1968

ANNUAL REPORT

of the

RESOURCE DEVELOPMENT BRANCH

MARITIME REGION

DEPARTMENT OF FISHERIES OF CANADA

(RESTRICTED TO OFFICIAL USE)

QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1969
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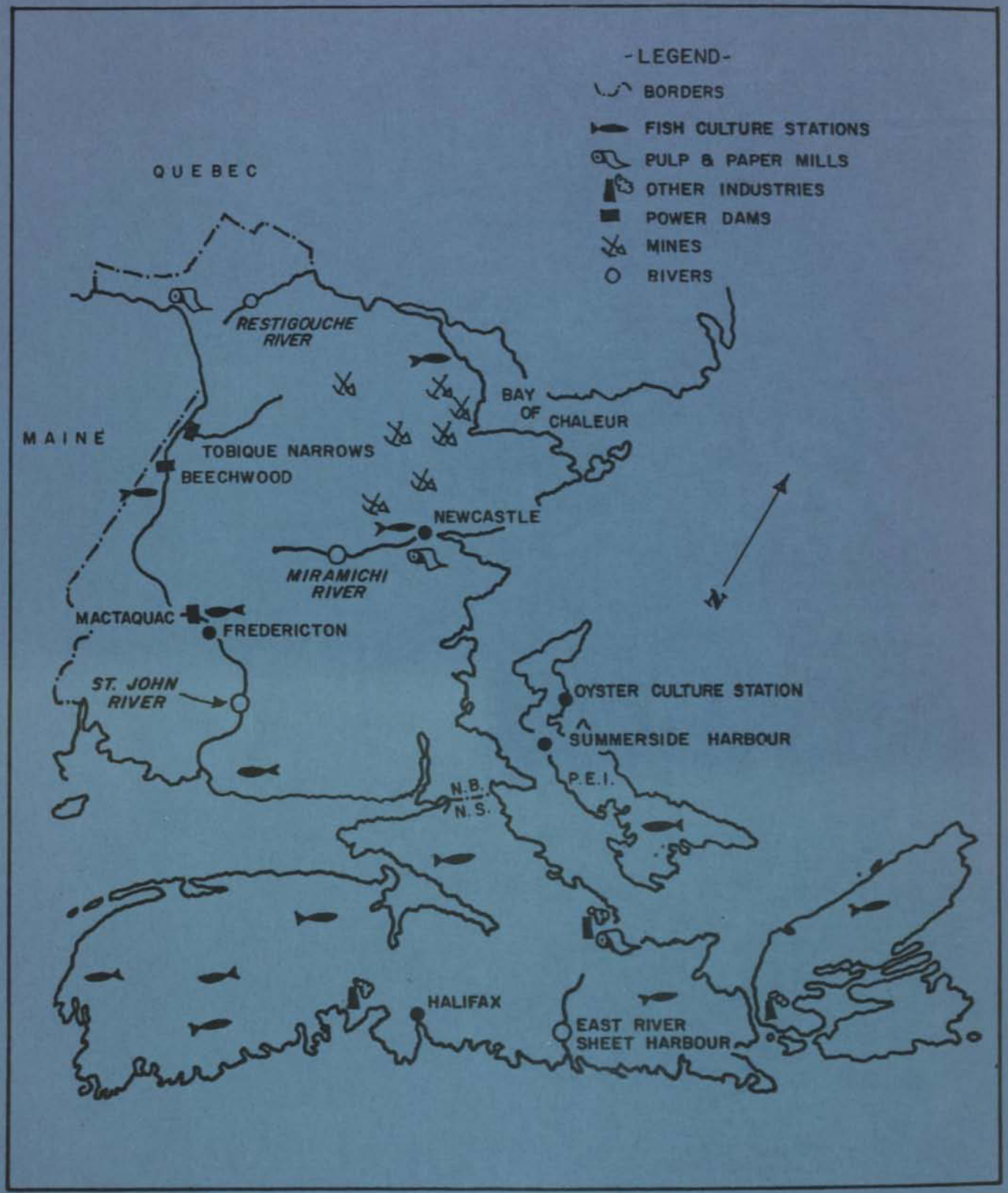

THE MARITIME PROVINCES OF CANADA

A LOCATION MAP OF SOME IMPORTANT
ITEMS MENTIONED IN THE ANNUAL REPORT

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PART I

INTRODUCTION

Reduced to simplest terms, the aim of the Resource Development Branch in the Maritimes is to create more fishing. We employ biological, engineering and fish cultural skills to achieve this objective. In order to ensure "more fishing", we carry out four broad sub-activities:

1. environmental protection
2. pollution control
3. resource development and expansion
4. resource allocation

The overall aims and objectives of the Branch are depicted in Figure 1. This figure also indicates the diversity of problems and activities in which the Branch is currently involved, or in which we plan to become involved in the near future. Our activities encompass the entire spectrum of fishery conservation. The growing demand for both recreational and commercial fishing opportunity on the one hand, and the relentless pressure of industrial development and deterioration of fish habitat on the other, demands a total and co-ordinated attack on fishery conservation problems.

One important activity identified in Figure 1 is Resource Inventory. Basic information on the fishery resource is a pre-requisite for protecting, managing and increasing the resource. The heart of the Resource Inventory program is the District Biologist organization. One of the principal objectives of the District Biologist is to gather, compile and analyze basic resource information on a regional basis so as to establish and maintain an inventory of the major anadromous, fresh-water and marine fishery resource under direct jurisdiction of the Department. In 1968, three District Biologists were assigned to specific areas in Nova

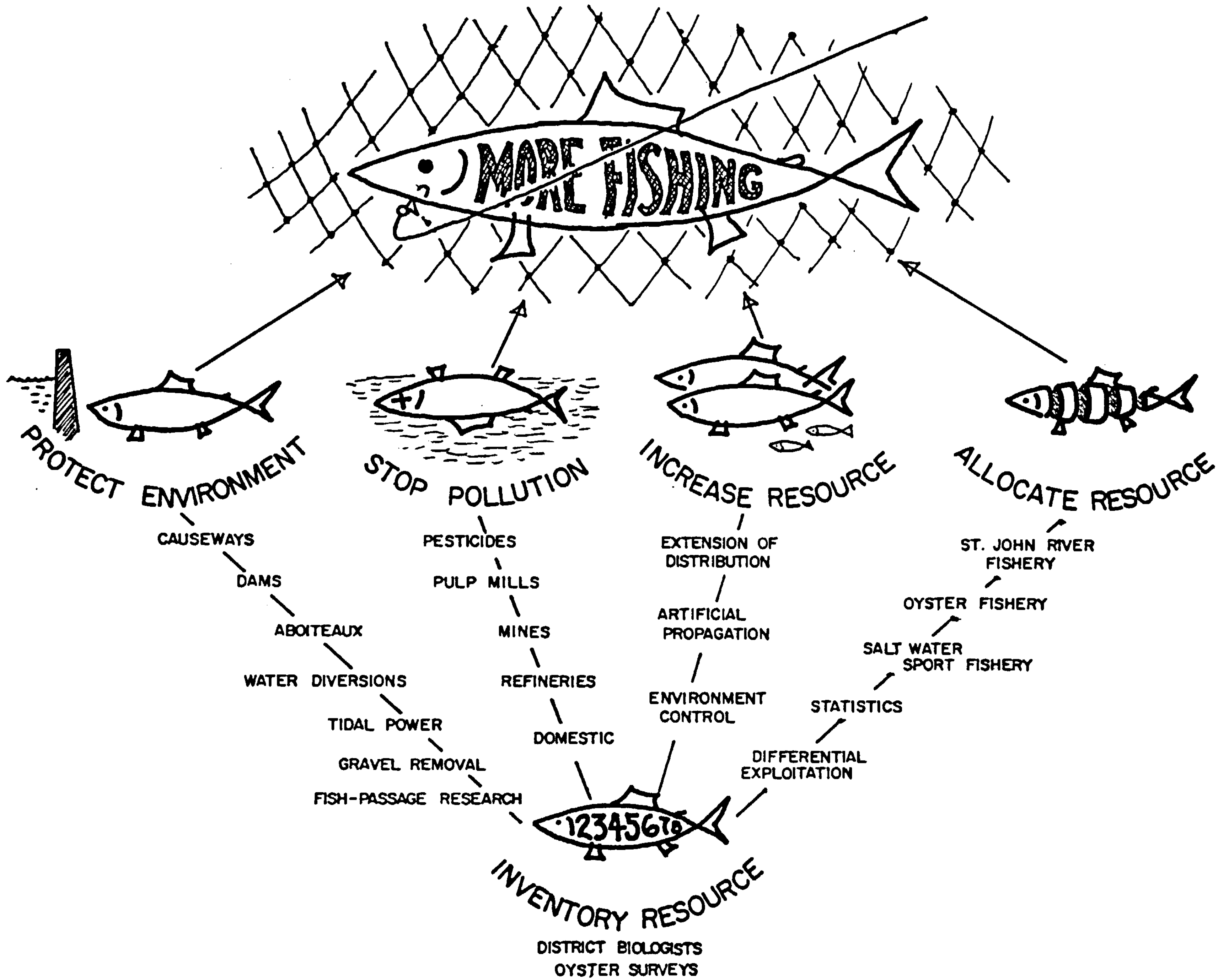

Figure 1. Aims and objectives of the Maritimes Resource Development Branch.

Scotia and New Brunswick. The usefulness of their activities is already being felt through pertinent recommendations concerning hatchery fish distribution, the discovery of several development possibilities and the beginning of a body of information which will contribute to the knowledge of a stream's capacity to produce fish and the nature of fluctuations in abundance.

A start was made in 1968 towards gathering additional information required for scientific fishery management purposes. Twelve commercial salmon fisheries were studied including Miramichi Bay, Bay of Chaleur, Saint John River, Antigonish, Ingonish and Halls Harbour.

In the field of fish culture, 1968 was a year of important change. Five of the older, less productive stations were closed; Mersey Station was completely rebuilt; and Mactaquac, the largest Atlantic salmon rearing station in the world, was officially opened.

Fisheries development work in the Region was again focused on the East River (Sheet Harbour) Rehabilitation Project where continued progress was recorded through additional salmon introductions to the river and the successful testing of experimental devices to prevent fish from entering hydro-power turbines. The present directed efforts to inventorize the fisheries resource of the Region will point to new opportunities in the fisheries development and expansion field.

Important strides were also made in oyster fishery development when the world's first mobile hatchery began to determine the suitability of sites for future permanent establishments in a program designed to pave the way for the commercial seed oyster industry.

There has been no reduction in industrial activities or in construction of other works which affect the quantity, quality and accessibility of water for fish in the Region. A considerable amount of time has been spent monitoring changes in the aquatic environment and devising means to minimize the effects of these changes on fish. Pollution and hydro-power dams on the Saint John River and base metal mining in northern New Brunswick continue to pose the most dangerous threats to freshwater-dependent fish in the Region.

An important phase in the development of plans for the management and use of water and its dependent resources in the Maritimes was completed in 1968 as the Atlantic Provinces Water Resources Study continued. Branch personnel contributed substantially to this exercise in forward planning.

Once again it is a pleasure to acknowledge our colleagues in the Conservation and Protection Branch and the Fisheries Research Board. Our close collaboration with them has been an enjoyable part of 1968. Unfortunately, we lost our Branch Chief, Mr. J. P. Parkinson, who is now the Chief Engineer attached to our Ottawa headquarters staff. On the bright side is the acquisition of a senior biologist, Mr. D. B. Lister. Brent is especially well qualified to head up our fisheries development section and will, no doubt, add much to our future accomplishments.

PART II

BIOLOGICAL DIVISION

2.1 SAINT JOHN RIVER, NEW BRUNSWICK

2.11 Mactaquac Fish Culture Station - Biological Program

The primary function of the biological program at the Mactaquac Fish Culture Station is to assess the total effectiveness of the station and to develop and refine the knowledge necessary for successful attainment of hatchery production goals; 500,000 two-year-old smolts are to be released annually beginning in 1970. Under this program, a variety of experiments in selective breeding, tagging, nutrition, optimum rearing densities and smolt release procedures will be conducted. As the station commenced operation in 1968, focus was centered on the selective breeding program.

The fish collection facilities at Mactaquac Hydro Power Station provided brood stock for the breeding program. The best salmon and grilse, as determined by their general appearance, lengths and weights, were selected as brood stock, and each fish was tagged and a scale sample taken for age determination. Program objectives entail analysis of the success of progeny of selectively bred adults of various ages and age crosses from the spring, summer and fall sections of the Saint John River salmon run to determine which combinations will yield the best growth, fecundity and adult return.

An exceptionally low escapement (2,005 salmon and grilse at Mactaquac facilities) made the collection of a proper brood stock and the subsequent planning of the selective breeding program a difficult task. The shortage of salmon and grilse of the proper ages, and in some cases a lack of one sex due to mortalities and tag losses in the holding pond, resulted in a lower yield of eggs for the Mactaquac Station than had been anticipated. At the end of the season, a total

of 1,366,900 eggs were taken from 889 salmon and grilse; representing 211 from the spring run, 598 from the summer run and 80 from the fall run.

Regular monitoring of temperature, dissolved oxygen and pH of hatchery water was conducted along with three complete chemical analyses in an effort to discover any constituents which might be in concentrations deleterious to fish. None were found.

2.12 Saint John River Adult Salmon Migration

Adult salmon trapping operations in the Westfield area continued to provide data on the size, timing, distribution and composition of the migration. A total of 1,232 salmon and grilse were tagged and released in 1968, an increase of forty per cent over the previous year. This is not attributed to any increase in abundance but rather to improved gear, methods and fishing site selection as a result of experience gained in previous years.

As in 1966 and 1967, the peak of the run this year occurred at least two weeks later than in earlier years resulting in the limited availability of salmon to sport and commercial fishermen. There are indications that salmon may have approached the river earlier in the season without actually entering; extreme low river flows and concomitant high water pollution are likely contributors to this unnatural behaviour.

Almost 900 tagged Atlantic salmon which had been used as brood stock for Mactaquac Fish Culture Station were released in the fall of 1967 to the Nashwaak River, a Saint John River tributary. Tag returns to date amount to just over three per cent, mostly from

the Saint John River estuary and harbour and from Newfoundland, along with some from Nova Scotia, Miramichi River and Labrador.

Salmon which were not required for the selective breeding program at Mactaquac Fish Culture Station during the current year were transported for release upriver in an effort to provide angling and a natural spawning stock. The numbers transferred are listed below according to their destination.

	Large Salmon	Grilse
Woodstock area	75	621
Tobique River	74	346

2.13 Saint John River Natural Smolt Migration

The migration of Atlantic salmon smolts from the upper Saint John River was studied by tagging fish taken from the gate wells at Beechwood and recapturing a portion of these using a Miramichi-type smolt trap below Mactaquac. It was estimated that 300,000 smolts migrated past Mactaquac, of which 91 per cent were three years old, 7 per cent were four years old and 2 per cent were two years old. A sample examined for sex determination revealed that 60 per cent were female.

Smolt mortality was observed at Mactaquac where smolts were trapped in the trough-shaped tops of rising gates and dead smolts were observed in the tailrace after apparently passing through the turbines.

2.2 EAST RIVER (SHEET HARBOUR), NOVA SCOTIA

The salmon rehabilitation program for the once-productive East River entered its fourth year in 1968 and good progress was made in stocking adult fish from a sister stream and testing the experimental louver installation.

Fifteen Mile Stream, a tributary to East River, received 103 adult salmon in which there was an equal number of males and females. Of this total, 57 were apparent remnants of the East River run and the remainder were transported from collection facilities in the neighboring West River. Spawning activity was observed during the three week period from late October to mid-November and an investigation of redds on the spawning grounds revealed that spawning had been successful.

Population densities and distribution of juvenile salmon residing in freshwater were monitored by electro-seining for the second consecutive year and data were compared with those from West River. Low fry densities (4.8 per 100 square yards) in East River in 1968 reflected the shortage of adult spawning stock in 1967. However, the average density of 1966 brood parr (3.5 per 100 square yards) is considered satisfactory in that it approached the average density established for West River. Fry were concentrated on the spawning grounds in Fifteen Mile Stream whereas parr were more evenly distributed throughout the stream.

Excellent progress was made in the second year of tests on the experimental louvers located in the power canal of Ruth Falls Hydro Development at East River. Hatchery-reared smolts were used in the tests. The louvers are designed to divert downstream migrating salmon to a by-pass channel and away from the turbine intake. Guiding

efficiencies were significantly increased when the ratio between by-pass and approach velocities was greater than one and trash wood and predators were eliminated from the test area. In addition to these items, the variables of louver bar spacing and smolt vertical distribution were studied.

A suitable ratio of by-pass to approach velocity was achieved by manipulating the size of the by-pass opening through blockage, thereby altering water velocity in the by-pass channel. Special tests were designed to investigate the vertical distribution of smolts in the 12 feet deep power canal as well as the effect of extreme acceleration on guiding efficiency. It is encouraging to note that guiding efficiencies in the order of 90 per cent were achieved when the opening extended just two and one-half feet below the water surface. These and other findings will be incorporated into the design of future louver installations.

2.3 INVENTORY AND ASSESSMENT

Three District Biologists were given permanent assignments to their respective field headquarters in 1968. This marks the beginning of a long-term program to gather biological data on Maritime Province waters which is pertinent to the overall maintenance, management and development of the various fisheries throughout the region.

2.31 Fredericton District

The attentions of the biologist in this district were focused primarily on censusing juvenile salmon stocks and stream rearing potential in a number of tributaries to the Saint John River, including the Canaan, Kennebecasis, Keswick, Nashwaak, Nackawic, Becaguimec, Shikatehawk, Tobique and Little Salmon rivers. Two of these, the Keswick and Becaguimec were selected for detailed study.

Relatively high fry densities in two tributaries immediately below Mactaquac Dam may reflect in part the effects of this obstruction on the salmon spawning migration in 1967. This is further exemplified by the relatively low fry densities in tributaries above Mactaquac. Fry and small parr were practically non-existent in the Tobique River and large parr were estimated to be approximately two-thirds of the normal index of 9 fish per 100 square yards.

2.32 Newcastle District

Important gaps in the knowledge of New Brunswick inland fisheries were filled in 1968 when the biological team out of Newcastle completed inventories in three important streams in this area: the Bartholomew, Bartibog and Nepisiguit rivers.

Highest densities of juvenile Atlantic salmon were recorded in the Bartibog River while useful information was obtained for a continuing evaluation of the seeding requirements of the Bartholomew River. Recommendations are being prepared on the potential for Atlantic salmon development of the upper four-fifths of the Nepisiguit River drainage basin above Nepisiguit Falls. The total basin area of this river is 900 square miles.

2.33 Nova Scotia District

In the absence of adequate numbers of staff in 1968, one Halifax-based biologist was given responsibility for the inventory and assessment work in Nova Scotia.

Considerations by other government agencies to build a causeway across the Shubenacadie River estuary provided the impetus for an intensive survey of this large river system, with particular emphasis on the Stewiacke River tributary. The effects that the proposed causeway will have on fish are being forecasted.

Exceptionally high densities of juvenile Atlantic salmon were found throughout the Stewiacke River system and there are indications that this river is one of the top producers of salmon in the Maritimes. The presence of other fish such as trout, eels, shad and striped bass was also recorded. Valuable information is currently being developed on the capacity of this river to support fish and the optimum number of spawners needed. This investigation will continue.

A brief field survey of West and Middle Rivers in Pictou County revealed that the two causeways located in Pictou Harbour do not cause any severe obstruction to the salmon spawning runs but that there may be some delay to descending smolts in the spring.

2.34 Hatchery Smolt Evaluation Program

A long-term program was initiated in 1968 designed to evaluate the benefits accruing to various salmon fisheries from stocked hatchery-reared smolts. A total of 59,700 tagged smolts, over 48,000 of which were hatchery produced, were distributed to four selected rivers in Nova Scotia and New Brunswick.

	SMOLTS	
River	Hatchery-reared	Native
Miramichi, N. B.	18,800	3,490
Big Salmon, N. B.	10,000	5,060
West (Sheet Harbour), N. S.	9,840	2,730
Philip, N. S.	9,780	-
TOTALS	48,420	11,280

Benefits will be assessed in future years as tags are returned from commercial fishermen, anglers, counting fences and sampling traps. A large amount of biological and other data is being recorded and a computer program is being developed for the analysis.

2.35 Miramichi Estuarial Traps

This is the fifteenth consecutive year of sampling smolt and adult salmon in the Miramichi estaury near Chatham in order to provide an annual index of the timing and magnitude of migrating salmon runs.

The adult salmon trap was operated from May 24 to November 7 inclusive and a total of 4,710 large salmon and grilse were counted during the upstream migration. This total is almost 50 per cent below the yearly average recorded since 1954, thereby making 1968

one of the poorest years on record for salmon abundance. Seventy per cent of the run was grilse.

In opposition to the timing of the runs in previous years, a majority of large salmon and grilse entered the trap prior to mid-August (Figure 2), rather than after this date. Grilse dominated the early run whereas a higher proportion of large salmon appeared later in the season.

Numbers of grilse were substantially less than in previous years and this decline was also reflected in low angling catches along the freshwater reaches of the Miramichi River and tributaries.

Problems were experienced with the smolt trap in 1968 following construction of a causeway to Middle Island which is directly below the trap site. Hydrokinetic conditions have been severely altered so that the stronger water currents no longer pass through the sampling gear. As a result, only 6,467 smolts were counted during the spring seaward migration. This represents about one-sixth of the fourteen-year average annual total. Alternative trap sites are being considered for the 1969 fishing season.

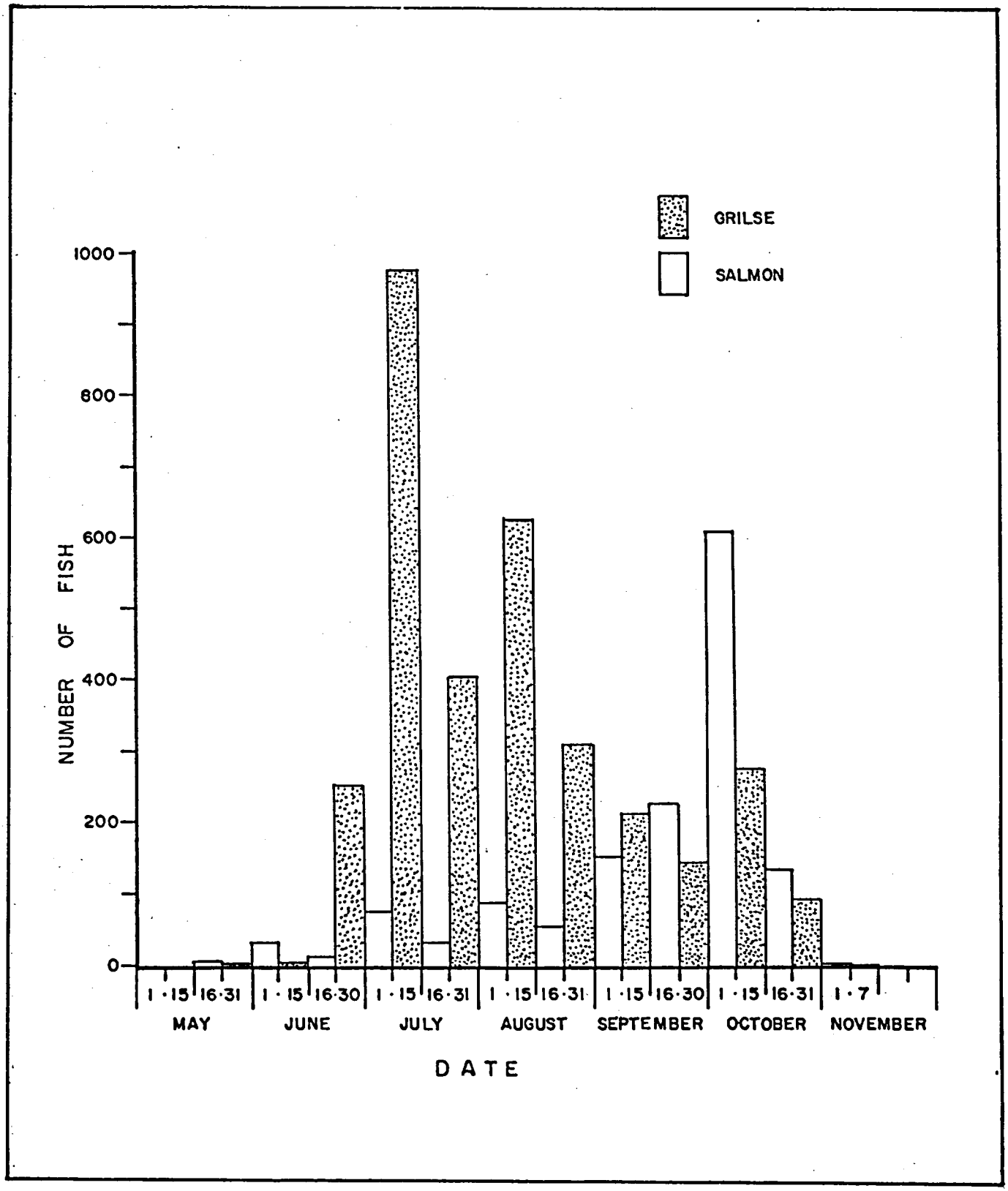

Figure 2. Numbers of Atlantic salmon, in bi-monthly intervals, at Miramichi River estuarial trap near Chatham, N.B., 1968.

2.4 FISHERIES MANAGEMENT PROGRAM

The fisheries management program, initiated in 1968, is developing biological knowledge of Maritime Atlantic salmon fisheries upon which rational management recommendations can be based.

The commercial utilization of salmon stocks in thirteen selected areas of the Region was investigated according to types of gear. In New Brunswick, the Provincial Fish and Wildlife Division co-operated and assisted in data collections from fishermen in the Saint John River area; Bay of Chaleur, Miramichi Bay and Richibucto salmon fisheries were also investigated. Nova Scotia areas included Antigonish, Ingonish, Louisburg, Sherbrooke, Musquodoboit Harbour, St. Margaret's Bay, Bridgewater, Liverpool and Halls Harbour. In each area, two to six commercial fishermen were asked to keep daily catch and effort records, and on one day each week during the fishing season all salmon in his catch were individually weighed, measured and a scale sample taken for aging.

As an example of the kind of information forthcoming from this program, large salmon caught in the Miramichi drift net fishery were found to be 10 per cent heavier than those caught in the stationary trap nets while the weight of grilse taken by these two types of gear was the same. The trap net fishery reported almost 10 per cent grilse which is five times higher than the drift net fishery. Over 87 per cent of the total sample from these fisheries in Miramichi Bay had resided three years in freshwater and 2+ years in the ocean.

Many management decisions are based on fisheries statistics and for this reason the reliability and biological usefulness of present commercial statistics is being examined by Branch personnel.

A computer is being employed to process data and test the value of proposed changes. Angling statistics are also being scrutinized and efforts are being co-ordinated with staffs of Provincial Fish and Wildlife agencies.

2.5 OYSTER PROGRAM

2.51 Oyster Development

The two basic problems currently facing the oyster industry of Eastern Canada are insufficient supplies of seed oysters, and the need to develop more efficient means of rearing seed oysters to market size. Studies were begun or continued in 1968 on three aspects of seed production and four methods of floating tray rearing.

A mobile oyster hatchery, operated by the Department, was used to test a potential hatchery site at Freeland Creek, Prince Edward Island and collect information on the factors influencing spat production.

Operations were generally successful in that it was demonstrated that hatchery production could be carried out at the site tested. A private commercial unit, which will be in production in early 1969, has now been built at this site.

Although capable of determining the suitability of a site, the mobile unit, due to its size and complexity, is unable to give good production cost estimates or to develop commercially applicable techniques. It has, therefore, been decided to use the unit as a mobile laboratory in other oyster development projects.

Efforts to determine the effectiveness of the bottom management technique of planting shell for spat settlement proved highly successful. Three areas of Summerside Harbour were selected for this experiment. Each plot of 900 square yards was planted with 150 oyster boxes of broken scallop shell. The results tabulated below indicate that a two to thirteen fold increase in spat settlement is possible.

	Spat per square metre	
	Experimental	Control
Dunk River		
Plot 1	804	497
Plot 2	152	12
Wilmot River	380	62

In addition to experiments with the mobile hatchery and bottom management techniques for increasing seed production, certain commercial spat collectors were also assessed.

Further experimentation and assessment was carried out on the plastic-topped rearing trays designed in 1967. These are designed to take advantage of the greenhouse principle. Growth and body condition were as good as or better than in the control but the differences are not as marked as in 1967, and it will be necessary to continue assessment. Attempts will be made in 1969 to modify the tray sufficiently to make commercial use practical.

Another new tray, designed and tested in 1968, may prove practical for commercial culturists. It consists of a polyvinyl chloride pipe frame with plastic mesh bottom and sides, and is designed for suspension from long-lines or floats. Oyster growth and condition in this tray compare favourably with that achieved in standard board topped trays. The cost is approximately half that of the standard tray. The handling of these trays is difficult but this can be overcome by designing a boat specifically for this purpose.

Modifications of the Japanese long-line technique and the development of light but efficient floats offer some promise for the suspended culture of bedding or shucking oysters. Two shore-to-shore long-lines have been strung across small coves in the Gillis Cove area of Bras d'or Lake. Strings of scallop shells, previously set

with spat, have been suspended from the long-lines and floats and the spat will be grown to maturity on them. Growth and condition will be monitored.

A fibre-glassed, paper tube float, consisting of two 6-inch by 12-foot paper tubes connected in parallel by four smaller paper tube cross members has been developed. Light enough to be easily lifted by one man, this float is capable of supporting approximately 400 pounds of collectors and oysters. It has been loaded with collectors, anchored in Gillis Cove, and left in the ice to determine its durability as a year round suspension device.

2.52 Oyster Management

Figures available for the first eleven months of 1968 show an increase in the quantity of oysters landed in all three Maritime Provinces.

Caraquet Bay, New Brunswick, was fished this year for the first time since the oyster disease struck in the late 1950's. Approximately 1,800 boxes were taken at a landed value of $29,000.

The spring fishery for relaying to pure water from contaminated areas of the Miramichi River was up this year to 442 boxes, with indications of a good fishery in 1969. Similarly, over 10,000 boxes were relayed from contaminated areas in Summerside Harbour. This is an increase of over 1,000 boxes compared with 1967 and may be attributed to the early disappearance of ice from the harbour along with better fishing weather.

Spat were collected in the three Maritime provinces using cement-coated cardboard egg case fillers, crushed scallop shells, veneer rings and plastic collectors.

Sales were made of seed oysters reared by the Department at Conway Narrows in Prince Edward Island and Orangedale, Nova Scotia. In addition, 86 boxes of spat were spread back on the Conway Narrows Farm. A tabulation of sales of seed oysters (in numbers of boxes) since 1964 is presented below.

Year	P.E.I.	N.S.	N.B.	Total
1964	154	30	138	322
1965	234	40	177	451
1966	210	38	226	474
1967	278	44	280	602
1968	209	26	163	398

Two field survey crews surveyed or re-surveyed a total of 225 new areas for oyster leases along with 43 old areas. A breakdown by province is presented below.

	New Areas	Old Areas
Prince Edward Island	83	20
New Brunswick	122	18
Nova Scotia	20	5

Four weeks were devoted to completing an inventory survey of Tabusintac Lagoon and River in New Brunswick.

Three Public Health Shellfish closure boundaries were established and marked with concrete monuments in Prince Edward Island, twenty-seven in Nova Scotia and six in New Brunswick.

During 1968, eighty concrete monuments were installed; twenty-three as reference points for oyster lease surveys and fifty-seven as boundary markers for Public Health Shellfish Closures.

Oyster spat abundance was monitored using a collector float

in the Richibucto and St. Louis Rivers in New Brunswick; heavy sets were recorded for each area.

An examination of the public fishing area in Neguac Lagoon, New Brunswick, was carried out prior to the opening of the public fishing season and on the south side of Miramichi Bay during the public fishing season.

Oyster leases increased in number by 84 (273 acres) in 1968 and this is incorporated into the following summary of Maritime leases.

	No. of Leases	Area (acres)
Prince Edward Island	1,093	3,400
New Brunswick	733	1,785
Nova Scotia	206	538
TOTALS	2,032	5,723

During the past year, 190 leases were cancelled for non-payment of rental and 84 were reinstated throughout the Region. A total of 287 applications for oyster leases were received, an increase of 8 per cent over 1967.

2.6 POLLUTION

2.61 Base Metal Mining

Base metal mining wastes continue to cause problems in north-eastern New Brunswick. Toxicity readings were low in the Northwest Miramichi River below the Heath Steele Mine during the summer and early fall, but were high during periods of heavy runoff late in the fall. Improved facilities on the mine property have helped to control pollution during the winter months. Additional facilities are still necessary to control pollution during periods of heavy runoff.

Mine wastes from the Brunswick #12 development continue to pollute Little River. Unfavourable conditions for fish life also exist in the Nepisiguit River below Brunswick #6 development during the spring runoff.

The Wedge Mine located near the confluence of 40-Mile Brook and the Nepisiguit River closed because of the lack of high grade ore. The mine water treatment ponds were sealed with earth to prevent future contamination from this area. Waste disposal facilities at Nigadoo River Mine have been successful in preventing contamination of the river below the property. A water sampling program was continued to obtain background information at five other prospective developments in the area.

Biological surveys were conducted to collect background information on the Upsalquitch River and the Sevogle River, in anticipation of the opening of base metal mines in these areas.

2.62 Pulp and Paper

The effluent treatment facilities were monitored at the new

Scott Maritimes Limited 500 ton bleached kraft mill located at Abercrombie Point in Pictou Harbour to ensure that effluent quality is being maintained. The results of these tests indicate that the average BOD reduction in the Boat Harbour Lagoon during 1968 was 77 per cent. Bioassay tests, using young Atlantic salmon, indicated that the treated effluent was non-toxic at 65 per cent concentration, and during December was non-toxic at 100 per cent concentration.

The effluent from Anil Canada Limited hardboard plant continues to pollute East River, Chester, in Nova Scotia, as well as a section of Mahone Bay. Tests carried out during the summer and fall indicate that the effluent has a high BOD, and is quite toxic to fish. The bottom of the lagoon has to be sealed before the effluent can be effectively treated.

The effluent from Fraser Companies Limited bleached kraft mill at Newcastle, New Brunswick, continues to pollute the Northwest Miramichi River. Tests carried out in the area indicated that the pollution was severe in the river near the mill. A survey carried out for the Branch by Dr. W. K. Oldham of Stanley Associates indicated that sufficient land is available on the company property to provide biological treatment facilities. Negotiations will continue concerning adequate effluent treatment facilities.

In June 1968, Fraser Companies Limited approached the New Brunswick Water Authority with a proposal to change from sulphite to kraft at their Edmundston mill. Under this proposal, the mill would produce 700 tons/day of bleached kraft, 300 tons/day of groundwood and 100 tons of liner board. Negotiations are being held with the Company to ensure that adequate effluent treatment facilities are

installed.

2.63 Other Industries

Negotiations were carried out with the British American Oil Company concerning effluent treatment facilities for their refinery to be built at Point Tupper, Nova Scotia. The crude unit will be large enough to handle 87,000 bbls. per steam day of crude. The effluent from the crude unit together with the ballast water will pass through separators to remove excess oil, before being treated in a two day retention pond and a three day aeration pond. Branch personnel feel that if the effluent objectives are attained, the treated effluent will not adversely affect the fishery in the area.

Negotiations were carried out concerning effluent disposal facilities for the Canadian Industries Limited caustic-soda chlorine plant to be built at Abercrombie Point, Nova Scotia. They propose to treat the effluent in Boat Harbour Lagoon.

The untreated effluents from food processing plants continue to be troublesome in some areas. During the spring of 1968, many thousands of spawning smelts were killed in the Barbara West River in Prince Edward Island from some toxic material discharged from Seabrook Farms Frozen Food Limited plant. A meeting was held at the plant on June 18 to discuss the problem. The Company proposed to build a series of three lagoons which will provide primary treatment, and to continue spray irrigation during the summer.

2.64 Agricultural Spray

The Department's bioassay program was continued this year at the Cardigan Fish Culture Station, Prince Edward Island, in order to assess the toxicity of eight additional agricultural chemicals to

fish. During the last three summers, twenty agricultural chemicals, peculiar to our area, have been tested in order to assess their toxicity to fish life.

2.65 Forest Spraying in New Brunswick

Biological studies in 1968 indicated that stocks of juvenile Atlantic salmon were little affected where the organophosphate insecticides sumithion and phosphamidon were sprayed. Reduced fish populations reflected the use of DDT. Baygon, a new insecticide, was found to be relatively non-toxic to salmonids. Populations of aquatic invertebrates, the fish food organisms of young salmon, were slightly reduced where sumithion was sprayed, but recovery to former levels appeared to be rapid.

2.66 Saint John River Pollution

Both quantity and quality of water diminished during the summer and early fall in the Saint John River. River discharge for the summer of 1968 was the lowest ever recorded. Dissolved oxygen concentrations fell below levels necessary for fish survival on the upper Saint John between Edmundston and Beechwood. This was a direct result of gross organic pollution. Effects of this pollution were observed in the new Mactaquac flowage where dissolved oxygen concentrations approached critical levels for fish.

Sixteen fish kills were reported and investigated on the Saint John River in 1968. Two kills in late summer below Mactaquac dam resulted in the death of many adult salmon. These kills have been attributed to gas bubble disease. Subsequent tests demonstrated increases of nitrogen gas concentrations well above saturation values,

due to super-aeration of water as it passed through the turbines. Other causes of fish kills have been identified as turbine mortalities other than gas bubble disease, spills of agricultural pesticides and oxygen depletion due to gross pollution.

2.67 Marine Seismic Explorations.

Marine seismic surveys were conducted in the coastal waters of the Maritime Provinces by five oil companies and by Ocean Science and Engineering, Incorporated. Pan American Petroleum Corporation, Texaco Explorations Company and Hudson Bay Oil and Gas Company Limited conducted surveys in the Gulf of St. Lawrence area. Mobile Oil Canada Limited continued their work near Sable Island and in the Bay of Fundy. Shell Canada Limited concluded their seismic program off the Nova Scotia coast prior to test drilling in 1969. With the exception of a small sonobuoy survey conducted by Shell, non-lethal energy sources were used during the operations.

Ocean Science and Engineering, Incorporated, conducted a survey immediately adjacent to the Atlantic shoreline of Nova Scotia for Matachawan Canada Gold Limited. As a result of this survey, a small placer mining operation for gold will be carried out in selected areas during 1969.

2.7 STREAM ALTERATIONS

As in the past, many de facto and proposed alteration projects arose which required technical advice from Branch personnel. The following items are included under this heading: gravel removal, bank erosion control work, pool formation, stream diversion, multi-purpose dam construction, bridges and culverts.

The New Brunswick Stream Alterations Committee, including a representative from the Resource Development Branch, reviewed approximately 50 applications of which 15 were for permission to create ponds on small streams and the remainder were for gravel removal, pool formation or restoration, erosion control work and bridge construction.

Forty-seven applications were processed by the Nova Scotia Water Resources Commission after consultation with Resource Development Biologists. Included among these applications were the Avon River Causeway, Nictaux River Irrigation project, dam construction and dredging of Musquodoboit River, and gravel removal from Salmon-North (Truro) rivers. Considerable effort was expended on a survey of selected portions of the Musquodoboit River in order to assess the effects of proposed dams on fish populations in the river.

2.8 ATLANTIC PROVINCES WATER RESOURCES STUDY

In 1966 the Atlantic Development Board instituted a study of the fresh and estuarine waters of the Atlantic Provinces with the aim of developing a comprehensive plan for the management and use of this valuable resource in the region. All facets of supply, including both the quantity and quality of water available, and demand, both present and forecasted, were to be investigated by Consultants as far as available data would permit and would be incorporated into Stage I of the study. This part of the work was completed during the current year and an important contribution related to the demands of fish for water was made by this Branch.

In view of the importance of the recreational and inshore commercial fisheries in Eastern Canada and the anticipated impact of the Water Resources Study on future water use and allocation, a Biologist was assigned to the project for the duration of Stage I and he spent over seven months of the past year on temporary assignment in Ottawa working directly with the Consultant. As a result of this work, a series of descriptive fisheries reports were completed for 23 selected river basins in New Brunswick and Nova Scotia and for the Province of Prince Edward Island. The following rivers were included in this "Fisheries River Basin Study" series: Restigouche, Nepisiguit, Miramichi, Richibucto, Petitcodiac, Saint John, Magaguadavic and St. Croix in New Brunswick; and Shubenacadie-Stewiacke, Salmon-North, Avon, Cornwallis, Annapolis, Mersey, Medway, LaHave, Gold, St. Mary's, Bras d'Or Lake, Margaree, West-Middle-East (Pictou) and Philip in Nova Scotia.

PART III

ENGINEERING DIVISION

3.1 MACTAQUAC FISH CULTURE STATION AND COLLECTION FACILITIES

Construction of the two million dollar Mactaquac Fish Culture Station was virtually completed in 1968, culminated by the official opening on October 18. Considerable engineering staff involvement continued throughout the year involving frequent site inspection of construction operations, assessment, modifications and improvements to this facility.

Negotiations were finalized with the New Brunswick Electric Power Commission for the design and construction of a smolt release channel, design and installation of mechanical filtering equipment for filtering the river water supply for the incubating facility, and mechanical travelling fish feeders for the rearing section. Negotiations are continuing regarding design of automatic fish feeders for the incubating facility and modifications to the aerating facility.

To provide more flexibility in the river water and ground water blending process, departmental engineers designed and supervised construction of additional facilities during the year. The additional facilities will permit independent control of water temperatures entering the jar culture units and total blending of the ground water and river water entering the incubating units.

Specifications have been prepared for a comprehensive water quality monitoring and recording installation. This system is expected to be in use in 1969.

Negotiations are continuing with the New Brunswick Electric Power Commission regarding the provisions for an adult sorting and holding facility at Mactaquac to permit selection and limited retention of brood stock salmon and 100 per cent separation of

salmon from non-salmon species.

The newly constructed fish handling facilities at the Mactaquac dam commenced operating in time to accommodate the early spring run of anadromous fish ascending the St. John River. Several minor operating difficulties were encountered resulting from mechanical problems with the equipment. Due to the tailwater levels dropping substantially lower than predicted by the engineering consultants, problems were encountered with the automatic operating features incorporated into the facility. The consultants have this matter under study to determine what modifications are necessary to resolve this operating problem.

During the year hydraulic assessment of the Mactaquac fish handling facilities was conducted and resulted in action being taken on various adjustments to the central diffusion works. The hydraulic assessment program is to be continued in 1969 to determine various hydraulic features under higher tailwater conditions. Negotiations were finalized and appropriate action taken by the New Brunswick Electric Power Commission regarding several improvements necessary to enhance the operational features and efficiency of this facility.

3.2 EAST RIVER (SHEET HARBOUR), NOVA SCOTIA

No major construction was undertaken on the project this year, but several small additions and modifications were made. Improvements to the Ruth Falls collection facility water supply included changing the location of the pump intake and addition of a wing wall to the gravity water supply reservoir.

At the louver site, a floating trash rack was installed and a foot bridge was built for velocity measurements in the power canal. The louver bypass has been redesigned to take advantage of the information derived from the test program. The new design should result in satisfactory guidance at a smaller discharge.

An evaluation was made of the various means available to provide water to be diverted at the louvers. As the quantity of water to be provided is still not determined, this matter is not yet resolved. A site survey of the Malay Falls power canal was completed and design studies are proceeding on the problem of installing downstream guidance for smolts at this site.

3.3 MISCELLANEOUS FISHERIES DEVELOPMENTS

3.31 LaHave River, Nova Scotia

A promising potential development for Atlantic salmon and other anadromous species is presented by a large inaccessible portion (almost 50 per cent of the total drainage basin area) of the LaHave River above two barrier dams. It is estimated that the Atlantic salmon rearing area of the basin will be doubled by the provision of access to the upper basin and that a similar increase in the number of salmon available to both sport and commercial fishermen will also occur. The current angling catch averages 400 salmon per year while commercial fishermen capture 500 to 700 per year.

Detailed engineering surveys were conducted in 1968 in the upper reaches of the LaHave River to determine the stream areas available for salmon rearing during low water levels. A stream area/discharge relationship was established to extrapolate the minimum flow requirement. Site surveys were conducted at two obstructions, Morgan Falls and Zwicker's Dam, in the central part of the drainage basin. A vertical slot fishway has been designed for each location. Contract documents are being prepared and construction is expected to begin in 1969.

3.32 Tusket River, Nova Scotia

A detailed survey was made of a hydro-electric generating station on the estuary of the Tusket River to determine most feasible fish passage facilities and respective costs. An inventory survey was also conducted in the upstream portion of the river system. There is an opportunity to substantially

increase runs of Atlantic salmon and alewives in this river.

3.33 Musquodoboit River, Nova Scotia

A watershed management program initiated by A.R.D.A. on the Musquodoboit River is now in the fourth year of development with four of the fifteen proposed water retention dams completed. Besides the monitoring of this program to detect changes in the system that may alter the natural habitat for salmon, considerable attention has been directed to the possibility of utilizing the reservoirs for augmenting low stream flows. In this connection, preliminary surveys were conducted at various points throughout the system to determine flow distribution and the stream area discharge relationship.

3.34 St. Mary's River, Nova Scotia

The analysis of data from a previous inventory survey of the St. Mary's River indicated that low water levels during dry weather periods are not critical by rates of occurrence and magnitude. Flow control studies on this river were discontinued as little evidence is available to indicate that the present magnitude of low flows reduce the status of the system or that the potential would be increased sufficiently through flow control to justify the costs.

3.35 Nepisiguit River, New Brunswick

General reconnaissance of the Nepisiguit River included the survey of a major obstruction near the estuary. It consists of a natural rock falls and a concrete dam. The dam supplies a hydro-electric generating station owned by the Bathurst Power and

Paper Company. A detailed survey was made at the site to depict the physical characteristics and provide an estimate of costs for fish passage facilities.

If the development is found to be feasible, it could result in this river being rated among the top three or four Atlantic salmon angling rivers in Canada. The apparent supporting potential of the river is for a total stock of from 10,000 to 15,000 salmon per year, compared with the present stock of 2,000 to 3,000 fish per year.

3.36 Other Work

Preliminary surveys were made on the Tetagouche, Didgeguash, Pocologan and Lepreau Rivers, New Brunswick as part of the continuing inventory survey program to document the topographic and hydrologic characteristics of river systems in the Maritimes Region for classification and development potential.

3.4 FISHWAYS AND OBSTRUCTIONS

Considerable staff effort was directed towards the provision of adequate adult fish passage facilities in dams proposed by the Department of Forestry and Rural Development under the A.R.D.A. program. Fish passage facilities have been designed for Sherlock Homes Storage Dam on the Musquodoboit River and Sand Pond control structure located on a tributary of the Argyle River System, Yarmouth County. Negotiations were finalized with A.R.D.A. agency regarding the design and installation of temporary counting facilities for the newly constructed Petitcodiac River Fishway at Moncton, New Brunswick.

Negotiations are continuing with the St. Croix Pulp and Paper Company regarding adequate fish passage facilities to be incorporated in the reconstruction of Forest City Dam at the outlet of East Grand Lake on the St. Croix River.

Discussions are in progress with Foundation of Canada Engineering Limited relative to suitable fish passage facilities to be incorporated into a storage dam on the outlet of Moore's Mill Lake, Charlotte County, New Brunswick. The storage facilities are being constructed by the St. Stephen's Water Commission to provide additional water storage for domestic use.

Discussions are in progress with the Nova Scotia Light and Power officials regarding additional and improved facilities for the White Rock Fishway located on the Gaspereau River, Kings County, Nova Scotia. Discussions have centered around the possibility of providing additional attraction water and restoring this

structure to the original design layout that existed prior to the 1967 land slide that dislodged the lowermost section. Branch engineers have prepared functional design layouts to assist the Company engineers in the detail design of these improved facilities.

Discussions are in progress with the Sydney Steel Corporation regarding the complete rebuilding of the Sydney River Fishway. Branch Engineers are reviewing the information available to determine the feasibility of designing and constructing a denil type fishway instead of a pool and weir type design at this site.

Maintenance and improvement work was carried out on a number of existing fish passage facilities during the year and include the following: supervision of repairs and rebuilding a portion of the Bartholomew River Fishway at Blackville, New Brunswick; and repairs to the Magaguadavic River Fishway at St. George, New Brunswick, Pollett River Fishway at River Glade, New Brunswick, Fraser Mills Fishway at Fraser Mills, Nova Scotia and Grand River Falls Fishway at Grand River, Cape Breton, Nova Scotia.

Routine stream obstruction reports were received during the year and remedial action taken to alleviate the problems created by these obstructions to anadromous fish stocks. In this regard, two large blockages were removed from the lower reaches of Middle River, Cape Breton, Nova Scotia.

The engineering staff advised on and approved the installation of water intake screens for various pumping and diversion installations during the year.

A large number of stream channelizations, gravel removal activities, and bridge and culvert installations were assessed and solutions to these problems were recommended.

3.5 OYSTER PROGRAM

A greenhouse for growing algae under artificial conditions is being constructed at Ellerslie. The algae will be used as supplemental feed for oysters.

The mobile hatchery was completed and commissioned during the year. The boiler capacity was found to be deficient and additional coils have been ordered to remedy this. Generally, the equipment performed satisfactorily.

An experiment has been set up to evaluate the performance of a high humidity cold storage method of storing oysters in comparison with the standard dry cold storage. This investigation is proceeding.

3.6 FISH CULTURE STATIONS

Modernization of the fish culture stations provided varied work for Resource Development Branch engineers during 1968. Design and testing of the new fiberglass fish feeder was completed and this unit is now being installed at all stations. In addition to the feeding units, an automatic timing and switching control board was developed to a local design and the prototype installed and tested at Cobequid Station. Similar control panels are now being manufactured for all stations. The additional electrical loads which have accumulated at most stations necessitated extensive re-wiring.

Equipment for the jar culture of eggs is being installed at all stations. The installation at each station includes, in addition to the racks, jars and plumbing, a pressure sand filter and a chemical treatment system. The 1968 brood of eggs is being partly raised in jars. Installation at some stations was not sufficiently complete to allow its use.

Eight foot diameter circular fiberglass tanks have been installed indoors at some stations to enable rearing of emerged fry under more ideal conditions.

New pumps have been installed for well water supplies at Charlo and Miramichi Stations.

The contract for the construction of the Mersey Ponds was completed and these ponds are now in use. A service building for this station is now being erected.

A new model fish transportation tank was built of fiberglass reinforced plastic and tested. This tank is capable of carrying 150 pounds of fish for six hours. Two similar tanks are now being modified to include the improvements.

PART IV

FISH CULTURE DIVISION

4.1 PRODUCTION

Several major physical and operational changes were effected in 1968 in an effort to further increase the efficiency of hatcheries and rearing establishments in the Region. Five older, less productive stations were closed; one station in Western Nova Scotia was completely rebuilt; and Mactaquac Fish Culture Station, the largest for Atlantic salmon in the world, was officially opened. Substantial progress was also made in the conversion and modernization program through increasing automation and in the continuing program to restrict Atlantic salmon production exclusively to smolts.

Mactaquac Fish Culture Station was placed in limited production early in 1968 when eyed eggs in March and 113,000 yearling salmon in May were transferred from other Maritime stations. The first smolt release from this small stock of yearlings will be made in 1969.

Several months delay in the completion of the station created many operational problems during the past year. The facilities provided to control water quality and temperature have not proved satisfactory and will be modified to provide suitable dissolved oxygen and temperature levels at all times.

Production of salmon and trout at all the other stations reached a very high level this year and, even with the closure of five stations, the total production by weight was down only 10 per cent. With some additional modifications to ponds and holding facilities, production of smolts can be doubled with no additional labor and operational costs except for food. In 1968, food conver-

sion was maintained at a very satisfactory level of 2.2.

Experimental feeding using different diets was conducted again in 1968 and although several groups of both salmon and trout were held on a 100 per cent dry diet, mortality in the early stages was very high. More work is needed before the use of this type of diet becomes universal throughout the Region.

A good supply of 44°F well water at the Charlo and Miramichi stations is being used in the indoor rearing tanks to raise the temperature of the river water above the normal winter level of 32°F. This will reduce the high mortalities in fingerling salmon carried over winter. Some of the well water will be used to control water temperature in the egg incubating units; this will advance the hatching date and lengthen the feeding season by several weeks at these stations.

The 20 modern rearing ponds at the Mersey Station have been completed and this unit is now in full production.

The production figures presented in Table I represent a 50 per cent reduction from 1967 in the number of fish produced. This is explained by the shift in emphasis from the production of many small fingerlings to the production of larger fish such as 16 centimeter trout and Atlantic salmon smolts.

TABLE I PRODUCTION OF FISH AT FISH CULTURE STATIONS, MARITIMES REGION, 1968

Species	No. ('000)	Weight (lb.)('000)
Atlantic Salmon		
fingerlings	3,212.0	113.9
yearlings	982.0	
Speckled Trout		
fingerlings	3,725.9	107.6
yearlings	160.5	
Brown Trout		
fingerlings	299.9	6.7
yearlings	2.6	
Rainbow Trout		
fingerlings	109.2	2.5
yearlings	1.4	
Landlocked Salmon		
fingerlings	0.3	6.7
yearlings	130.9	
TOTALS	8,624.7	237.4

4.2 DISTRIBUTIONS

Atlantic salmon eggs were transferred to Sir George Williams University, Montreal; University of Krakaw, Poland; State Laboratories, Sydney, Australia; and to Berlin, New Hampshire, Canaan, Vermont and Chateaugay, New York. Consignments of speckled and rainbow trout went to Dalhousie University and the Halifax Laboratory, Fisheries Research Board of Canada, respectively.

Research agencies received the following products from our Fish Culture operations:

	No.	Weight (lb.)
Atlantic salmon	20,984	297
Speckled trout	7,502	883
Rainbow trout	12	17
Landlocked salmon	278	10

Provincial agencies received 167,000 speckled trout weighing approximately 8,500 pounds from Maritime Fish Culture Stations in 1968, while the National Parks Service received over 45,000 of the same species at a total weight of 4,000 pounds.

The Fish Culture Stations received very valuable assistance in 1968 from Dr. McKelvie, Halifax Technological Station, Halifax, when he completed a survey of all Fish Culture Stations and examined stocks of fish for the presence of infectious pancreatic necrosis. Rodger Dexter, Pathologist with the Fish and Wildlife Section of the U.S. Department of Interior, provided valuable assistance to the Mactaquac Station by making a study of a disease problem there and recommending corrective procedures to control losses.