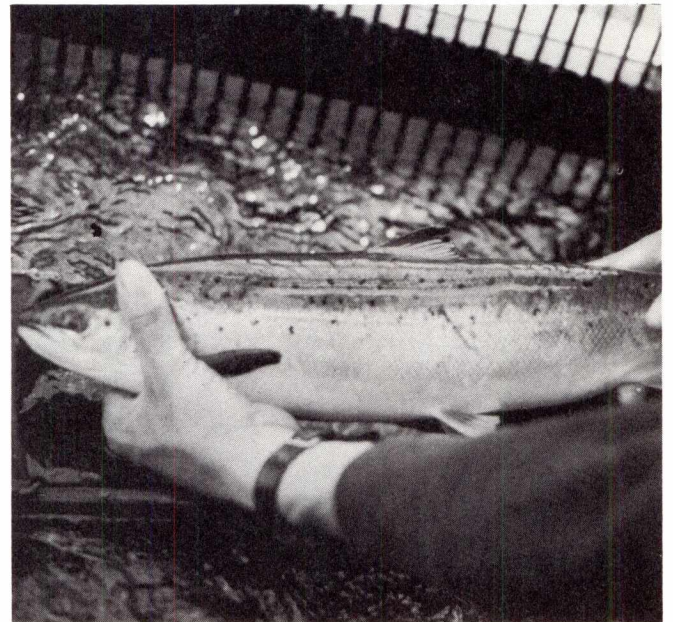


Fig. 14. Cumulative catch data, Millbank salmon trap, Miramichi River estuary.



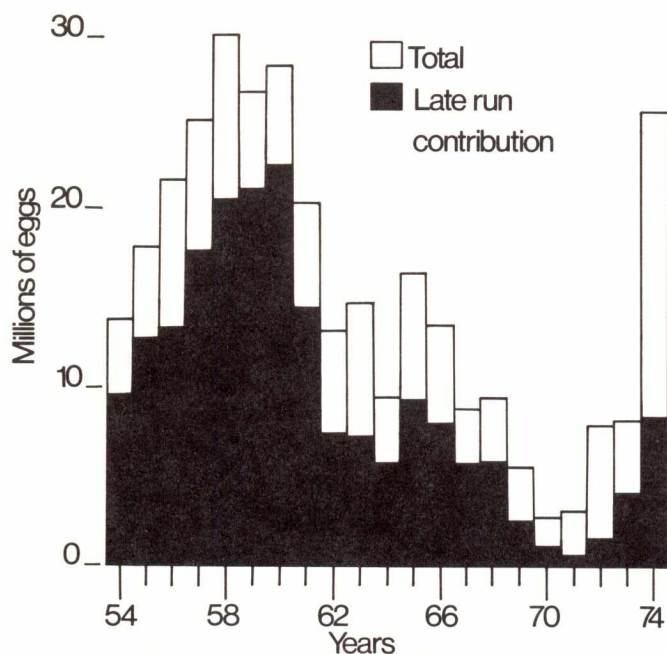
Grilse captured in Northwest Miramichi River.

recorded since 1969. This was still well below the average yearly catch for the period 1954-67 (Fig. 14). The late-run grilse in 1974 represented only 27% of the total grilse catch, down from 39.2% in 1973, and less than one third the long-term average between 1954 and 1967.

The average weight of large salmon at the sampling trap in 1974 was 5.5 kg (12.1 lb), as compared to 4.4 kg (9.7 lb) in 1973, while the average weight of grilse was 1.5 kg (3.4 lb), similar to that of 1973. The increase in average size of large salmon, coupled with the higher percentage of females (86%) and larger run size, resulted in a considerable increase in potential egg deposition at the trap over those levels calculated for 1972 and 1973. Potential egg deposition at the trap is considered an index of egg deposition in the total system. The 1974 level at Millbank, 17.4 million eggs, indicates that minimum requirements for the entire Miramichi system have been achieved. The late run

Table 18. Total sampling-trap catch and run-composition data, Miramichi estuary.

Year	Large salmon			Grilse		
	Annual catch	Catch per fishing day	Percent of total catch	Annual catch	Catch per fishing day	Percent of total catch
1954-60 av.	3,632	23.7	52.1	3,727	24.3	47.8
1961-70 av.	1,431	9.3	17.9	7,614	49.7	82.1
1973	1,132	7.1	31.6	2,450	15.3	68.4
1974	1,791	11.7	30.7	4,038	26.4	69.3

**Fig. 15.** Potential egg deposition to Miramichi River system of grilse and large salmon trapped at Millbank, 1954-74.

accounted for 50% of the potential egg deposition at the sampling trap, similar to that of 1973 (Fig. 15).

Table 19. Distribution and rates of recapture from wild-smolt tagging at Millbank in the Miramichi estuary, 1968-72. (Recaptures from smolts tagged in 1970-72 were affected by the commercial salmon-fishing ban, instituted on the Miramichi in 1972.)

Recapture location	Sea age at recapture (yr)	Year tagged and recaptures per 1,000 tagged				
		1968	1969	1970	1971	1972
Greenland	1	3.8	3.5	7.5	2.9	1.8
	2	0.6	0.3	0.4	0.1	—
Newfoundland	1	2.3	3.7	3.5	1.9	3.5
	2	2.3	4.4	0.9	1.7	1.8
	3	0.0	0.0	0.0	0.2	—
Miramichi system (home waters)	1	9.9	5.4	3.9	1.8	1.6
	2	13.4	3.1	2.3	1.7	2.1
	3	0.6	0.1	0.6	1.8	—
Miscellaneous	1	0.6	0.1	0.3	0.1	1.0
	2	0.0	0.2	0.2	0.3	0.7
	3	0.0	0.0	0.0	0.0	—
Total recaptures per 1,000 tagged		33.6	20.8	19.3	16.1	12.5
Total tagged		3,421	8,648	6,835	8,462	4,887

As in 1972 and 1973, returns from adult-salmon tagging at the sampling trap were almost exclusively from anglers. Calculated utilization rate, based on tags applied and actually available to the angler, was approximately 25% for the entire system. Late-run bright salmon are still utilized at a considerably lower rate than early-run (May-August), due to the reduction of the fall angling season.

G. E. Turner and E. J. Schofield

Smolt Abundance and Migration

Wild smolt studies begun in 1968 were continued in 1974, to provide information on population size, migration routes, migration timing and exploitation.

A total of 19,837 wild smolts was trapped, and 12,528 of these were tagged at three smolt traps. Two traps were located on the Southwest Miramichi and provided valuable population estimates. The third trap was located in the Miramichi estuary at Millbank, and provided continuity of data related to migration and exploitation, since it has operated in the same site since 1954.

Returns from wild-smolt tagging between 1968 and 1974 have given us considerable insight into

where and by whom our salmon are being harvested (Table 19). The two major distant-water exploitation areas have been Greenland and Newfoundland, and have accounted for up to 63% of total recaptures by all means from a single year's smolt tagging (1970). Recapture rates have decreased because of closure of the commercial fishery, beginning in 1972. Since 1972, home-water returns of tagged wild salmon have been almost exclusively from anglers.

Recapture rates in both Newfoundland and Greenland have varied considerably from year to year. This is considered to be a result of varying sea-survival rates and year-to-year variations in fishing pressure, particularly in Newfoundland.

Analysis of data on recapture timing in Newfoundland indicates that Miramichi 2-sea-winter salmon migrate along the east and south coasts earlier than do 1-sea-winter salmon. In all probability, a significant proportion of these 1-sea-winter Miramichi salmon are not destined to return to their home river as grilse.

G. E. Turner

Juvenile Salmon Abundance

Since 1968, juvenile salmon population densities in the Miramichi River system have been measured annually, with coverage increasing from 14 stations on selected tributaries to 98 stations on 29 streams in 1974. This year, electrofishing operations expanded into the Dungarvon and Sevogle rivers, and included a number of sites on the Northwest Miramichi River formerly surveyed by the Research and Development Directorate (Fisheries Research Board).

Average fry density in 1974 ($22.5/100\text{ m}^2$) was approximately one third higher than estimated for 1973 and was the highest recorded in the history of Branch studies on the system (Fig. 16). This reflects increased spawning escapement for the second successive year since the full commercial salmon-fishing ban was established and increased angling restrictions were introduced in 1972. Fry levels

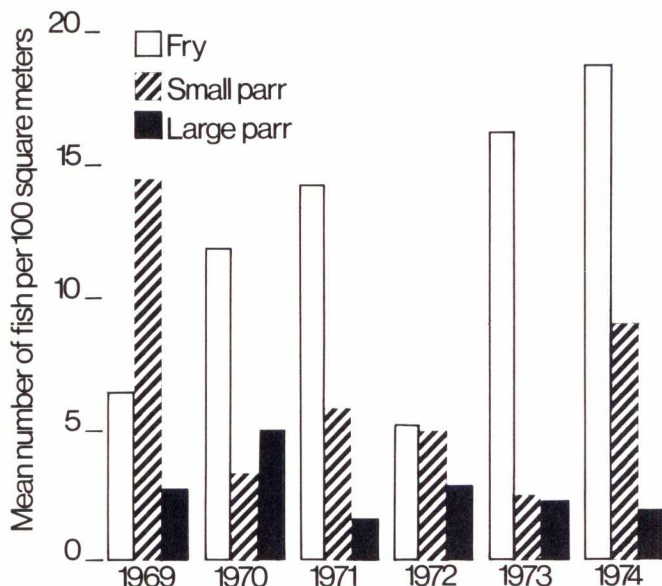


Fig. 16. Average yearly juvenile salmon densities for the Miramichi River system, 1969-74.

continue to approach the average density recorded on the Miramichi by the Fisheries Research Board in the 1952-61 period. Small-parr density ($10.8/100\text{ m}^2$) was approximately six times higher than estimated for 1973 and was the highest recorded since 1969. This, in turn, reflects the increased fry density determined for 1973. Large parr density ($2.3/100\text{ m}^2$) remained very low, as expected. The overall improvement in the 1974 Miramichi salmon parr population should result in increased adult-salmon runs beginning in 1976.

T. G. Lutzac

Black-Salmon Angling Mortality

Black-salmon angling began on the Miramichi in the 1930's. Between 1951 and 1974, the average number of black fish angled on the Miramichi approximated 9,000. These figures, however, do not represent the actual numbers of fish angled, since



Extracting a blood sample from a black grilse at Millbank.

current New Brunswick regulations permit hooking as many as five kelts daily, while only one of these may be retained. Studies done in 1973 at Curventon Fence on the Northwest Miramichi, by personnel from the Royal Victoria Hospital in Montreal, in cooperation with the Fisheries Research Board, suggested that many of the kelts angled and released may not have survived.

Preliminary studies on kelts in 1974 by Branch personnel, including trap netting, recording incidence of hook marks, blood lactic-acid analysis and tagging, gave no indication of short-term mortality (up to 5 days). It is hoped that tag-return data from distant-water fisheries and a full-scale program now being planned, including studies of hooked fish immediately after capture, will resolve the question of kelt survival in the angling fishery.

T. G. Lutzac

Hatchery Contributions

Approximately 34,000 salmon smolts and 73,000 fingerlings of Miramichi origin were stocked in the system in 1974 from the Miramichi Hatchery. Seventy-five percent of these smolts were distributed to the Northwest Miramichi, Tomogonops and Bartholomew rivers, while the remainder were allowed to run from the adult holding pond at the hatchery on the Northwest Miramichi.

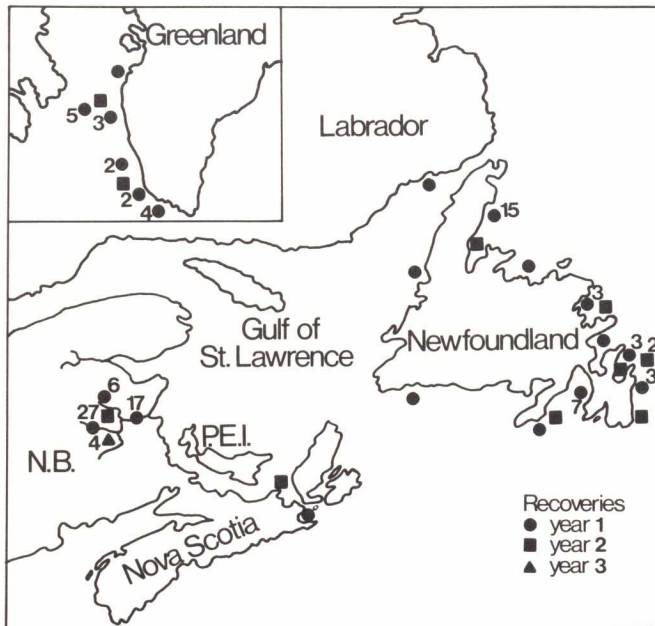


Fig. 17. Distribution of tag returns from groups of hatchery-reared smolts of Miramichi stock, released in the Miramichi River, New Brunswick, in 1971 and 1972.

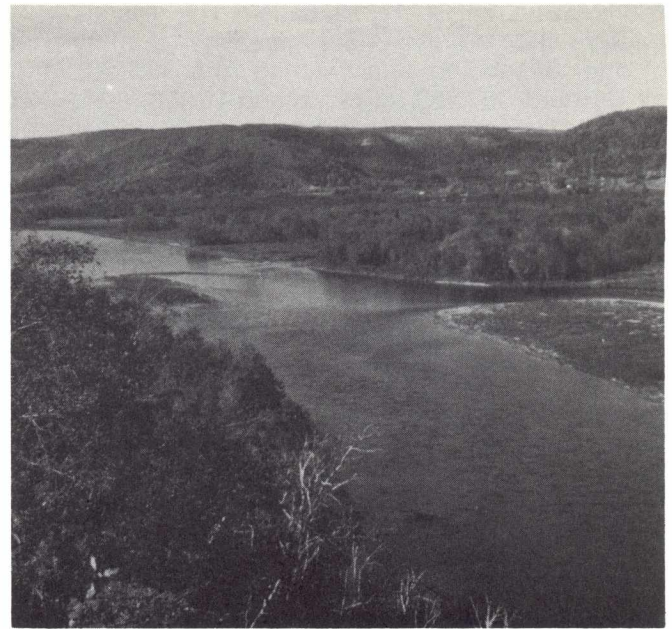
The use of hatchery-reared stocks to supplement natural salmon production in the Miramichi River has been evaluated in previous years by tagging portions of the smolt production released. Results of the tagging experiments suggest that the ocean distribution of Miramichi hatchery-reared stocks is at least superficially similar to that of the wild stock. Hatchery stocks appear to contribute heavily to the oceanic fisheries off the coasts of Newfoundland and West Greenland (Fig. 17).

T. G. Lutzac and J. A. Ritter

RESTIGOUCHE RIVER SALMON MANAGEMENT

The Restigouche River system refers to the complex of the rivers Restigouche, Kedgwick, Upsalquitch and Patapedia. Together, they account for about 456 river kilometers of salmon water and approximately 27% of the total drainage area in northeastern New Brunswick. The Restigouche River is a quality early-run salmon stream, the stocks of which are utilized extensively by sport and commercial fishermen. Before a commercial-fishing ban was imposed in 1972, the Restigouche River system was second only to the Miramichi in the production of Atlantic salmon in Canada.

The Resource Development Branch's biological investigations in the Restigouche were initiated in



Restigouche River at Morrissey Rock, near head-of-tide.

1972, to provide management data necessary to assess effects of the commercial-fishing closure, to predict the magnitude of future runs and to provide advice on the resumption of commercial fishing. Activities have paralleled those on the Miramichi, and have included adult salmon and smolt enumeration and tagging, and juvenile salmon population assessment.

J. L. Peppar

Adult Abundance and Exploitation

Enumeration and tagging of a sample of Restigouche River adult salmon continued in 1974, utilizing a Chaleur Bay floating salmon trap, set just

Table 20. Grilse and large-salmon catch statistics from the Restigouche sampling trap at Dalhousie, New Brunswick, 1973 and 1974.

Bi-monthly period	Total catch			
	Grilse		Large salmon	
	1973	1974	1973	1974
May 16-31	0	0	5	4
June 1-15	2	0	385	127
June 16-30	33	61	496	419
July 1-15	184	434	252	348
July 16-31	94	181	22	44
Aug 1-15	9	12	3	3
Aug 16-31	0	2	0	0
Sept 1-15	4	6	3	0
Sept 16-30	0	3	4	3
Oct 1-15	0	1	0	1
Oct 16-31	0	0	0	1
Totals	326	700	1,170	950

south of Bon Ami Rocks, Dalhousie. This trap allowed capture of both grilse and large-salmon components of the ascending run. During the period May 17-October 30, 950 large salmon (57.5%) and 700 grilse (42.4%) were captured (Table 20). Of these, 581 large salmon and 116 grilse were tagged and released.

Fifty percent of the total catch of large salmon in 1972 and 1974 was taken by June 27, whereas in 1973, the same point was reached by June 17. The 1974 large-salmon catch at the sampling trap was the lowest recorded since trapping began in 1972.

The grilse run peaked during the first 15 days of July, approximately 2 weeks later than the peak of the large-salmon run. The 1974 grilse catch was more than twice that recorded in 1973. This increase should be reflected in higher large-salmon runs to the Restigouche in 1975.

During the 1974 fishing period, 145 large salmon and 342 grilse were sampled for sex ratio, length and weight. Average fork length was 81.9 cm for large salmon and 54.2 cm for grilse. Average weights were very similar to those calculated in 1973, 1.6 kg and 6.1 kg for grilse and large salmon respectively. Large salmon were 67% female and grilse, 3.5% female.

Despite the slight increase in average weight, the lower percentage of females among grilse and salmon and the decrease in the large -salmon run in 1974 resulted in a lower potential egg deposition at the trap than in 1973.

Table 21. Sport-fishery recoveries of Restigouche River salmon, tagged as bright grilse or large salmon in 1974 at the Dalhousie sampling trap.

Recovery river	Grilse recoveries		Large salmon recoveries	
	No.	% of total	No.	% of total
Jacquet	0	0.0	1	2.5
Matapedia	2	22.2	9	22.5
Patapedia	2	22.2	1	2.5
Main Restigouche	3	33.4	17	42.5
Upsalquitch	1	11.1	10	25.0
Kedgwick	1	11.1	1	2.5
Little Main				
Restigouche	0	0.0	1	2.5
Total	9	100.0	40	100.0

As in 1972 and 1973, the most important area in terms of recaptures of tagged large salmon by sport fishermen was the Main Restigouche River (Table 21). In 1974, more grilse were also returned from the main river than from any tributary.

J. L. Peppar

Smolt Abundance and Migration

Wild-smolt tagging, initiated in 1973 to provide information related to migration routes, timing and exploitation rates, was continued in 1974. During the period May 26-June 21, 2,173 smolts were captured; 1,139 were subsequently tagged and released.

To date, five of the 771 wild smolts tagged in 1973 have been recaptured as 1-sea-winter salmon; all

were returned from distant-water fisheries. Greenland accounted for three of these fish and Newfoundland the other two. The timing of the Newfoundland recaptures off the Avalon Peninsula (early to mid-July) indicates that these fish were probably destined to remain at sea another year, rather than return as grilse to the Restigouche River.

J. L. Peppar

Juvenile-Salmon Abundance

Electroseining studies on juvenile-salmon populations of the Restigouche River system, initiated in

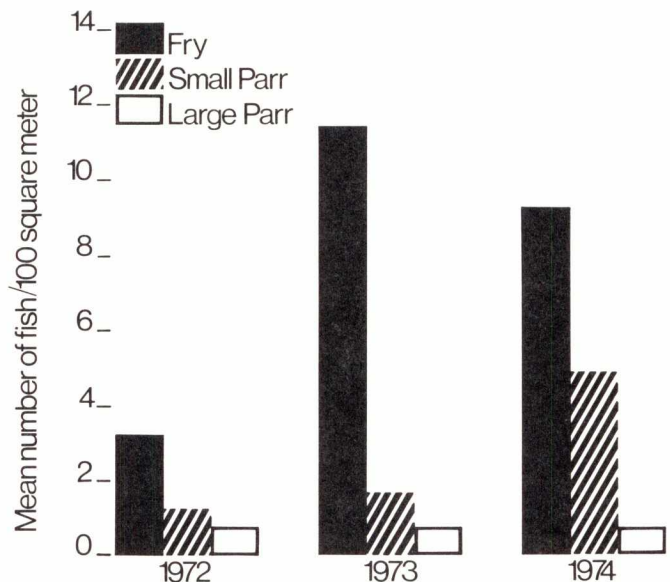


Fig. 18. Average yearly juvenile salmon densities for the Restigouche River system, 1972-74.

1972, were continued in 1974. Decreases in fry densities from 1973 levels were recorded for the majority of sites sampled this year (19.4% overall) (Fig. 18). The decreased fry levels are felt to be a result of the reduced large-salmon escapement to the



Measuring juvenile salmon, during electroseining operations on the Kedgwick River.

system in 1973. Large-salmon escapement in 1973, as recorded by the adult sampling trap, was down 24.8% from that recorded in 1972.

Small-parr densities determined in 1974 were up almost three-fold over levels recorded in 1973. These parr are the survivors of 1973 fry, or the 1972 adult escapement. Fry densities in 1973 were almost four times those recorded in 1972; thus, increased small-parr levels recorded this year are in the order of magnitude expected.

Large-parr densities in 1974 were comparable to the low levels recorded in 1972 and 1973, as expected, and indicate that adult-salmon runs to the Restigouche will remain relatively low over the next two years.

J. L. Peppar

Hatchery Contributions

Approximately 23,000 salmon smolts of Restigouche origin were stocked in the system in 1974 from the Charlo Hatchery. Little Main Restigouche, Main Upsalquitch and Southeast Upsalquitch rivers received these smolts in almost equal proportions.

The benefits of a hatchery stocking program, which has been in progress on the Restigouche River for several years, are being assessed. Results of tagging experiments indicate that a large portion of the hatchery-reared stocks liberated in the Restigouche migrate to distant feeding grounds off the coasts of Newfoundland and West Greenland (Fig. 19). Tag-return data show an unfavourable picture

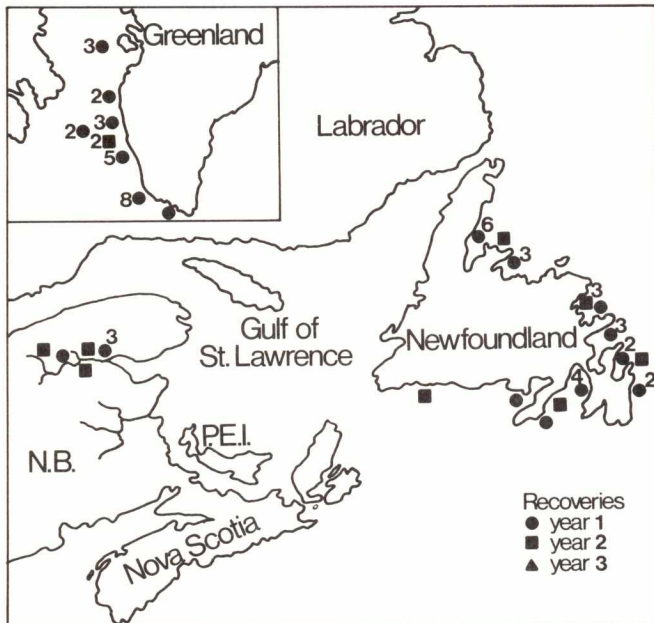


Fig. 19. Distribution of tag returns from groups of hatchery-reared smolts of Bay of Chaleur stocks, released in the Restigouche River, New Brunswick, in 1971 and 1972.

with respect to the distribution of benefits from hatchery stocks released in this river. The distant oceanic fisheries of Newfoundland and Greenland accounted for 95% of all tags returned from fisheries for hatchery-reared smolts released in 1971 and

1972. Prior to 1972 and the imposition of the ban on commercial fishing in New Brunswick and Quebec, the same distant fisheries accounted for 78% of the tags returned from hatchery stocks liberated in 1967, 1968 and 1969.

J. L. Peppar and J. A. Ritter

FISHERY RESOURCE SURVEYS — NORTHEASTERN NEW BRUNSWICK

In order to more closely assess the anadromous fisheries resources of northeastern New Brunswick for both their management and enhancement potential, surveys were carried out on potential salmon streams of the area. Commercial smelt and alewife fisheries were also examined. Data collected should aid in determining the direction of Branch efforts in these areas over the next few years.

G. E. Turner

Stream Surveys

Stream surveys included examining relative salmon rearing potential and documenting major stream obstructions and basic water chemistry. During the period September-October, 1974, 197 sites were examined on 91 streams.

Commercial Smelt Fishery

Sampling of commercial fishermen engaged in a winter ice fishery for smelt was conducted over the period January-April, 1974, in Restigouche and Northumberland counties (Fisheries Statistical Districts 63, 70, 71 and 73). The fishery was pursued with both bag nets and box nets in Restigouche County, and box nets only in Northumberland County. Nets checked in the Restigouche River and estuary and Chaleur Bay were restricted to those licensed in New



Fishing a commercial smelt box net, in the New Mills area of Chaleur Bay.

Brunswick. The survey included visits to the fishing locations and/or fishermen's homes. Data were obtained on catch and effort, and samples were secured for laboratory analysis, including determination of age, sex, average weight and length. Total catch estimates for the respective gear-types were derived from catch and effort data obtained from the fishermen.

In Restigouche County, a total of 202 trap visits was made on 34 survey days. It was estimated that a total of 91,781 kg (203,957 lb) of smelt was taken from Restigouche County waters, 83,863 kg (186,361 lb) from bag nets and 7,918 kg (17,596 lb) from box nets. Total landings from District 63, as reported by Statistics Canada, were 78,930 kg (174,400 lb). This figure represents only 85% of the catch estimated by field-sampling techniques.

In Northumberland County, data were collected from 194 trap visits over 55 fishing days. It was estimated that commercial fishermen took a total of 324,821 kg (716,112 lb) of smelt. Statistics Canada records for the three districts involved (70, 71 and 73) indicate that landings totaled 257,527 kg (567,753 lb) or only 79% of the winter-survey estimate.

Commercial Alewife Fishery

Thirty-nine commercial alewife traps, associated with the Tracadie, Pokemouche, Miramichi, Black, Baie du Vin, Eel, St. Louis, St. Charles, Richibucto, Buctouche, Cocagne, Shediac and Scoudouc rivers of eastern New Brunswick, were monitored continuously over the fishing season for catch and effort data, and samples were taken periodically for biological analysis. The commercial gaspereau sea-



Approximately ten barrels of commercially-caught gaspereau.

son opened on May 15, except in the Miramichi River, Miramichi Bay and streams tributary to the Bay, where it opened on May 12. The season closed on June 15 in the Miramichi area, June 22 in Kent and Westmorland counties and July 5 in Gloucester County.

Data collected from the 39 traps, plus information on the fishery in general (with respect to total units of effort expended over the season), were used to derive a total catch estimate for the fishery in the Statistical Districts sampled (67, 68 and 71-78). It was estimated that a total of 2,717,544 kg (5,991,192 lb) of alewives was landed here. Total landings reported by Statistics Canada for the same area were 1,084,404 kg (2,390,713 lb). The 39 traps monitored, comprising about 20% of the total number of traps fishing over the season, actually caught a total of 452,474 kg (1,019,586 lb) or about 43% of the total landings recorded by Statistics Canada.

T. G. Lutzac and J. L. Peppar

SAINT JOHN RIVER SALMON PROGRAM

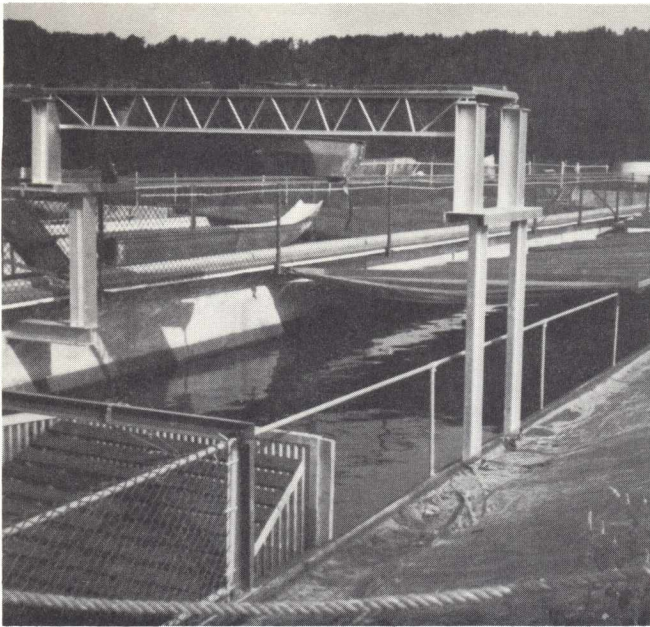
In 1974, the Resource Development Branch continued to obtain data on the size and composition of the Saint John River salmon run, on the spawning escapement and on the juvenile population. Fishery officers of the Conservation and Protection Branch again provided information on local exploitation by anglers and commercial fishermen. Such basic data are required yearly, to provide sufficient comparative information to evaluate past management practices, and to assess and recommend measures to ensure adequate future runs. In 1974, Resource Development Branch activities again included adult trapping and tagging in the lower estuarial area. Total adult counts were obtained just above head-of-tide at Mactaquac, where each fish was carefully examined before selection for hatchery broodstock or transfer upriver for spawning. A complete count was also made at Beechwood fishway and electrofishing was expanded to include major tributaries of the estuary below the Nashwaak River.

M. R. Robertson

Adult Abundance, Exploitation and Migration

Adult salmon studies on the Saint John River are designed primarily to determine the numbers of adult salmon and grilse entering the river. Those fish not harvested by estuarial angling or commercial fisheries and not ascending estuarial tributaries are collected at the first main stem hydro-dam (Mactaquac). A relatively small number of fish are retained for hatchery broodstock, and the remainder are trucked to selected upstream locations, where they should reproduce most effectively to perpetuate the run.

A brief account of 1974 adult studies and preliminary results, along with those of 1973, and some previous comparisons and information, follows. Conservation and Protection Branch angling-catch figures (Table 22) and other local harvest information are also presented.



Holding ponds for adult salmon broodstock at Mactaquac Hatchery.

Table 22. Saint John River salmon angling catch, 1973 and 1974.

Location	Salmon		Grilse		Total	
	1973	1974	1973	1974	1973	1974
BRIGHT FISH						
Above Mactaquac						
Tobique River	176	549	206	127	382	676
Main stem	47	157	157	176	204	333
Below Mactaquac						
Nashwaak River	1,279	576	215	175	1,494	751
Kennebecasis and Hammond rivers	82	87	19	194	101	281
Main stem	43	250	50	62	93	312
Totals	1,627	1,619	647	734	2,274	2,353
BLACK FISH						
Below Mactaquac						
Nashwaak River	52	42	40	22	92	66
Kennebecasis and Hammond river	0	0	0	9	0	9
Totals	52	42	40	31	92	75

Westfield Trapping

For the third successive year, adult trapping and tagging operations were carried out in the lower estuary near Westfield. The operations were designed primarily to obtain, by tagging and recovery, an estimate of the number of adult salmon passing the tagging points. All fish caught in the tagging traps and not bearing a tag from previous captures were tagged. In addition to the primary objective of a

population estimate, information was collected on run timing, salmon and grilse proportions, sex, size, age and returns of previously tagged and marked fish. Subsequent recovery at upstream locations, also provided information on the travel time and distribution of fish.

In 1974, a total of 4,135 fish was tagged, of which 1,485 were large salmon and 2,650 were grilse, compared with 1,693 fish in 1973 (947 salmon and 746 grilse). A population estimate from the 1974 operations at Westfield (using the Schaefer mark/recapture technique) ranged from 22,000 to 24,000 fish (13,000-15,000 in 1973).

Of the tagged fish released at Westfield in 1974, about 41% were later recaptured at upstream traps and by anglers. Of those tagged and released in 1973, 46% were later captured upstream (Table 23).

Table 23. Percentage recovery of fish released at Westfield in 1973 and 1974.

Recovery location	Percent recovered	
	1973	1974
Mactaquac Dam and migration channel	27.4	37.1
Nashwaak River trap	14.6	— ¹
Angling — Nashwaak River	2.8	2.0
Angling — (Other than Nashwaak)	0.6	1.5
Others	0.6	0.7
Totals	46.0	41.3

¹Trap not operating in 1974.

Critical examination of mark/recapture data, utilized in estimating the number of salmon passing Westfield on the Saint John River estuary for the period 1972-74, has revealed the need for greater understanding of trap selectivity and salmon behavior, for proper interpretation and conduct of that salmon sampling program. It was discovered that trap selection may occur for either large salmon or grilse, depending on fishing location. Existence of this factor was suggested by the consistently higher proportions of large salmon captured in Long Reach tagging nets than in recapture traps fished 5-6 miles further upriver. Differences in the numbers of tag returns from recapture traps on opposite sides of Long Reach emphasized possible incomplete mixing of tagged and untagged fish in the intervening 5-6 miles of estuary, which jeopardized the accuracy of population estimates based on an assumption of complete mixing.

Behavioral differences between large salmon and grilse, and between hatchery and wild components, suggested the preferable treatment of four data sets rather than a pooled one. For example, tagged wild large salmon and grilse had a greater tendency to stray downriver from the tagging nets than did fish of hatchery origin. Rates of movement of large salmon and grilse from tagging to recapture sites were especially different in 1973. In 1974, maximum estimates of downriver straying, tag loss and mortal-

Table 24. Summary of salmon and grilse catches in the Mactaquac area, 1973 and 1974.

Origin	Dam		Channel ¹		Total		Total fish
	Salmon	Grilse	Salmon	Grilse	Salmon	Grilse	
1973							
Hatchery	514	1,621	27	209	541	1,830	2,371
Wild	2,309	1,766	10	14	2,319	1,780	4,099
Totals	2,823	3,387	37	223	2,860	3,610	6,470
1974							
Hatchery	1,828	2,485	61	1,258	1,889	3,743	5,632
Wild	4,801	3,400	5	9	4,806	3,409	8,215
Totals	6,629	5,885	66	1,267	6,695	7,152	13,847

¹Inoperative Aug. 30-Oct. 12, 1973.

ity for large salmon and grilse of hatchery origin in the Long Reach area varied from 20% to 30%. However, percentage losses for various tagging periods were relatively constant for grilse, but were greater for salmon towards the latter part of the season.

Mactaquac Area

Catches in the Mactaquac area (dam and hatchery migration channel) in 1974 were more than double those of 1973, although salmon:grilse ratios were about equal (Table 24). About 50% of the total grilse run to Mactaquac for both 1973 and 1974 originated from hatchery operations, while the hatchery component of the large salmon run increased from 19% in 1973 to 28% in 1974.

In addition to salmon and grilse catches at the Mactaquac Dam and the hatchery migration channel, the local Kingsclear Indian Band were given food-fishing privileges in Saint John River waters adjacent to their reserve, located between Mactaquac Dam and Mactaquac Hatchery. Fishery officers of the Conservation and Protection Branch reported the Indian catch at 140 salmon, taken during September



Recovery trap for salmon returning to Mactaquac Hatchery release channel.

Table 25. Distribution of salmon and grilse from Mactaquac Dam and hatchery migration channel, 1973 and 1974.

Location	Salmon		Grilse		Totals	
	1973	1974	1973	1974	1973	1974
Broodstock	197	253	34	0	231	253
Headpond above dam	130	0	223	0	353	0
Woodstock area	1,191	1,619	1,763	2,547	2,954	4,166
Tobique River	1,295	4,382	1,543	3,919	2,838	8,301
Nackawic River	0	98	0	112	0	210
Becaguimec River	0	48	0	155	0	203
Shikatehawk River	0	69	0	34	0	103
Salmon River	0	212	0	317	0	529
Released below dam	13	0	35	0	48	0
Mortalities	34	14	12	68	46	82
Totals	2,860	6,695	3,610	7,152	6,470	13,847

and October.

Area Above Mactaquac

The distribution of salmon from the two Mactaquac collection facilities was undertaken in 1974 in accordance with the estimated egg requirements for various spawning and rearing areas (Table 25). Adult spawners were placed directly into tributary streams such as the Nackawic, Becaguimec, Shikatehawk and Salmon rivers.

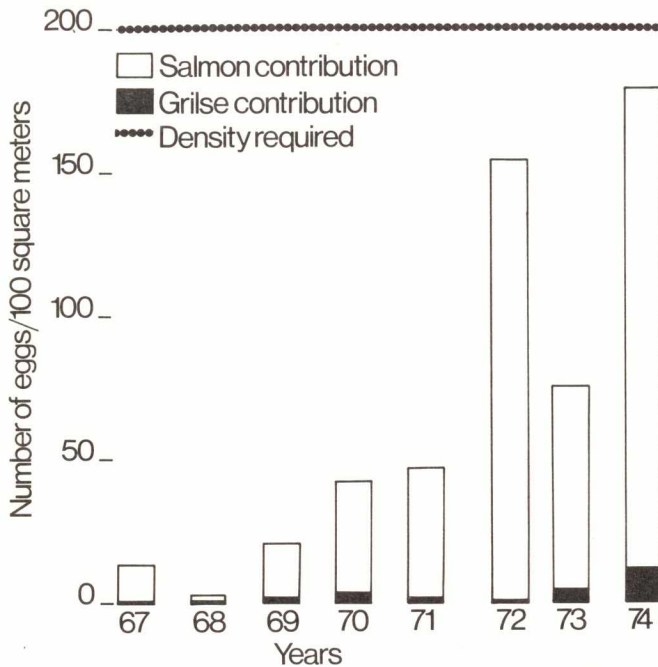


Fig. 20. Atlantic salmon egg deposition per unit of area, Saint John River above Mactaquac, 1964-74.



Overall view of fish lift facilities at Beechwood Dam.

Of the adult salmon and grilse available to ascend the Beechwood Dam, located approximately 135 kilometers upstream from the Mactaquac Dam, 34% and 44% passed over in 1973 and 1974 respectively. The annual average for the period 1967-74 inclusive is 27%. Transportation of greater numbers of fish to Woodstock increases the proportion ascending Beechwood Dam.

Since the completion of Mactaquac Dam in 1967, distribution of fish to the various areas above has been accomplished by trucking, mainly to the main stem at Woodstock and to the Tobique River. Since the numbers of fish trucked to each area and the

Table 26. Estimates of fry and parr densities per 100 m² in Saint John River tributaries in 1973 and 1974.

Location	1973			1974		
	No. of sites	Fry	Parr	No. of sites	Fry	Parr
Above Mactaquac						
Salmon River	0	—	—	2	0.1	1.0
Tobique River	15	12.1	2.9	15	4.8	3.5
Shikatehawk River	3	36.6	9.6	3	21.5	41.0
Becaguimec River	5	70.2	2.6	5	6.4	16.1
Mean	23	28.0	3.7	25	6.7	10.3
Below Mactaquac						
Keswick River	5	17.3	2.5	5	46.0	10.0
Nashwaak River	10	16.1	4.9	10	28.3	8.6
Little River	0	—	—	1	5.2	0.4
Gaspereau River	0	—	—	1	4.8	3.7
Salmon River	0	—	—	2	61.6	17.0
Belleisle Creek	0	—	—	1	5.5	4.0
Kennebecasis River	0	—	—	2	43.9	1.4
Hammond River	0	—	—	2	39.5	8.0
Nerepis River	0	—	—	2	13.8	5.3
Mean	38	23.4	3.8	51	19.9	9.2

numbers ascending Beechwood are both known, approximate spawning potential can be calculated by subtraction of the reported angling catch. This potential can be calculated separately for the area between Mactaquac and Beechwood dams and for the area above Beechwood, primarily the Tobique River system. In 1974, potential egg deposition above Mactaquac reached the highest level in recent years. It was, however, about 20% short of the level considered necessary for maximum production (Fig. 20).

G. H. Penney and Dr. T. L. Marshall

Juvenile Abundance

Sampling is carried out on various tributaries of the Saint John River each year to obtain quantitative and qualitative information on juvenile salmon. This information can be related to success of a previous spawning escapement or egg deposition in various



Typical view of upper section of Nashwaak River, New Brunswick.

sections of the river. The estimates are a useful aid in forecasting general levels of adult returns and in planning distribution of adult spawners.

In 1973 and 1974, densities of fry (young-of-the-year) and parr were determined by electrofishing at established sampling sites throughout the system (Table 26). In 1974, 11 additional sites were selected in the lower estuarial tributaries below the Nashwaak River. Sampling is generally conducted during the July-September period, at which time fry are large enough to sample easily.

Electroseining results are not always precise indicators of fry and parr abundance in a tributary or system, due to factors such as water conditions at time of sampling, and local movements of juveniles in response to changing water levels and temperatures. The estimates do, however, indicate year-to-year differences in relative production throughout the system, and can be related generally to a known

spawning escapement and survival of year-classes in various sections of the river.

Where comparisons are available for the past two years, 1974 fry and parr densities below Mactaquac were considerably greater than those of 1973. Fry densities above Mactaquac in 1974 were, however, much lower than those found in 1973. Parr densities above Mactaquac in 1974 reflected favourably the relatively high fry densities of 1973.

G. H. Penney

Hatchery Contributions

Hatchery stocking to supplement the natural salmon production on the Saint John River continues to be successful. The number of hatchery-produced returns to the river has been steadily increasing (Table 27).

Table 27. Wild and hatchery-reared adult salmon returning to Mactaquac Dam, 1970-74.

Year of return	Wild		Hatchery		Total run
	Number	Percent	Number	Percent	
1970	5,187	98.2	94	1.8	5,281
1971	3,837	91.1	373	8.9	4,200
1972	5,686	87.2	838	12.8	6,524
1973	4,099	63.4	2,371	36.6	6,470
1974	8,215	59.3	5,632	40.7	13,847

A noteworthy feature of the 1974 adult salmon run was that 1,333 fish migrated to the hatchery migration channel. Ninety-nine percent of those were fish which had been reared in the hatchery.

Analysis of adult salmon runs to Mactaquac Dam shows that the hatchery-reared stocks are generally producing proportionately more grilse returns than are the wild stocks. In recent years, the percentage of one-sea-year fish produced by a given brood year has been relatively constant for wild stocks but quite variable for hatchery-reared stocks (Table 28).

Survival rates of hatchery-reared smolts released into the Saint John River have improved markedly (Table 29). Smolts from the 1973 release yielded approximately four times as many one-sea-year fish

Table 28. Comparison of one-sea-year returns to Mactaquac, from wild and hatchery-reared fish of the 1968-72 smolt year-classes.

Smolt year-class	Percentage of one-sea-year returns	
	Wild	Hatchery
1972	28	51
1971	27	28
1970	27	36
1969	57	72
1968	53	N/A

Table 29. Summary of adult returns to Mactaquac from all hatchery-reared smolts released into the Saint John River.

Year of release	Number released	% return to Mactaquac		
		1-sea-winter fish	2-sea-winter fish	Total
1969	170,182	0.05	0.02	0.08
1970	412,860	0.08	0.15	0.23
1971	352,933	0.07	0.15	0.22
1972	683,646	0.26	0.26	0.52
1973	362,000	1.00		

to Mactaquac as did those from the 1972 release. Tag returns to date parallel these results, since recovery rates in fisheries and at Mactaquac of one-sea-year-fish from 1973 smolts were approximately ten times those from 1972 smolts.

Analysis of tag-return data for smolts released in the Saint John River is providing information on the ocean distribution and exploitation of hatchery-reared stock. The pattern of tag returns from ocean fisheries shows that at least a portion of the hatchery-reared fish migrate to distant feeding grounds off the coasts of Newfoundland and West Greenland (Fig. 21). Of the total recovery from 1971 and 1972 releases of hatchery-reared smolts, approximately 18.5% were harvested in these distant waters.

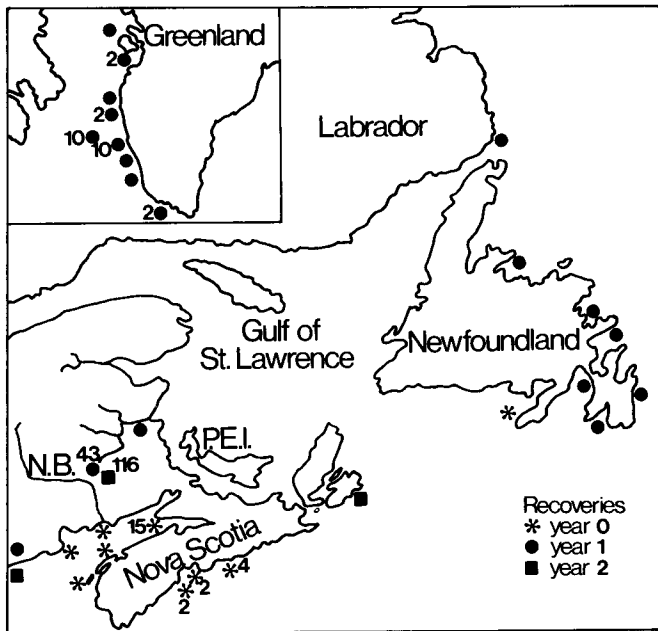


Fig. 21. Distribution of tag returns from groups of hatchery-reared smolts, released in the Saint John River, New Brunswick, in 1971 and 1972.

Therefore, the proportion available to fisheries and spawning escapements in Maritime waters (81.5%) is high and favourable, compared to those estimates derived for groups of hatchery-reared smolts of other Maritime stocks released in their native waters (Fig. 22).

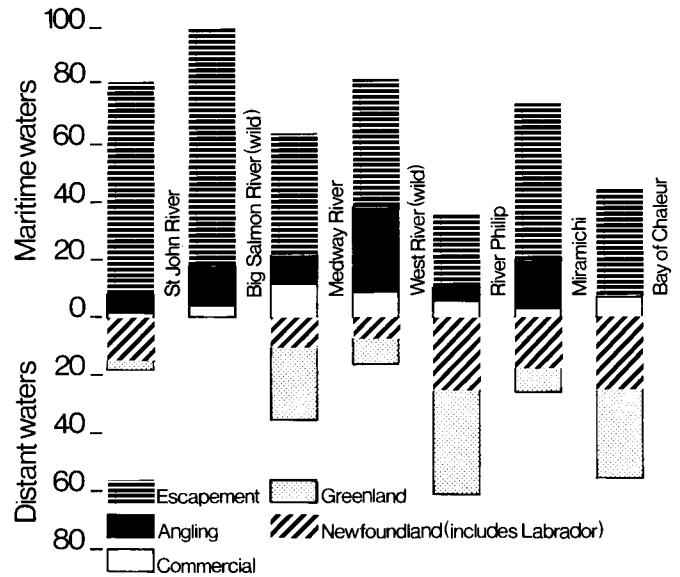


Fig. 22. Estimated contributions to fisheries and spawning escapements of seven hatchery-reared stocks, distributed in native waters in 1971 and 1972.

J. A. Ritter

Engineering and Facilities

At the Mactaquac Hatchery, a heating/recirculation system for the incubation water supply was designed and installed in 1974. Also, a new built-up roof was provided for the main hatchery building, to replace the original construction which had failed prematurely.

A consultant was retained to prepare a report on modifying the aeration tower to achieve better removal of supersaturated nitrogen from the river-water supply. In view of the projected high cost, a re-design was requested.

Design of a new 3,000 Imp. gal fish-transportation tanker was completed. The aluminum tank was fabricated and installed on a new truck. However, extended delays in delivery of some elements of the life-support system prevented the unit from being put into service in 1974 on the 200-km run from Mactaquac to the Tobique River.

A new release site was selected on the Tobique River, because of the need for deeper receiving water and a farther upstream release point. Development work was carried out in preparation for use of the new site next year.

Design work is in progress on an expansion of the secondary sorting facilities at Mactaquac Hatchery. This expansion is considered necessary to accommodate anticipated increased salmon runs in future seasons.

G. H. Jenkins

SALMON DEVELOPMENT

Many areas of the Maritimes have the potential to support anadromous fishes. However, there are rivers where, due to lack of fish passage or greatly depressed stock levels, management regulations alone will not increase populations. It is in cases such

as these that a fully integrated program, involving several Branch units, is required to increase the resource base. Biologists must assess the potential for enhancement and engineers must determine the feasibility and costs of fish passage. Following the decision to construct new fish passage facilities, selection of a stock must take place, one which will return to the right place at the right time, with the correct age and size of adult return spawners. After this phase, fish culture staff must collect broodstock and rear the necessary smolts for the initial plantings, which will start the river on the road to producing a self-sustaining salmon population.

During such activities, experiments may be carried out by tagging juvenile fish, to determine contributions to distant fisheries, such as Greenland. Different rearing practices may be tried to produce different types of returning fish, and juvenile densities will be measured to determine the spawning success in the wild of the returning hatchery-produced fish.

The projects outlined below are examples of every stage of this process, from the planning stage (Tetagouche River) to the final assessment stage (LaHave River and East River), and illustrate the multidisciplinary approach used in this aspect of the Branch's activities.

M. R. Robertson

Long-Term Planning

In 1974, preliminary steps were taken to define the extent to which the "enhancement" of Atlantic salmon stocks is possible in the Maritimes. Using various methods, the current potential of Maritime watersheds was determined, the reasons for under-production were identified, and estimates of fish passage and hatchery costs required to increase salmon stocks were made.

Although many of the dams built towards the end of the 1800's are now gone (Fig. 23), there is still a sizable proportion of Maritime rearing area which currently is not being fully utilized for salmon

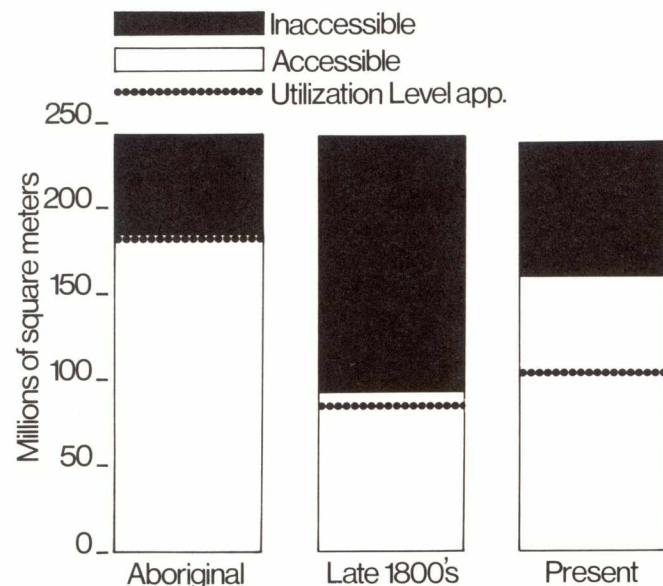


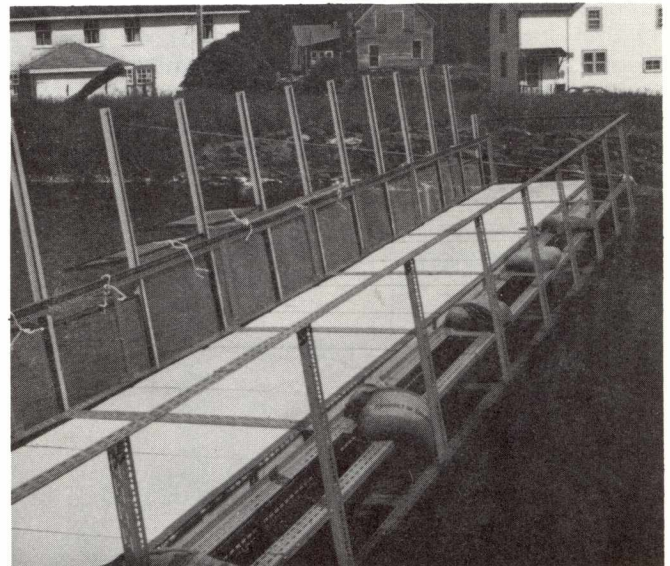
Fig. 23. Approximate historical and present accessibility and use of Maritime salmon rearing area.

production. In some areas, the problem lies in poor or non-existent fish passage, while low stock levels in other areas are preventing the re-establishment of populations. Overall, approximately 33% of Maritime rearing area is currently inaccessible to salmon. This has the potential to produce 470,000 fish annually when fully developed. Present hatchery-production capabilities, however, are considerably below the levels needed to begin a larger-scale enhancement program. The main enhancement potential lies in the Saint John and Nepisiguit rivers in New Brunswick, and smaller systems such as the Liscomb, Tusket, Mersey and LaHave in Nova Scotia. The estimated cost of a development program to utilize all Maritime salmon-producing areas is \$2.6 million per year, over a 20-year period.

M. R. Robertson

East River

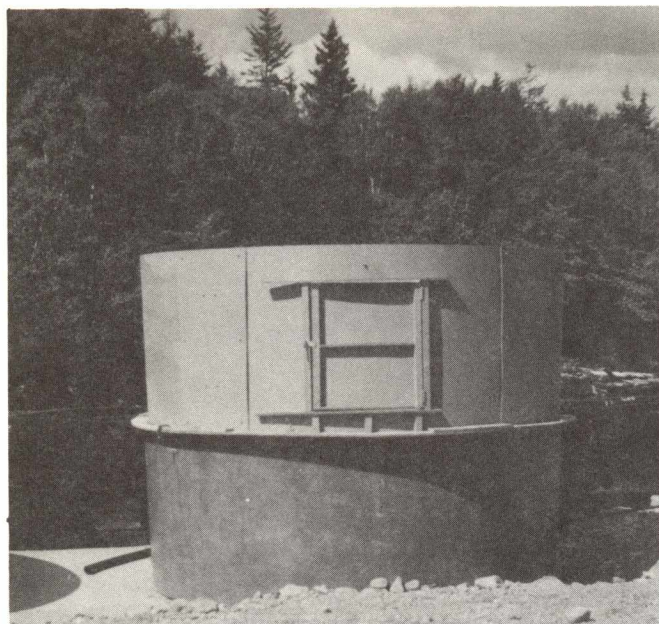
The East River salmon development project on Nova Scotia's eastern shore was initiated in the mid-1960's, in response to a rapid decline in the



Floating-screen smolt deflector across power canal, above Malay Falls, East River Sheet Harbour.

salmon population resulting from intensive hydroelectric power development. Downstream fish passage facilities were constructed at two dams, for the purpose of guiding smolts away from the turbine intakes. The latest facility, completed in the spring of 1974 at Malay Falls, consists of a floating-screen deflector across the power canal, leading to a fiberglass flume, which bypasses the turbines and enters the tailrace downstream of the hydro station. A trapping and trucking facility, located at the head-of-tide (Ruth Falls), is used to transport returning adults to upstream tributaries for natural spawning.

For many years, the lack of adequate numbers of adults of suitable genetic characteristics for transplantation in the river resulted in underseeding and a slow recovery rate in population size. Hence, in 1974, the development program was altered to speed up the restoration process.



Tank for acclimating salmon broodstock to fresh water at East River, Sheet Harbour, Nova Scotia.

Table 30. Atlantic salmon fry and parr densities, as determined by electrofishing, for the East and West rivers, Sheet Harbour.

Stage	Juvenile densities per 100 m ²		
	Average 1967-70	1973	1974
East River			
Fry	8.4	4.9	2.4
Parr	2.0	1.8	1.9
West River			
Fry	8.6	5.1	3.9
Parr	1.7	0.7	1.2

It was decided to release annually 50,000 hatchery-reared smolts, as well as surplus under-yearling and yearling parr of St. Mary's River genetic stock. This would increase the two-sea-year component, generally lacking in the East River population; rapidly build up a run of a suitable "strain" or "race" of Atlantic salmon; and establish a run from which broodstock could be selected for other development projects along the eastern shore of Nova Scotia. A review of the exploitation (angling and commercial) of East River and West River stocks suggested that more two-sea-year and repeat spawners should be allowed to escape to the spawning areas, to increase fry and parr densities, which are at dangerously low levels (Table 30). Since a closure in the angling fishery would affect a large number of trout anglers as well as salmon anglers, and since only a few "large" salmon were taken each year, the Branch decided to allow the angling fishery to continue in 1974 on West River. An agreement was reached with commercial fishermen to close the fishery in 1974 on a trial basis, to determine what effect this would have on increased escapement and subsequent fry densities in 1975. The results clearly indicate that increased escapements of one-sea-year salmon

Table 32. Adult return rate from Atlantic salmon smolts emigrating from East River, Sheet Harbour.¹

Year of emigration	Estimated No. of smolts reaching the sea	Number of adult returns		% return as adults
		1-sea-year	2-sea-year	
1969	3,797	31	1	0.84
1970	980	19	—	1.94
1971	3,276	111	2	3.45
1972	1,475	29	—	1.97
1973	1,770	87	n/a	4.91
1974	2,143	n/a	n/a	n/a

¹Smolt age composition = 2, 3 and 4 years.

Table 31. A summary of the survival data for Atlantic salmon in East River Sheet Harbour, for the broodyears 1966-71.

Broodyear	Egg deposition	Smolt emigration						Freshwater survival, egg to smolt (%)	Adult returns			
		1969	1970	1971	1972	1973	1974		Total	Number		Percent
										1-sea-year	2-sea-year	
1966	313,600	3,797	480	32				4,309	1.37	21	3	0.56
1967	35,520		500	295				795	2.24	58	0	7.29
1968	169,600			2,949	427			3,379	1.99	80	0	2.37
1969	199,200				1,048	138		1,186	0.59	26	0	2.19
1970	153,000					1,632	480	2,112	1.38	73 ²	n/a	3.46 ²
1971	102,000						1,663	1,663 ¹	1.63 ¹	n/a	n/a	
1972	251,400											
1973	162,700											
1974	132,000											

¹Three-year-old smolts will emigrate in 1975.

²Further returns of age 3.1 salmon are expected in 1975.

were achieved (Tables 31 and 32). However, a lack of two-sea-year adult returns to East River strengthened the view that this component of the population has been selectively decreased and almost eliminated over the years.

The native smolt run from East River, as recorded at the Ruth Falls louvers in 1974, was 2,143; the egg to smolt survival rates were 1.38% and 1.63% for the broodyears 1970 and 1971, respectively. In addition to native smolts, 9,011 hatchery-reared smolts and 65,908 yearling and underyearling parr of St. Mary's River genetic stock were released in this watershed in 1974.

A total of 87 one-sea-year salmon returned to the Ruth Falls fishway in 1974, and were transported to the headpond where they could spawn in Grant River. While this represented a significant increase over 1973 returns, the new development plan is expected to have even more encouraging results. The absence of a commercial fishery at the mouth of East and West rivers has significantly contributed to these increased returns, and the cooperation received from local fishermen indicates their willingness to assist in restoration programs.

Modifications to the Ruth Falls fishway in 1974 allowed gaspereau to enter the collection facilities, and 2,924 were transported upstream and released in the headpond for spawning. In a sample of 218 gaspereau, 45% were females, with an estimated egg deposition of 175.5×10^6 . Resulting juveniles, with a mean length and weight of 58.9 mm and 2.12 g respectively, moved downstream from July 20 to September 5, 1974.

R. W. Gray and V. Conrad

West River

Decreased angling catches and information from the stock assessment program (Table 30) in recent years indicate that stocks have declined in West River. In 1974, an effort was made to increase the spawning escapement through the closure of the commercial fishery in the estuary. Although this measure enabled more salmon to escape and spawn, it may not be sufficient to restore the run to its previous level, and additional action based on information collected in 1974 may be necessary.

R. W. Gray

LaHave River

The biological program on the LaHave River in 1974 involved the following: (a) assessment of the salmon run in the main and north branches of the river through the operation of fishway traps at Morgan Falls and Indian Falls, (b) sampling of the angling fishery and commercial fishery, (c) assessment of the gaspereau run at the aforementioned traps, and (d) enhancement of the gaspereau run above Morgan Falls on the main branch.

Totals of 314 one-sea-year and 25 two-sea-year hatchery-return salmon and 40 one-sea-year and 2 two-sea-year wild salmon were recorded at the Morgan Falls fishway on the main branch of the river in 1974. From these fish, 49 were selected for broodstock and transported to Coldbrook Hatchery. Analysis of data on tagged salmon indicated that a significant degree of fallback occurred after fish passed through the fishway. Thus, although 517 fish

Table 33. Distributions of hatchery-reared juvenile Atlantic salmon and adult returns of wild and hatchery origin to the Morgan Falls fishway, 1971-74.

Year of release	Stage	Number released	Adult returns			
			Hatchery		Wild	
			1-sea-year	2-sea-year	1-sea-year	2-sea-year
1971	Smolt	4,890				
	Parr	9,440				
	Total	14,330	12	12 ¹	10	7
1972	Smolt	14,850				
	Parr	6,790				
	Total	21,640	147	24	11	2
1973	Smolt	29,226				
	Parr	78,364				
	Total	107,590	314	n/a	40	n/a
1974	Smolt	33,054				
	Parr	3,735				
	Total	36,789	n/a	n/a	n/a	n/a

¹One tagged salmon released in 1971 returned in 1974.

Table 34. Tag recaptures from hatchery-reared smolts of Medway River origin, released in the LaHave River in 1971-73.¹

Year of release	Parentage/smolt age	No. of tagged smolts released	Exploitation				Total contribution per 1,000 released
			Distant ² fisheries	Home waters			
				Commercial	Angling	Escapement	
1971	1- and 2-sea-yr/1 yr	4,892	6	2	2	4	2.86
1972	1- and 2-sea-yr/2 yr	5,000	10	1	6	30	9.40
	grilse/1 yr	3,400	10	3	0	3	4.70
1973 ²	salmon/1 yr	5,000	0	0	1	1	0.40
	grilse/2 yr	3,973	15	15	21	70	30.45
	salmon/2 yr	3,998	12	7	14	60	23.26
	salmon/1 yr	4,970	1	1	1	2	1.01

¹J. A. Ritter, pers. comm.

²Newfoundland and Greenland.

³Tag recaptures for 1-sea-year only.

were recorded in the fishway trap, many had ascended two, three, four, and even five times. This problem, which has not been solved by different release techniques at the trap, will require engineering input to redesign the fishway exit. The number of hatchery returns to the fishway in 1974 has risen sharply over that of 1973 (Table 33). The largest contribution appears to be coming from the release of two-year smolts (Table 34).

In addition to the salmon, a total of 7,245 gaspereau (*Alsoa pseudoharengus*) passed through the Morgan Falls fishway trap from June 3 to July 11, 1974. Forty speckled trout (*Salvelinus fontinalis*) ascended the fishway in June and July; and during late September to mid-October, 16 adiposeclipped parr and 9 unmarked parr moved upstream through the fishway.

A second fishway trap was operated on the LaHave River in 1974, at Indian Falls on the north branch. Fifty-one wild two-sea-year and 232 wild one-sea-year salmon moved through this fishway from May to late October, 1974. Some difficulties

were experienced in attracting salmon into the fishway at certain periods during the summer; however, engineers have examined the facilities and plan to finalize fishway modifications to improve fish passage in 1975. In addition to salmon, an estimated 720,000 gaspereau passed through the fishway during July, 1974. Of these, 2,450 were collected and transported by tank truck to an area above Morgan Falls on the main LaHave River. These fish are expected to spawn and produce progeny which will return to utilize the lake areas above Morgan Falls, previously inaccessible to them.

R. W. Gray and V. Conrad

Liscomb River

The Liscomb River salmon development program was impeded in 1974, pending final negotiations on future hydro development plans by the Nova Scotia Power Corporation. Once these plans are identified, the Branch will finalize design criteria for fish-passage facilities at Liscomb Falls, and development work can begin. In 1974, a preliminary assessment of the salmon angling fishery on the river was made. Should salmon development materialize in 1975, information will be available to regulate the fishery to maximize spawning escapement during the early stages of the restoration process.

V. Conrad and R. W. Gray

Morell River

Preliminary survey work carried out in 1973 indicated that the salmon rearing potential of the Morell River was excellent. However, the availability of clean spawning gravel is limited.

The Morell River is typical of a number of streams on Prince Edward Island, in having relatively light agricultural activity along its banks, thus having the best immediate potential for salmon enhancement work. Realizing this, a series of meetings took place during 1974 between federal and provincial fisheries personnel to discuss a salmon development program



Fishway at Indian Falls, LaHave River.



Typical salmon habitat, Morell River, Prince Edward Island.

for the river. The outcome of these meetings has been the preparation of an enhancement proposal by the Resource Development Branch, and the allocation of 10,000 hatchery smolt for stocking in the river in 1975. These fish are being held at Cardigan Hatchery, which in recent years has been used exclusively for raising speckled trout.

G. E. Turner

Tetagouche River

The Tetagouche River, flowing into Bathurst Harbour, New Brunswick, has a meander length of 42 miles and drains approximately 140 mi² of principally forested area. Atlantic salmon — although at times not abundant — annually frequent the stream to Tetagouche Falls, nine miles from the river's mouth. The overall drop at the falls is 45 feet, with a gradient too steep for the passage of salmon and other anadromous species. Studies were initiated in 1971 to determine the benefits of passing fish over this barrier.

The studies of 1971 and subsequent years have shown that 75% of the total salmon rearing area of the river lies above Tetagouche Falls. In terms of fish production, 900-1,800 adult salmon could be produced annually from this section of river, a four-fold increase in the existing production potential. Water quality tests conducted during early studies showed the presence of heavy metal pollutants, but further studies showed no severe effects on fish life or aquatic fauna. The major obstacle to development is one of accessibility.

Engineering studies, undertaken in 1974, established that the best method of passing fish over Tetagouche Falls was by constructing a vertical-slot fishway at the site, making use of several features remaining from a previous power development. The proposed route was chosen to minimize both rock excavation and the need for structural support of the fishway (Fig. 24). The fishway entrance would be



Downstream view from Salmon Hole holding pool, Tetagouche River, New Brunswick, showing typically steep river banks.

located 70 ft downstream from the base of the falls and 130 ft downstream from the dam. Approximately 50 ft of the fishway at the entrance is in a tunnel. Fishway plans provide for 46 pools, and include a second tunnel section of approximately 70 ft with the fishway centerline coinciding with the penstock centerline. Immediately upstream of this tunnel section, the fishway spans 30 ft across a gully to the headpond.

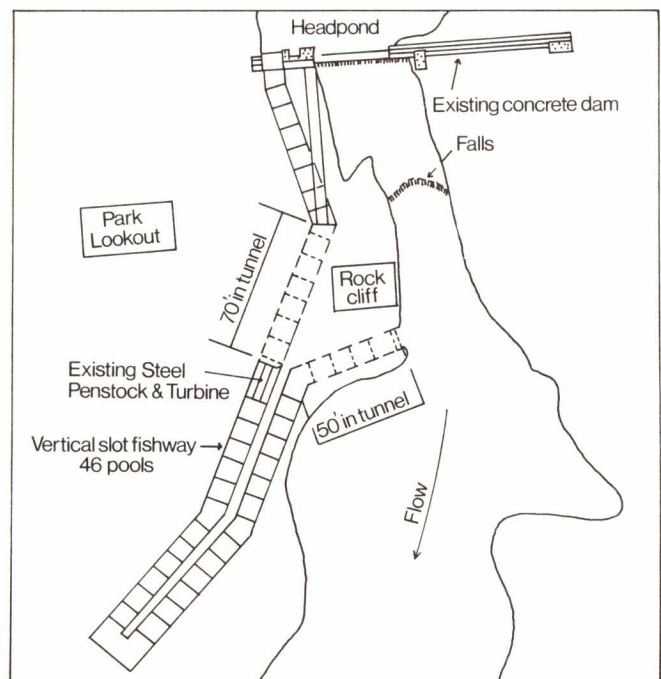


Fig. 24. Site plan of proposed fishway for Tetagouche River, New Brunswick.

It is estimated that the current cost of construction would be approximately \$300,000. Further studies are anticipated for this development in the coming

year.

V. Conrad and G. E. Turner

Medway River

A survey of obstructions on the Medway River in 1974 indicated that improvements in fish passage were required at the Harmony Mills fishway, Base Camp and the outlet from Medway Lake. Branch engineers are presently designing fish-pass facilities for these sites.

In 1974, totals of 16,699 hatchery-reared Atlantic salmon smolts and 576 parr were released in various tributaries of the Medway River. With the planned improvements in fish passage, the Branch will initiate a stocking program above McGowan Lake, which is presently unutilized by salmon.

R. W. Gray and V. Conrad

Nepisiguit River

The Nepisiguit River, with a drainage basin of 900 mi², flows out of north central New Brunswick into Bathurst Harbour. Its recognition as a salmon river goes back to the mid-1600's, when Nicholas Denys erected a trading post at its confluence with the Gulf of St. Lawrence and took advantage of its salmon resource. By the mid-1700's, salmon taken in the river were exported to Europe and the Mediterranean, and early in the 19th century it became one of the first major salmon angling streams in eastern Canada. In 1867, for example, it was yielding more fish to the angler than any other river in New Brunswick or Quebec. This sport fishery now produces between 300 and 1,300 salmon and grilse annually.

The Nepisiguit's production capacity, however, has always been limited to an 18-mile segment of the river below the spectacular 100-ft Nepisiguit Falls; over 50 miles of stream lie above this barrier.



Aerial view of Nepisiguit River's Grand Falls hydroelectric development, showing horse-shoe spillways and deep gorge below.



Pabineau Falls, proposed site for salmon trapping and trucking facilities on the Nepisiguit River.

Physical investigations to determine the river's potential for salmon production began in 1967. Over ten million square yards of salmon rearing area were catalogued above the falls, which suggested an annual production of between 8,000 and 12,000 adults. In comparison, the Nepisiguit might be expected to produce 1/4 as many fish as the famed Miramichi system.

Investigations since 1967 revealed that heavy-metal pollution and effluents from pulp mills presented problems to development; but in the course of regular pollution-abatement programs, the threats of these conditions on aquatic life have been considerably reduced and are considered as controllable factors.

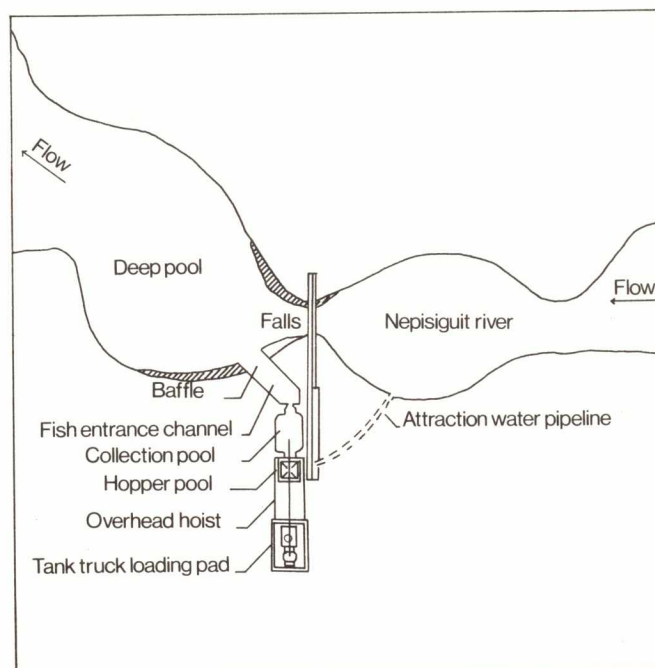


Fig. 25. Site plan for proposed fish pass facilities for Nepisiguit River, New Brunswick.

Preliminary engineering studies resulted in the recommendation of a trapping and trucking facility as a means of passing fish around the obstruction. Several possible locations were examined, the most desirable site being at Pabineau Falls, 11½ miles below Grand Falls; the present cost of construction is estimated at half a million dollars (Fig. 25). Alternate schemes could require expenditures in excess of a million dollars. Apart from providing upstream passage for adults, provision for the downstream passage of smolts would also have to be considered.

Further examination of the developmental problems of the Nepisiguit are planned. The possible opening of the river above the falls is foreseen as a major contribution to increasing salmon stocks in New Brunswick.

V. Conrad and G. E. Turner

Point Wolfe River

Totals of 7,500 tagged and 4,385 adipose-clipped smolts of Big Salmon River genetic origin were released in the Point Wolfe River in the spring of 1974. Construction of a new fishway is expected to be completed in 1975, in time for the upstream migration of adults resulting from smolts released this year. Although the river has limited development potential, the new fishway design — allowing tourists an opportunity to view adult Atlantic salmon migrating upstream — is expected to create a unique attraction in Fundy National Park.

V. Conrad and R. W. Gray

St. Mary's River

The Atlantic salmon commercial and angling fisheries of the St. Mary's River, Guysborough County, Nova Scotia, were examined in 1974. The objective of the program was to collect biological data on run timing, age composition, length and weight distributions, exploitation and fishing effort. The sampling program consisted of twice-weekly checks of commercial fishermen in Indian Harbour, St. Mary's estuary and Ecum Secum Harbour, while daily checks were made on the angling fishery in the river.

Total commercial salmon landings in the above areas (District 17) amounted to 813 kg. Of these 58% were caught within the half-mile boundary of the St. Mary's River estuary and, therefore, presumably came from St. Mary's River salmon stocks. Incidental catches of salmon in gaspereau, herring, and mackerel nets are significant; however, the program established in 1974 did not quantify this exploitation.

The 1974 salmon angling fishery on the St. Mary's River showed a marked increase in the catch over that of 1973. A total of 1,469 was landed, of which 164 were large, virgin or repeat-spawning salmon. Although the three-sea-year salmon component — reported to be declining in numbers, and whose continued existence is threatened — was sampled in the main river below the confluence of the east and west branches, it was not sampled above. However, based on information obtained from Conservation



Equipment used for transporting salmon broodstock captured in estuarial trap, St. Mary's River, Nova Scotia.

and Protection Branch officers, approximately 25 fish of this age class were angled in the east branch, leading to the hypothesis that this genetic stock inhabits only the East River St. Mary's.

R. W. Gray

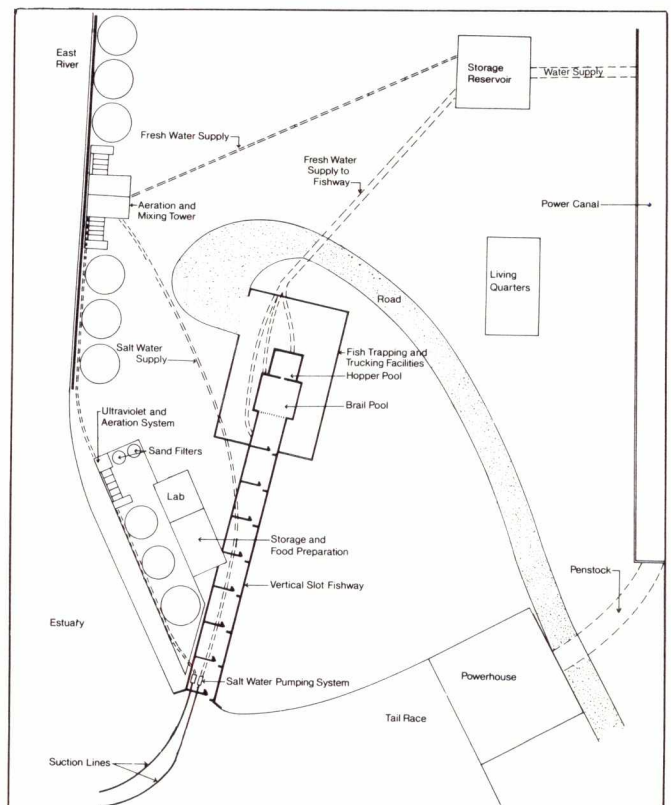


Fig. 26. Diagrammatic view of the water supply and general layout of the kelt recycling facilities at Ruth Falls, East River Sheet Harbour.

Experimental Kelt Study

Investigations initiated in 1971, on reconditioning Atlantic salmon kelt in captivity for artificial spawning purposes, were continued in 1974. Rearing facilities for the study were constructed at Ruth Falls, East River (Fig. 26), where both fresh- and salt-water supplies were available. In 1973 experiments, higher kelt survival was achieved in captivity than would occur in nature, and viable progeny were produced from crosses of recycled kelt. Their survival and growth characteristics are compared with those of progeny from wild salmon crosses of Waweig River origin (Table 35). Results to date confirm that the technique has validity as a development tool to improve the efficiency of stock utilization, particularly in cases of rare stocks which possess valuable genetic characteristics.

Table 35. Growth and survival characteristics of recycled kelt progeny and progeny from wild parents of Waweig River origin.

Parameter	Stock origin	
	Recycled kelt	Wild salmon
Number of eggs collected	57,296	68,880
Number of egg mortalities to June 9	26,690	18,100
Percent survival (incubation phase)	53.4	73.7
Number of mortalities (June 10-September 18)	1,572	2,090
Percent survival (June 10-September 18)	94.9	95.9
Fork length (cm) ¹	7.7	8.0
Weight (g) ¹	5.1	6.1

¹Data collected during the last sampling period, September 18, 1974.



Collection of eggs from recycled kelt, East River Sheet Harbour.

The main objectives of the experiments in 1974 were to study the effect of saltwater age at first maturity on consecutive- or alternate-year spawning in captivity, and the effect on sexual maturity of different rearing salinities during the overwinter and summer periods. Studies on stress, diet and fecundity were continued in 1974. Eighty-three thousand eggs were collected from recycled kelt in 1974 and are being incubated at Cobequid Hatchery. Since the 1973 fecundity data suggested that small, poorly colored eggs exhibited a significantly higher mortality rate than average, information on egg size, number and coloration from specific females will be related to the survival of resulting progeny. Spawning crosses similar to those in 1973 were carried out to study growth and survival characteristics of progeny from the different matings.

R. W. Gray

SAINT JOHN RIVER ALEWIFE AND SHAD STUDIES

In 1974, investigations were continued on the biology of the alewife (*Alosa pseudoharengus*) and blueback herring (*A. aestivalis*), and on the impact of commercial fisheries on these stocks in the Saint John River system. Fish were sampled weekly at Mactaquac Dam and at eight commercial fishery sites below. The sites at lower Grand Lake and lower Washademoak Lake, sampled in 1973, were eliminated in 1974, and were replaced by sites on Belleisle Bay and Kennebecasis Bay.

The 1974 return of 1.3 million alewives to Mactaquac Dam was very similar to the 1.4 million fish in 1973. As in past years, fish released into the headpond were trucked to a point about one-half mile above Mactaquac Dam. In 1974, an estimated 710,000 alewives and blueback herring were trucked above the dam; the remainder of the run (608,000 fish) was harvested by a newly developed commercial fishery at the dam.

This fishery, instituted in 1974, was designed to



Loading of gaspereau for commercial sale from fish collection facilities at Mactaquac Dam.

harvest those alewives deemed surplus to estimated spawning requirements for the headpond area. The fisherman, who had successfully bid for the right to receive the surplus fish, obtained them directly from the hopper of the fish-lift. The loading rate was dependent upon the supply of fish and, when plentiful, about 12,700 kg of fish could be loaded in 2½-3 hours. Normal disposal of this quantity of fish would have required approximately two days of constant tank-truck operation. Rapid removal in 1974 prevented the continuous and excessive build-up of fish at the fishway seen in past years, which had undoubtedly delayed their passage. Sale of the 345,500 pounds of fish brought a small income and appreciably reduced tank-truck operating costs.

Alewife mortality at the fish-lift was approximately 0.3% of the estimated run, about one-third of the 0.9% in 1973. Mortality during transportation above the dam and immediately after release was negligible.

No alewives were tagged and released above Mactaquac Dam in 1974. However, over a two-week period, 9,527 fish taken at the dam were transported by tank-truck 120 km downstream, were marked with yellow, Floy T-bar tags and then released. The objective was to determine whether these fish would home again to Mactaquac Dam and at what rate. A total of 143 tags was recovered (1.5% of total tagged), of which 52% were taken at Mactaquac Dam, 10-21 days after release. Remaining recoveries were made in Washademoak Lake (44%), and Grand Lake, Belleisle Bay and Saint John Harbour (4% combined). Considerable straying evidently occurs during upstream migration. The low recovery rate is largely explained by the difficulty of observing tagged fish under the conditions experienced at Mactaquac Dam or in the commercial fishery. Other alewives, tagged and released in 1973, were recovered at Mactaquac Dam (21), Belleisle Bay (1) and in the Saint John River near Westfield (1).

American shad (*Alosa sapidissima*) passing through the fish-lift at Mactaquac Dam were in better condition this year, possibly because of reduced crowding in the holding pool and shorter passage time resulting from the rapid removal of alewives. However, about 84% of the approximately 4,400 shad recorded at the fish-lift were harvested in the commercial fishery, since separation from the alewives proved impracticable. A system is being designed for implementation in 1975, whereby the shad can be more easily separated and released into the headpond.

SAINT JOHN RIVER AMERICAN EEL STUDY

In 1974, the Saint John River and tributaries above the Mactaquac Dam were opened for an experimental American eel fishery, with the objective of obtaining some insight into the abundance, distribution and size of eels and the suitability of the area for fishing. Efforts were made to have the Mactaquac headpond fished, but investigation revealed a lack of suitable net sites. Interest was therefore redirected to other areas, the Meduxnekeag and Eel rivers, both in Carleton County. Weekly samples were collected from the Medux-

nekeag River between September 17 and October 18. Samples were also taken from the fishery at lower Grand Lake between August 6 and October 17. Data on length, weight and condition (yellow or silver eel) were obtained, as were otoliths for aging purposes.

B. M. Jessop

TROUT INVESTIGATIONS

During 1974, the Branch continued its program of trout investigations designed primarily to determine the contributions to fisheries of hatchery-reared stocks. However, a small program of wild trout studies was also carried out.

Trout Stocking Evaluation

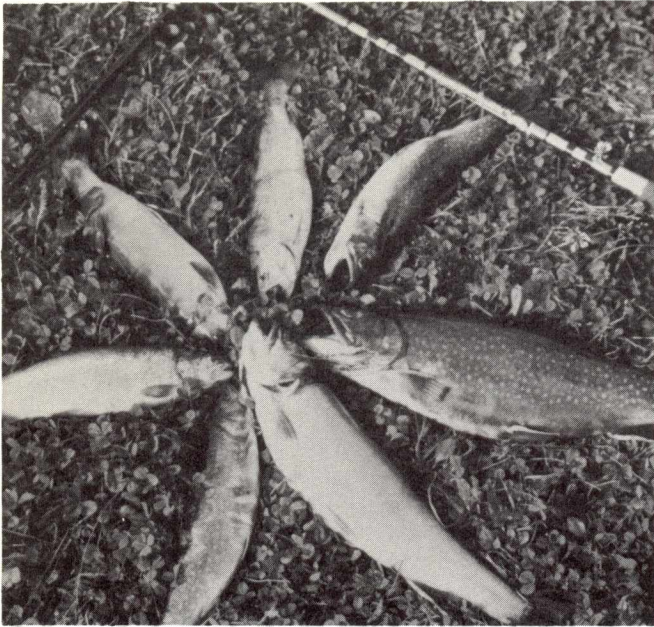
Assessment of the contribution to recreational fisheries of trout produced and distributed by Branch hatcheries has expanded greatly since its beginning with the Halifax-Dartmouth catchable-fishery evaluation in 1972. Many projects continue to be dependent on the return of jaw tags by anglers. Therefore, the draw for prizes initiated in 1973 was repeated in 1974, as a form of incentive for anglers to return tags.

The trout distribution program annually provides more than four million speckled (brook) trout from 10 hatcheries to as many as 1,600 streams and lakes. This large quantity causes some difficulties in recording and summarizing the data. In an effort to produce more detailed, uniform and consistent summaries of distribution data for both production and management purposes, records of the 1974 distributions were placed on forms for computer tabulation. The first of an annual series of trout distribution summaries will be available in early 1975.

Some assessment of annual trout stocking in national parks has been provided by Parks Canada personnel, in cooperation with professional staff of the Canadian Wildlife Service and the Resource Development Branch. In both 1973 and 1974, 3,000 one-year-old speckled trout were marked by fin clips and distributed to Bennett Lake in Fundy National Park. A partial creel census in 1974 revealed that, in 380 hours of fishing, anglers harvested 627 trout. These included 209 fish from the 1974 hatchery distribution but none from the 1973 distribution. Although hatchery trout comprised 33% of the total catch examined, the proportion of hatchery trout decreased from near 80% of the catch during the first week of angling to less than 10% by summer. No hatchery trout were found among 80 fish collected by gill nets in the fall of 1974. It appears that hatchery stocks are providing a short-term catchable-trout fishery. A similar assessment project is in progress in Cape Breton Highlands National Park.

Intensive catchable-trout stocking in four Dartmouth lakes is now an annual program. The 1974 results indicate a harvest of approximately 75% of the 32,650 trout distributed, and the annual angling effort continued near 40,000 hours. Lake surveys are planned in 1975 as a preliminary step in the establishment of a similar catchable-fishery program in the Sydney-Glace Bay area for 1976.

Estimation of angler harvest from one-year-old

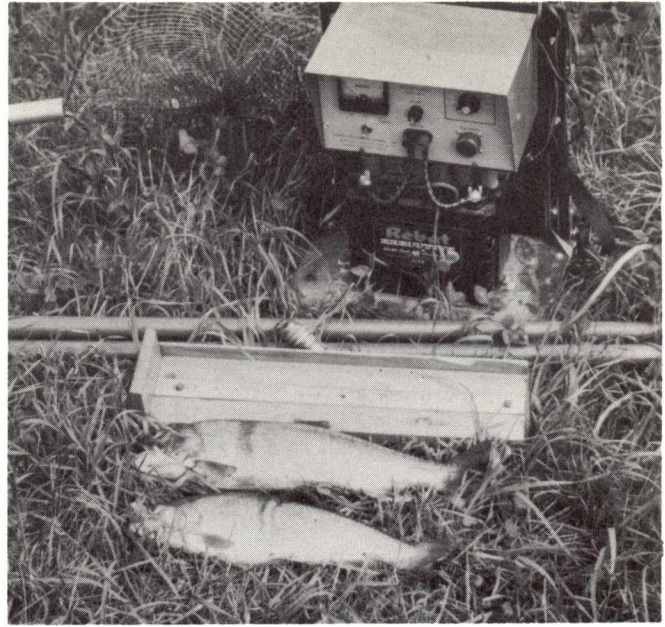


Hatchery-produced brook trout and rainbow trout from Anderson Lake.

speckled trout distributed by Antigonish and Yarmouth hatcheries was repeated in 1974. The project was expanded to include trout distributed by Florenceville Hatchery in New Brunswick. Jaw tags were applied to 10% of the 164,000 trout distributed to 197 waters. Tag returns to November indicate that the 1974 harvest rates were 14% for Antigonish, 31% for Yarmouth and 29% for Florenceville distributions. Additional tags from the 1973 distribution returned in 1974 were used in a final calculation of total harvests of 11.2% from Antigonish and 38.4% from Yarmouth. Respective harvests during the second angling season were approximately 1% and 2% of the previous year's distributions from these two stations. Consequently, it appears that one-year-old trout used in the present program support a catchable fishery with relatively low returns.

Comparison of the relative survival of fall fingerling versus spring yearling brook trout has been continued at Anderson Lake, Nova Scotia. Equal numbers of marked trout were released in the fall of 1973 and spring of 1974. The ratio at recovery by gill nets in the fall of 1974 was 1:3 (fall fingerling:spring yearling), compared to a 1:2 ratio in the 1973 experiment. These ratios may be used in predicting the relative contribution to the creel from fall fingerlings based on the spring yearling evaluations. By the date of recovery, fish from both spring and fall distributions averaged 23 cm fork length. Recaptures in 1974, from trout stocked in the spring of 1973 or earlier, indicate that this domesticated strain of hatchery trout has potential for long-term survival in this lake. However, Anderson Lake may be atypical of lakes normally receiving hatchery stocks, in that it lacks the populations of competitor species, such as white perch, yellow perch and brown bullheads found in most Maritime waters.

Brown trout (*Salmo trutta*) were introduced to Nova Scotia and New Brunswick in the 1920's and subsequent hatchery distributions have resulted in many self-sustaining populations. Production and



Two large brook trout, collected by electroseine, indicate the more productive nature of Prince Edward Island streams.

distribution of this species by the Resource Development Branch has been discontinued, with the exception of a small number released for stocking assessment in 1974. Lily Lake, within the city limits of Saint John, New Brunswick, was stocked with equal numbers of yearling brook trout and brown trout. Jaw tags returned from these fish by anglers indicate that the brook trout harvest was approximately 45% compared to only 5% of the brown trout. Although the brook trout harvest was disappointingly low in this catchable fishery, it was considerably more successful than that of brown trout. At this time, no further plantings of brown trout are anticipated.

The 1974 lake-inventory program was concentrated in the western end of Nova Scotia. Fifteen lake surveys were completed in Yarmouth County and three in Digby County. Of 3,275 fish sampled by gill net in these lakes, more than 50% were white perch. Brown bullheads and common suckers were the next two most abundant fish species. Salmonid collections consisted of 35 brook trout, 4 brown trout and 1 landlocked salmon. The brook trout included only 1 of 10,540 marked, yearling hatchery trout distributed among 13 of these lakes in the spring of 1974. Ten chain pickerel and 4 smallmouth bass were collected from one chain of four lakes, but pickerel are regarded as nuisance fish by local residents and bass appear to be low on the angler's priorities. The results of these and other surveys completed during the lake-inventory program clearly indicate that salmonid sport-fish populations are low in many Maritime waters, and that stocking of hatchery trout alone is unlikely to remedy the problem, particularly since most trout are distributed as fingerlings. The feasibility of chemical reclamation of selected lakes, followed by restocking with hatchery trout, is now being examined. One case of documented success with this management practice was revealed in the 1974 gill netting of Randall Lake, Lunenburg County. Only brook trout were captured, approximately 20

years after removal of coarse fish from this lake. Several failures of lake reclamation in Nova Scotia may be attributed to lack of proper barriers to prevent re-entry of coarse fish. Following the gill netting in Randall Lake, the deteriorated barrier dam was replaced.

Three additional lakes were surveyed in the headwaters of the Nine Mile River system, Halifax County, and fish collections were made from three other lakes in the headwater region of the Shubenacadie River system.

Wild Trout Studies

Wild trout studies were limited to the brook trout population in Big Indian Lake, Halifax County. A survey of this 107-hectare lake in 1972 indicated that a substantial trout population was present, and that it was largely unexploited because of the lake's restricted-access status as a water supply to the City of Halifax. Data from this project are being analyzed and presented as a thesis, in partial fulfilment of an honours B.Sc. degree at Dalhousie University.

Trap nets were used to capture fish in June, 1974. All captured trout were measured, weighed, scale sampled and marked with an adipose fin clip before release. Gill nets were used to take a second sample of trout during August, and the netting results were combined to provide a Peterson population estimate. Preliminary analysis of the data results in an estimated trout population of $2,161 \pm 1,043$. This estimate has not been revised to compensate for incomplete sampling of age 1+ fish and is exclusive of age 0+ fish, which were not captured in the nets. However, the estimate is a good approximation of that portion of the population which, by June, had reached a size which might be considered acceptable in the angler's creel (>16 cm fork length). Trout sampled in June averaged 21.8 cm fork length. The harvestable trout population was 20.3 fish/ha or 2.89 kg/ha. The harvestable crop was comprised of 12.4% age 1+, 52.4% age 2+ and 35.2% age 3+ by weight, or 35% age 1+, 49% age 2+ and 16% age 3+ by number. The number of fish older than age 3+ was negligible. Back calculation of size at annulus formation showed that these trout were 11.6 cm mean fork length at age 1, 18.5 cm at age 2 and 25.4 cm at age 3. These data provide one of the few known composition descriptions of a native trout population in a Nova Scotia lake.

D. R. Alexander

SALMON CATCH STATISTICS

The collection of data relating to the sport and commercial catch of fish has been a responsibility of the Fisheries Service since Confederation. Collection of the data is made by officers of the Conservation and Protection Branch and the Fisheries Statistics Branch on a regular basis, with the assembly and publication of the data principally the responsibility of the latter branch. In recent years, the Resource Development Branch has become involved in this operation in so far as it relates to the sport and commercial fisheries for Atlantic salmon. Through the

assistance of the two branches previously mentioned, certain modifications have been made in the system of data collection in order to obtain more information suitable for biological use. Basic primary catch, effort and related data are now made available to Resource Development Branch personnel for compilation and assessment. This procedure has resulted in the more effective use of the statistical material in the development of salmon management programs. This compiled data on the salmon fishery is available in a series of annual data reports published by the Resource Development Branch.

Commercial Salmon Fishery

The commercial salmon-fishery catch of the Maritime Provinces approximated 206,000 lb in 1974, as compared to 137,000 lb in 1973 (Fig. 27). Although a commercial salmon-fishing ban was in effect in New Brunswick, 11,000 lb were reported captured in that province while legally fishing for other species. This figure, however, is 8,000 lb less than the reported incidental catch of 1973. The commercial salmon catch of Prince Edward Island approximated 4,000 lb, the majority of which was incidentally taken in non-salmon fishing gear; 2,000 lb were taken in 1973.

Nova Scotia commercial salmon captures totaled 191,000 lb in 1974, a 66% increase over the previous season. Slight catch increases were evidenced in the Bay of Fundy area, slightly greater increases occurred along the Atlantic shore, and the most significant increases occurred in the Gulf areas.

In Nova Scotia, 385 commercial salmon-fishing licenses were issued in 1974, comprising 223 trap nets, 145 gill nets and 17 drift nets; this represented a decline of 19 licenses from the previous year, but reduction in real fishing effort was not appreciable.

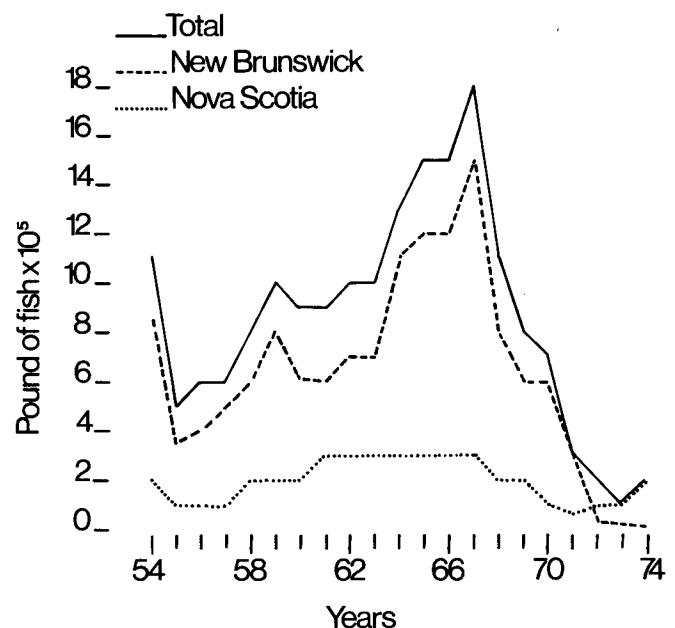


Fig. 27. Maritimes Region commercial catch of Atlantic salmon, 1954-74.

Sport Salmon Fishery

Over a quarter of a million pounds of bright salmon and grilse were angled from the freshwater streams in the Maritime Provinces in 1974. Coupled with the season's black-salmon catch, the total angling catch was 323,487 lb or 50,745 salmon and grilse. Angling catches of both bright and black salmon have been summarized for the years 1973 and 1974 (Table 36).

Overall angling results in Nova Scotia revealed that 1974 produced more fish to the angler than any other year on record, most individual stream records going back at least to 1935. Fishing effort was increased by almost 40% over 1973 and the average catch per unit of effort increased by 20%. Baddeck, Mira, Grand, Country Harbour, New Harbour, St. Mary's, Salmon (Guysborough County) and Stewiacke rivers exhibited the highest salmon catches on record; the Ecum Secum River produced more fish only in 1927. The LaHave and Gaspereau rivers recorded the highest catches since 1948; and the Gold River, the highest since 1959. Although the season's catch was excellent from a regional point of view, there were many streams which did not exhibit

Table 36. Maritime salmon-angling catch, 1973-74.

Province	Year	Salmon		Grilse	
		Number	Pounds	Number	Pounds
Bright salmon					
New Brunswick	1973	10,948	122,799	11,787	44,137
	1974	13,043	153,055	20,527	68,068
Nova Scotia	1973	1,441	13,275	3,746	14,824
	1974	1,826	16,279	6,680	26,549
Prince Edward Island	1973	2	10	0	0
	1974	2	18	0	0
Maritime total	1973	12,425	136,074	15,535	58,971
	1974	14,871	169,352	27,207	94,617
Black salmon					
New Brunswick	1973	5,902	42,933	2,055	6,255
	1974	6,135	51,116	2,532	8,402

an increase over 1973, the most notable example being the Margaree.

Bright-salmon fishing effort in New Brunswick increased by only 4% in 1974, but a 47% increase in catch occurred (large salmon, 21%; grilse, 74%). These increased catches principally occurred in the Miramichi River system, where 23,852 bright salmon and grilse were taken as compared to 13,914 in 1973.

R. W. Dunfield

COMPENDIUM OF SALMON STOCK CHARACTERISTICS

In the fall of 1973, the Resource Development Branch embarked upon a program to characterize the different Atlantic salmon stocks in the Maritimes Region. In this program the Branch is cataloguing its Atlantic salmon data under a common and comparable format. The data are being assembled on an individual-river basis, with equal consideration being given to both the salmon and the river it inhabits. By the spring of 1976, the backlog of data will be catalogued and procedures established for annual updating.

The second part of the program calls for the publication of a compendium of individually authored reports on the biology of the different salmon stocks. Similar to the data catalogue, the compendium will include the characteristics of both the individual salmon stocks and the rivers they inhabit.

A joint proposal by the Branch and the North American Salmon Research Center to expand the scope of this program was presented in late 1974 to representatives of major agencies controlling data pertaining to the Atlantic salmon stocks in North America. In general, the proposal received favourable consideration, and it is anticipated that the different agencies will contribute to the publication of a North American Atlantic salmon stock compendium.

J. A. Ritter and J. R. E. Harger

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