1969

ANNUAL REPORT

of the

RESOURCE DEVELOPMENT BRANCH

MARITIME REGION

DEPARTMENT OF FISHERIES AND FORESTRY OF CANADA

(RESTRICTED TO OFFICIAL USE)

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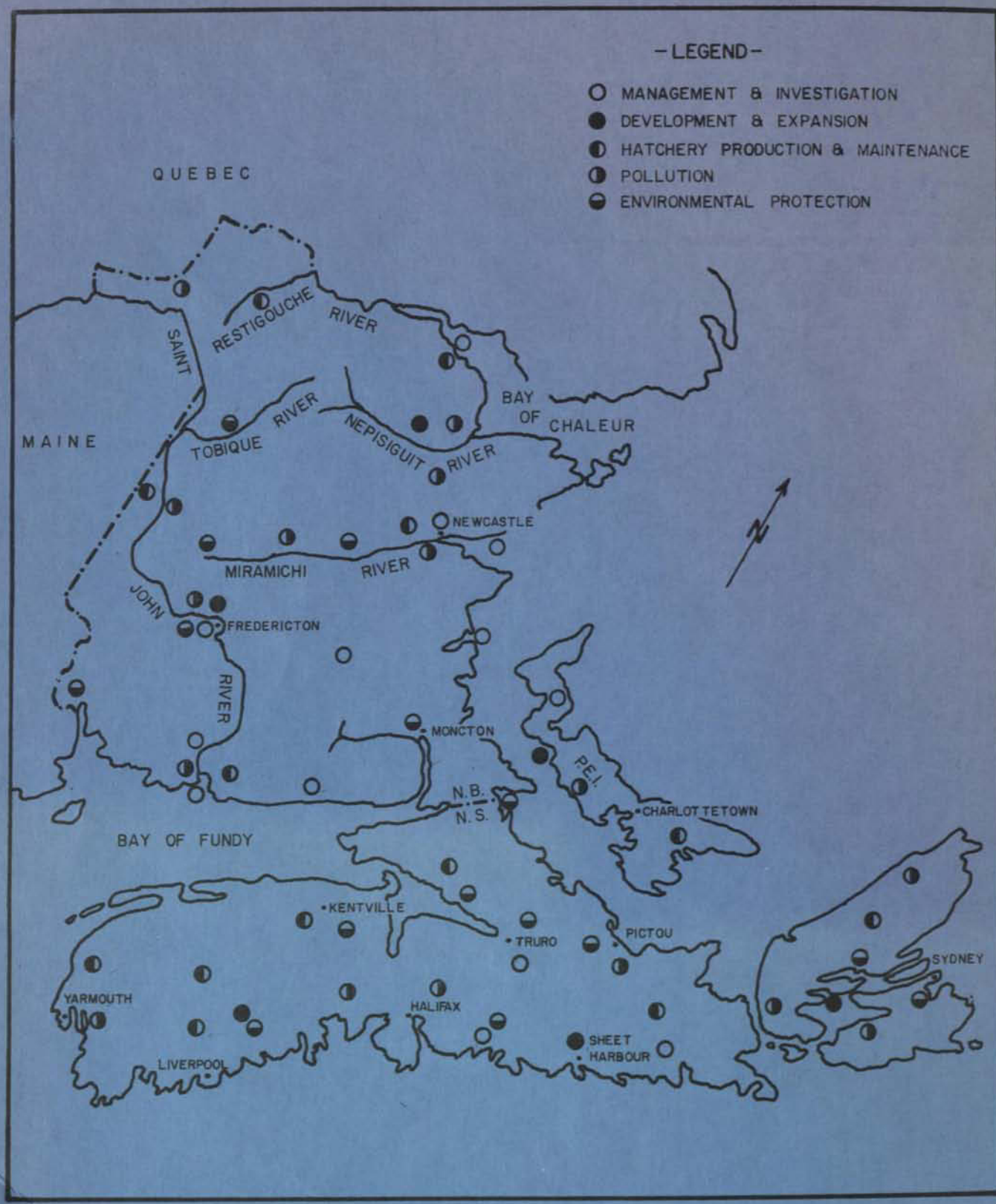

THE MARITIME PROVINCES OF CANADA

LOCATION OF THE PRINCIPAL FIELD ACTIVITIES
OF THE RESOURCE DEVELOPMENT BRANCH
IN THE REGION DURING 1969

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1.0

INTRODUCTION

1.0 INTRODUCTION

The year 1969 will be remembered by most members of the Resource Development staff as a difficult one. It will be remembered as the year that the Saint John River commercial fishermen had to tighten their belts in order to insure that sufficient numbers of fish could be available for Mactaquac Hatchery and for the Tobique River spawning grounds. It will be remembered as the year that the water quality situation and associated fish kills at Mactaquac Hatchery went from bad to worse. Most of us will remember 1969 as a year of government austerity. Most of us will remember a lack of manpower resources that seriously reduced our ability to carry out several important programs. It was a year when tough decisions had to be made concerning layoffs, reassignments and priorities. These events stimulated us to take a hard look at our overall organization with a view to increasing our general efficiency and effectiveness.

One result of this appraisal was that we organized into functional units so as to better assign staff and funds to the problems that confronted us. The new organization structure is depicted in Figure 1. This reorganization meant new jobs for key people in the Branch: Mr. Don Riley, Senior Engineer, is the new section leader in charge of Environmental Protection; Mr. John Dalziel, Senior Biologist, is in charge of our Pollution Abatement Section; Mr. Neil MacEachern, Senior Biologist, is in charge of our Management and Investigation

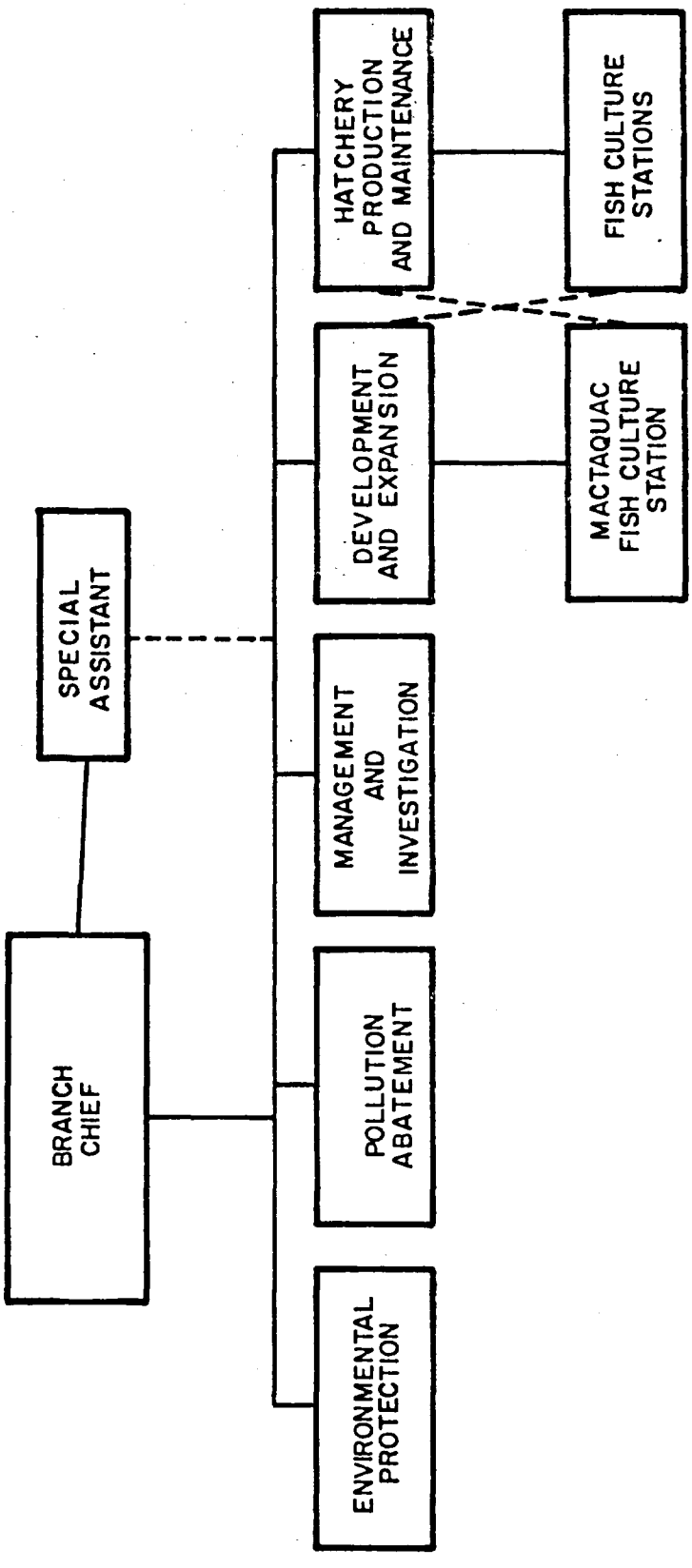

Figure 1. Organiation Chart of the Resource Development Branch, Maritimes Region. The solid lines indicate line responsibility while dotted lines show functional or advisory responsibility.

Section; and Mr. Brent Lister, Senior Biologist, is in charge of the Development and Expansion Section. Mr. Ray Macdonald remains in charge of the Hatchery Production and Maintenance activities of the Branch.

In these times of staff reductions and curtailment of funds, it is important that we re-examine our priorities to make certain that we do not neglect to perform those essential functions upon which the welfare of the salmon, trout and oyster fisheries depend. One such essential function of the Resource Development Branch involves our role in water pollution control. Despite overall cutbacks in staff strength, we have assigned more biological and engineering effort to this important phase of our work. A physiologist and a water resource engineer have been added to our pollution team thereby strengthening pollution abatement programs on the Saint John and Miramichi Rivers.

By far the most serious problem in 1969 concerned the preservation of the Atlantic salmon resource on the Saint John River. Nowhere in Canada is a major fishery resource more endangered. Water pollution, complicated by hydroelectric development, threatens to exterminate the salmon and other fish runs to the river. All of the technical resources of the Branch were deployed to solve the various problems involved. Water pollution control, artificial propagation, fish passage techniques and the scientific allocation of the salmon resource, were combined

into a total fishery management plan aimed at preserving this valuable resource.

Events on the Saint John River in 1968 had created a widespread feeling of gloom, and many anglers and commercial fishermen believed that the days of Atlantic salmon fishing on the river were numbered. We did not share this view and the Branch redoubled its efforts to overcome the serious conservation problems involved. In 1969 special commercial and sport fishery regulations were adopted to protect the reduced run from overexploitation and so provide the necessary number of spawners to continue the run. Relatively large numbers of adult salmon were placed in clean water tributary streams so as to provide natural reproduction. Over two-and-one-half million salmon eggs were taken for incubation and rearing, not only in the Mactaquac Fish Culture Station, but also in other fish culture establishments in the Maritimes. Joint study by Branch personnel and Fisheries Research Board scientists was initiated to identify the most serious contributors to pollution and the specific components of toxic material in the river.

Periodic upsurges of pollution in the Saint John River resulted in high fish mortalities at the Mactaquac Fish Culture Station, and it became essential to introduce effective backup procedures to insure that the necessary number of Atlantic salmon smolts were artifically reared for release to the river. To this end, two of our best salmon producing stations were given

the job of raising Saint John River salmon smolts; Saint John and Yarmouth Stations will each provide 250,000 smolts for liberation.

Three million acres of New Brunswick forest land was sprayed with sumithion in 1969 for spruce budworm control. For the first time since the spraying program began in 1952, DDT was not used. Resource Development studies showed no reduction in populations of aquatic insects or juvenile salmon that could be attributed to insecticide spraying. An experimentally sprayed insecticide Zectran gave the same results.

Pollution from base metal mines in northeastern New Brunswick has not diminished and substantial numbers of Atlantic salmon, particularly in the Miramichi and Nepisiquit Rivers, are still jeopardized by the escape of wastes from these operations. One company was presented with water quality standards for the receiving water so as to enable them to design adequate abatement measures.

Our program of artificial propagation of salmon has, in recent years, emphasized the production of increased numbers of smolts. The planting of young salmon fingerlings, which was standard practice a decade ago, has been reduced. We thought it wise to evaluate this technique and also to develop a strong base of information so as to increase the usefulness of our hatcheries in the future. We have committed ourselves to an eight-year evaluation program involving the tagging of large

numbers of both hatchery and wild smolts. This program was begun in 1968 and some interesting results are beginning to emerge. For instance, we have confirmed that the ocean migration routes of certain stocks of salmon are clearly different. Some, such as Big Salmon River, are taken only in fisheries along the shores of New Brunswick and Nova Scotia. Other stocks, such as the Restigouche and New Mills, ranged as far away as Greenland. Early results of our evaluation program indicate that certain of our hatchery stocks are more successful than others in providing returns to anglers and commercial fishermen. It is also evident that distant and high seas fisheries are exploiting some stocks at a much higher rate than others.

The nucleus of a biological and engineering team of fish passage specialists was formed in 1969 and work was begun on evaluating certain existing installations in the region. Their findings will have immediate value and application to our fish passage problems in the Maritimes and will also be of value and interest to fishery workers dealing with similar problems in other countries.

The oyster development unit reports encouraging results from studies on increasing the amount of bottom habitat suitable for spat settlement. We are also pleased to see that the oyster hatchery concept developed by the Branch and the Fisheries Research Board is now a commercial reality. We have made plans to turn

our attention to the development of off-bottom rearing techniques, since the relatively high cost of seed from an oyster hatchery makes it important to increase the yield from seed to market oysters.

There are many activities of staff members not covered in the Annual Report. Various members of the staff have attended scientific meetings, given talks and lectures, presented scientific papers, refereed manuscripts, served on working parties and task forces, attended special training courses and participated in various community activities of their choice. All of these activities play an important role in the overall success of the Branch.

Once again it is a pleasure to acknowledge the help and co-operation of our colleagues in the Conservation and Protection Branch and the Fisheries Research Board. Our close collaboration with them has been an enjoyable part of 1969. All of us share common objectives and it is essential that we continue to work closely together to provide effective protection and development of the fishery resource.

2.0

MANAGEMENT AND INVESTIGATION SECTION

2.0 MANAGEMENT AND INVESTIGATION SECTION

The aim of the Management and Investigation Section is to see that fish and shellfish stocks are harvested to the maximum levels while insuring that sufficient breeders are available for spawning. We must supply biological advice for the allocation of the resource between the fishermen and the reproductive requirements needed to maintain the resource in abundance. Before proper biological advice can be given, biological information must be collected and analyzed in order to provide a sound base on which a fishery can be regulated. Present efforts are concentrated on salmon, trout and oysters, and the section is organized into three sub-divisions in order to tackle the management responsibilities for these species. These three divisions are: Salmon Management, Oyster Management and District Biologists.

2.1 Salmon Management

In salmon management, the effort is divided into two main tasks: (1) obtaining a broad knowledge of catches and stocks in the Maritimes and other Atlantic regions; (2) commencing specific management techniques where salmon stocks are threatened.

The first task requires a better understanding of the Maritime commercial salmon catch because it is recognized that detailed catch statistics are an essential tool for fishery managers. In the past, commercial salmon catch statistics were collected mainly for economic purposes. In

1968 the raw data on commercial salmon catch statistics were obtained from the Economics Branch and assembled for computer processing in order to report the statistics with more specific breakdown on the catch, and to evaluate the progress that has been made to date in obtaining better statistics in regard to: (1) numbers rather than pounds caught and, (2) the reporting of salmon and grilse. A similar program, with some refinements, is being applied to the 1969 catch data. The 1967 catch figures will be handled in the same way, and these three years of detailed analysis will serve as a base for Atlantic salmon management statistics. Continuing efforts are being made to improve the techniques and methods of reporting in order to provide a uniform system throughout the Maritimes.

Along with the improvement in statistical reporting, specific data is being gathered on the commercial catch to gain a better biological understanding of stocks. As in 1968, weekly sampling of the commercial salmon catch was made at several locations throughout the Maritimes to determine weight, length, obtain scale samples for aging and gather effort information. In 1969 more intensive sampling was carried out in the three major commercial salmon fishing areas (Bay of Chaleur, Miramichi and Saint John). Selected fishermen representing various types of gear, kept

daily catch breakdowns along with records of their effort; and one day each week every salmon caught was weighed, measured and a scale sample taken by our staff. Data is presently being analyzed to provide information on catch per unit of effort for different gear, selectivity of different types of gear for different ages, weight-length relationship and frequency of repeat spawners in the landing.

Figure 2. Collecting salmon vital statistics from commercial fisherman Harry Williston on Miramichi Bay.

The second main task of the Management and Investigation Section, i.e. that of implementing specific management techniques on threatened salmon runs, is centred on the Saint John River where the effects of pollution combined with hydro development have reduced salmon runs. In 1967 and 1968,

commercial salmon catches in the Saint John estuary and harbour were above average, but there was a sharp decrease in numbers of salmon reaching freshwater. The effects of this occurrence were poor seeding of the river in both years combined with a lack of adequate brood stock for the Mactaquac Hatchery in 1968. Water quality upsets in the Mactaquac Hatchery supply together with other operational problems at this station emphasized the need to provide an alternative source of smolt production in the event that future problems created serious fish losses at the hatchery. Plans were made to provide a reasonable adult escapement to the river above Mactaquac, particularly the pollution-free Tobique River.

As the 1969 salmon run in the Saint John River was expected to be low, specific restrictions were imposed on the commercial and angling fishery to ensure that adequate seeding was obtained for the hatchery and for natural reproduction. The commercial fishery was permitted to operate only two days weekly until mid-June, and three days weekly between June 15 and July 19. After that date, it was reopened to the regular five day week. Similar weekly restrictions were applied to angling on the main Saint John River.

The 1969 salmon escapement was counted at the Mactaquac fish collection facilities from which fish were taken and sorted for hatchery brood stock or for trucking to upriver

dumping sites. The count in 1969 was 1,749 salmon and 2,572 grilse which is more than double the 1968 escapement. As salmon catches were generally low throughout the Maritimes, this doubling of escapement to the Mactaquac collection facilities indicated the degree of success resulting from the restrictions.

The disposal of salmon and grilse taken at the Mactaquac collection facilities was as follows:

Point of Release	Large Salmon	Grilse
Mactaquac Brood Stock	920	220
Tobique River	691	1,843
Saint John River (Above Mactaquac)	97	441
Meduxnekeg River	19	56
For Experimental Purposes	22	12
	1,749	2,572

Salmon and grilse were not released into the main stem of the Saint John until September, because it was not until that time that the level of dissolved oxygen remained above 5 p.p.m., a minimum level for survival.

The Mactaquac collection facilities operated during the 1969 season with none of the major mechanical or operational problems which plagued the 1968 season. Other species taken at the facilities in 1969 and trucked above the dam included 106,000 alewives, 37,500 shad, 5,000 suckers, 5,000 lamprey and 1,200 white fish.

Sampling of the 1969 smolt run on the Saint John River was attempted at two sites to estimate timing and possible magnitude of the run. High water in May hampered the installation of the trapping gear, and by the time the nets were operational the run had apparently moved out of the river; less than 100 smolts were taken at each site.

2.2 Oyster Management

The oyster management program is involved with several aspects of the oyster fishery in the Maritimes. The three main fields are: (1) oyster leasing; (2) inventory surveys to determine potential rearing areas and population data; and (3) various investigations associated with oyster culture technique. The operations are centred at Ellerslie, Prince Edward Island, with sub-stations in each of the other two Maritime Provinces.

The demand for oyster leases continued at a high level during 1969 and more applications for leases (323) were received than could be dealt with by the two survey crews. These crews carried out 208 surveys for new leases and 76 surveys of old leases in the three provinces. The total number of leases in effect up to November 30, 1969, is 2,125 involving 6,133 acres, an increase of 93 leases and 410 acres over 1968 figures.

The breakdown by provinces is as follows:

Province	No. of Leases	Acres
Prince Edward Island	1,144	3,675
New Brunswick	755	1,836
Nova Scotia	226	622
Total	2,125	6,133

In addition to surveying and mapping new oyster leases, the crews established and marked nineteen Public Health Shellfish closures in polluted waters.

Bottom inventory surveys to determine oyster rearing potential were carried out in Shediac Bay and its tributaries; Eastern and Western Barachois; Aboushagan River; Neguac; and Malpec. Reports are being prepared on these surveys.

Investigations of public fishing areas for oyster abundance were carried out in Caraquet Bay and in Miramichi Bay. Market size oysters were scarce in the Caraquet area, but small oysters were present. On the south side of the Miramichi Bay, large oysters were very scarce, and although small individuals were present in good numbers they were widely scattered with no heavy concentration in any one area. The lack of market size oysters in the Miramichi Bay in 1969 prompted a cutback of the season from 2 months to one month.

Spatfall was monitored at various points throughout the Maritime Provinces using cement-coated carboard egg fillers, scallop shell, veneer rings and plastic collectors.

Heavy sets were taken in only two of the nine areas sampled in Prince Edward Island; poor spat sets were found in the Caraquet-Shippegan area of New Brunswick; low to average sets were monitored at Malagash in Nova Scotia; and, as in the past, excellent spat sets were taken in the Gillis Cove and Crowdis Bridge area of the Bras d'Or Lakes in Cape Breton.

Other oyster culture activities undertaken during the season include: transplanting 145 boxes of oysters from the Conway Narrows Reserve to Bideford and Trout Rivers and Paugh's Creek for spawning stock; shelling of Enmore River in Prince Edward Island, and Tabusintac and Caraquet-Maisonette area of New Brunswick for spat collection purposes; picking 249 boxes of small oysters in Bedeque Bay area to spread on the public fishing areas in the Dunk and Wilmot Rivers; and bottom dragging to clean shell for improving spat setting in these two rivers.

Spat collection in the Molus, St. Nicholas and St. Louis Rivers were negligible in 1969. A portion of the successful 1968 spat collection made on the same rivers was placed in the Kouchibouguacis Lagoon during May to check on its rearing potential. All five plots examined in November of 1969 appeared to have thrived during the summer as reflected by better than average growth and survival.

2.3 District Biologists

One of the requisite needs for rational fishery management

is an inventory of the fisheries resource, a task which was started in 1967 with the implementation of the district biologist program. Three of the six Maritime districts are partially staffed (two in New Brunswick and one in Nova Scotia), but lack of full time technical support staff in these three districts has reduced field operations.

Most of the present district effort is assigned to gathering data on juvenile salmon populations and potential in some of the more important streams.

Figure 3. Determining juvenile salmon abundance by electro-seining in a Maritime stream.

Although the coverage of rivers in the Maritimes is still limited, the investigations made in 1969 point out a serious potential problem. Preliminary analysis of the data collected on juvenile salmon populations, particularly in New Brunswick streams, shows a very low density of salmon

fry. Sparse spawning escapement of salmon was indicated in 1968 by the decreased catches due to low water conditions, and the 1969 electro-seining operations confirm that natural seeding of Maritime rivers was much below average in 1968. This low year class could provide low numbers of returning adults in four to six years. The first effects of this low year class may be apparent in the 1972 grilse return with a more serious effect on salmon returns in 1973 and 1974.

All district biologists were involved with various parts of the hatchery evaluation program, particularly during the spring period; details of this program are presented in Section 3.3. Other projects carried out by the district biologists are discussed below.

2.31 Eastern Nova Scotia

The investigation of the Shubenacadie River system, where a proposed tidal causeway threatens anadromous fish runs, was continued this year with particular emphasis on the Atlantic salmon potential of the Stewiacke tributary. Physical surveys were completed on all major tributaries, fish distribution in the system was established and several of the larger lakes on the system were examined. Juvenile salmon population densities were obtained on the Stewiacke system for comparison with the 1968 data and new stations were sampled on the remainder of the system. Salmon smolt migrations were monitored on two small tributaries of the Stewiacke River and all captured smolts were tagged

and released. Sampling of salmon in the commercial drift net fishery of the Shubenacadie River estuary and Minas Basin area was repeated again this year. Data are in the process of being tabulated and analyzed.

An investigation of the salmon rearing area of the St. Mary's River was undertaken. Information on the fish distribution and juvenile salmon populations of the system was obtained, and data were collected on the chemical and physical characteristics of the river system.

Lake Whitefish, Coregonus clupeaformis, were found in the Musquodoboit system in 1968 and the possible development of a recreational winter ice fishery prompted a more detailed investigation. Growth data indicate that whitefish in these waters are smaller than those found in most other Canadian lakes studied.

2.32 Northeastern New Brunswick

Most of the activities in this district were associated with Atlantic salmon studies. Considerable effort was assigned to the portion of the smolt evaluation program underway in the Miramichi system. In 1969, tagging and release of 30,266 hatchery-reared salmon smolts was overseen; 8,700 native smolts were tagged and released at the Millbank sampling site in the Miramichi estuary; and tag returns from the 1968 releases were monitored. Recaptures of the 1968 releases to date are 207 grilse or 0.93 percent of the 22,291 tagged smolts released. This included 165 commercial returns, 40

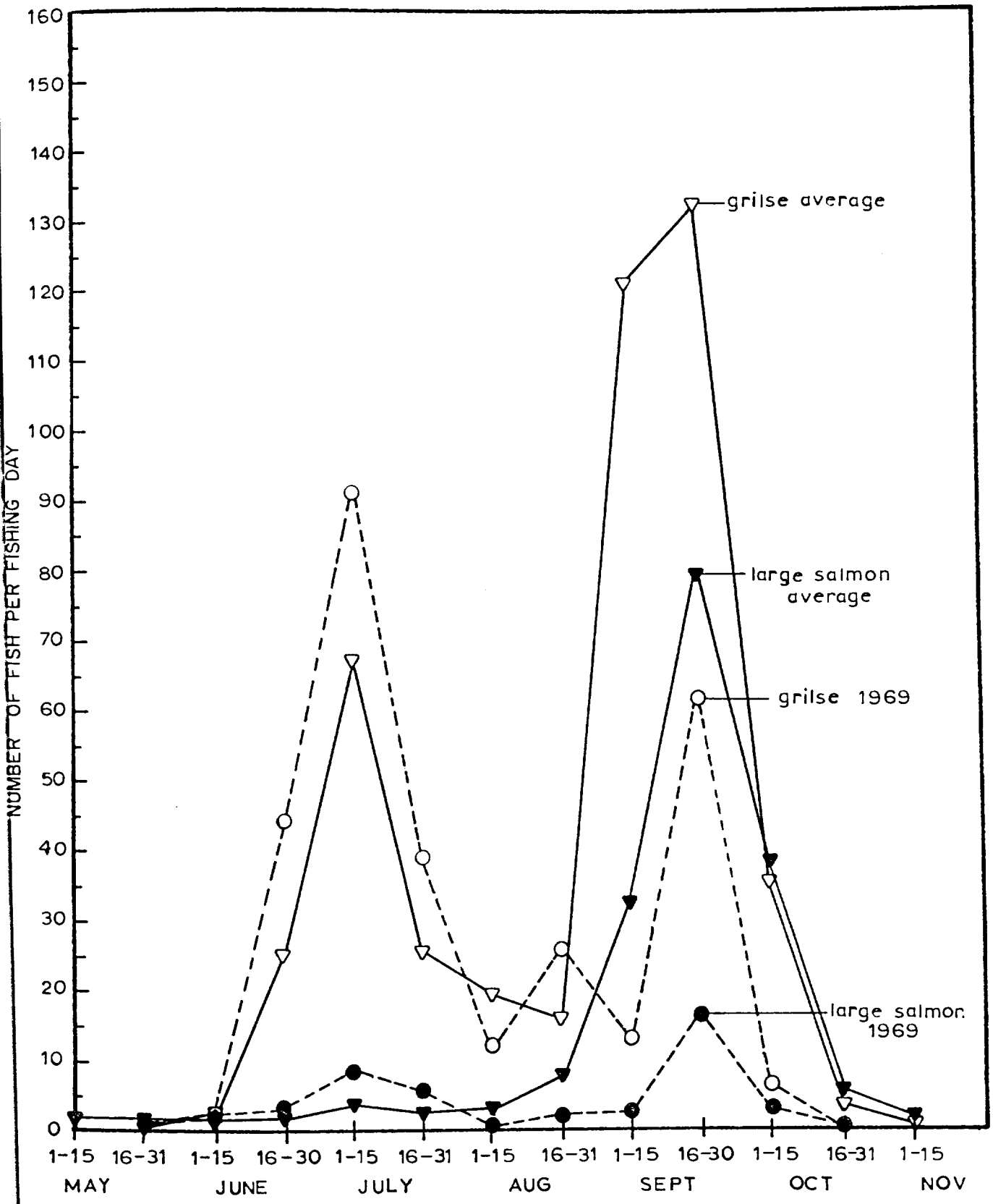

Figure 4. Mean catch per fishing day for grilse and large salmon for the period 1954 to 1969 inclusive, and for the year 1969, at Miramichi River estuarial trap near Chatham, New Brunswick.

recaptures by anglers and two recaptures at the Curventon counting fence. Of the commercial recaptures, 16 percent came from Greenland, 51 percent from Newfoundland, 6 percent from offshore sites, while the remainder were recaptured in the Miramichi trap net fishery. (Details on the smolt evaluation program are provided in Section 3.3)

Salmon and smolt sampling traps were again operated in the Miramichi estuary at Millbank from May 24 to October 31. The total trap count serves as an indication of the number and timing of Atlantic salmon entering the Miramichi River system. Catches per fishing day for grilse and salmon during the early run period (May to August 15) were better than the average calculated for the 16 year period 1954 to 1969 (Figure 4). The catch per fishing day of salmon and grilse for the late run period (August 15 to October 30), however, was below the long term average, while the catch per fishing day figure for large salmon in 1969 was the lowest since 1954.

Salmon fry and parr populations were examined in the following rivers: Bartholomew, Bartibog, Barnby, Black, Cains and Little Southwest of the Miramichi system, and in the Nepisiquit and Upsalquitch Rivers. All areas sampled, with the exception of Cains River, showed low salmon fry populations and in an effort to alleviate these deficiencies, hatchery releases were directed to the appropriate waters.

Work on recording the salmon rearing potential of Nepisiquit River was continued. A survey of Portage Lake on this system showed the presence of Arctic char (Salvelinus alpinus), a species not reported previously in these waters. A physical survey was started on Cains River, and an investigation of salmon runs to the Bartholomew River was continued.

2.33 Southwestern New Brunswick

In this district most of the effort was concentrated on the Saint John River. Surveys were completed on four tributaries, viz., Shikatehawk, Becaquimac, Muniac and Monquart Rivers. A general reduction in juvenile salmon densities compared with last year is noted on these and other tributaries and a particularly low density of fry populations was found (Table 1). The almost nil salmon fry abundance in the Saint John River basin above Mactaquac Dam reflects the very poor spawning escapement to this part of the river in 1968.

Investigation of the salmon run continued at Big Salmon River. The 1969 smolt run began on May 8 and continued to July 13 with the majority of the 10,606 smolts moving out between May 14 and June 17. Carlin tags were applied to 3,806 of the smolt counted through the fence.

The upstream adult run in Big Salmon River started on June 17 with the last salmon entering the trap on November 12. The total count of 1,279 salmon and grilse is far lower than the previous five year average of 3,026.

Table 1. Juvenile Salmon Density Estimates in Saint John River Tributaries, 1968 and 1969.

Sampling Locations	Density/100 sq. yds. (83.6 Sq. M.) Fry		Small Parr		Large Parr	
	1968	1969	1968	1969	1968	1969
Below Mactaquac Dam						
Canaan River	0	0	0	0	3.1	0.4
Kennebecasis River	1.5	0.9	0	0	1.9	0
Keswick River	34.8	11.0	22.4	13.2	4.8	6.6
Nashwaak River	13.4	5.6	7.3	4.3	6.6	8.3
Above Mactaquac Dam						
Nackawic River	5.4	0	8.8	0.7	17.4	12.5
Becaguimec River	11.8	0.3	25.2	6.8	18.8	11.2
Shikatehawk River	11.4	0	22.5	0	23.6	0.9
Tobique River	0.4	0.03	1.7	0.03	5.4	0.3

There is no indication of a reason for the low run in 1969 although the very low proportion of grilse (14.6 percent) in the run is unusual. The composition of the salmon runs for the years 1964 to 1968 has ranged from 31.3 percent to 55.7 percent grilse.

3.0

DEVELOPMENT AND EXPANSION SECTION

3.0 DEVELOPMENT AND EXPANSION SECTION

The objective of this section is to develop and implement measures which will increase the stocks of fish and shellfish in the Maritimes Region. The measures available fall into three general categories: (1) extension of distribution, (2) environmental control, and (3) artificial propogation. To date the emphasis has been on the Atlantic salmon and oyster resources of the region. A major effort is also going into the evaluation and biological direction of the Branch's salmon and trout hatchery program, which is a very important tool in the development of these resources. In April, 1969, operation of the Mactaquac Fish Culture Station on the Saint John River also became the direct responsibility of this section, with technical support and advice being provided by the Hatchery Production and Maintenance Section.

3.1 Salmon Development

3.11 East River Salmon Rehabilitation

A summary of activities associated with this project is given below under four major headings, viz.; (1) adult transplant and smolt output; (2) turbine mortality tests; (3) louver testing; and (4) smolt delays above hydro-power generating stations.

(1) Adult transplant and smolt output. In 1969, one hundred adult Atlantic salmon (53 percent female) were transplanted to Fifteen Mile Stream, a tributary to East

River, Sheet Harbour, Nova Scotia. Eighty-five were transported from neighbouring West River and the remainder came from collection facilities at the mouth of East River. The total number of females transplanted this year is similar to that for 1966 and 1968 (Table 2).

Table 2. Summary of Adult Atlantic Salmon Transplants to East River, 1966 to 1969.

	Males	Females	Average Female Weight (lbs.)	Potential Egg Deposition*
1966	26	51	7.7	313,600
1967	6	12	3.7	35,520
1968	48	53	4.0	169,600
1969	47	53	4.7	190,480

* Based on an assumed average fecundity of 800 eggs per pound of female.

A run of 4,000 smolts was enumerated this year at a counting fence on the tributary Fifteen Mile Stream. These smolts were the progeny of the first adult transplant in 1966. Egg to smolt survival was estimated to be 1.3 percent. This figure is not final; late summer electro-fishing in the stream revealed that an estimated 2,000 parr did not smoltify in 1969 at age II. Egg to smolt survival is expected to exceed by about three times the average determined from studies of several New Brunswick salmon streams, where the majority of smolts migrate at age III. The

excellent East River egg to smolt survival rate is probably due to (1) the shorter freshwater life span, and (2) both the low juvenile density and the correspondingly low intra-specific competition in the transplant stream.

(2) Turbine Mortality Tests. A study to determine turbine mortality for smolts at Malay Falls powerhouse was carried out in May, 1969 with hatchery-reared salmon smolts. The test group was released in the immediate area of the turbine intakes and the control group was released in the tailrace below the generating station. Recaptures were made two and one half miles downstream at the Ruth Falls louver site. It was found that in order to prevent major migration delay, the test group had to be injected deep in

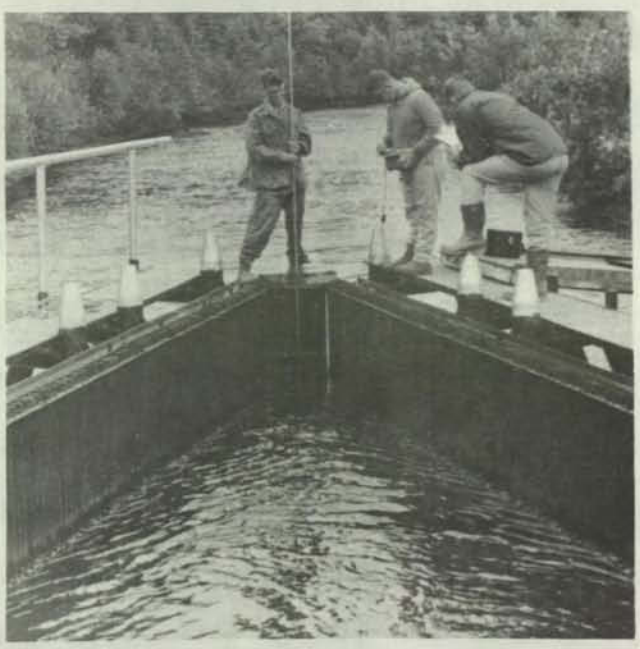

Figure 5. Measuring louver bypass velocity at East River.

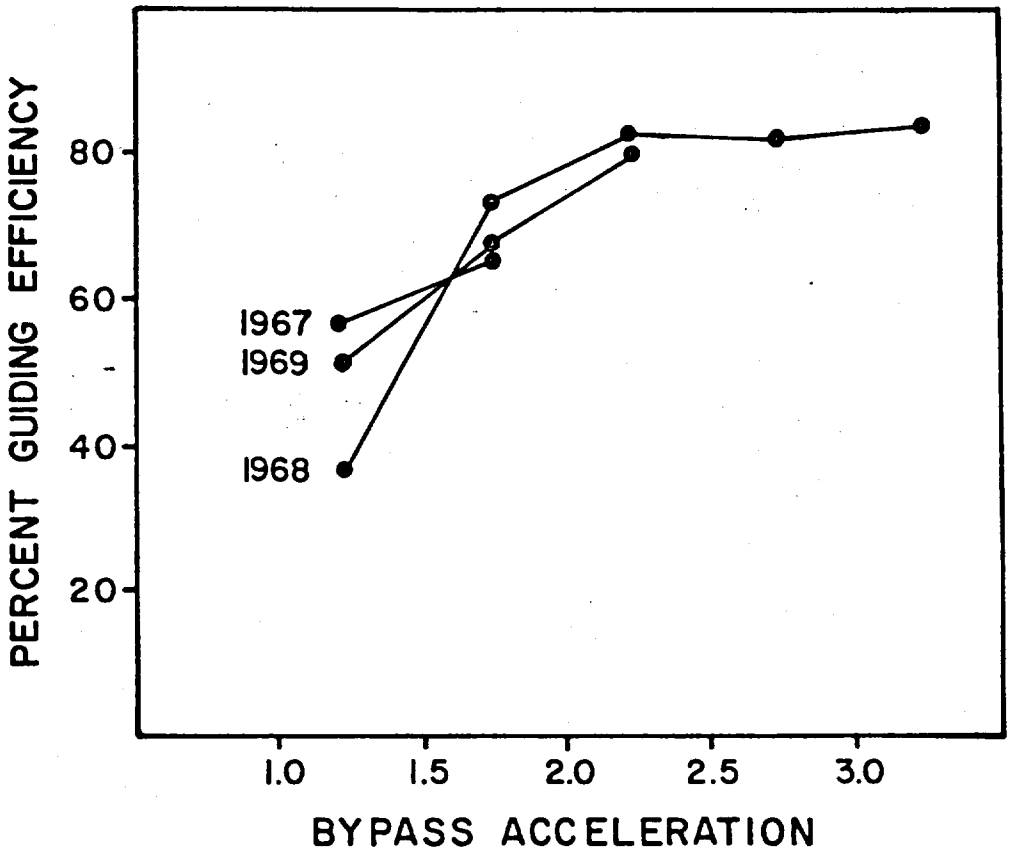

Figure 6. Guiding efficiency of louvers for salmon smolts at East River, Sheet Harbour.

the turbine intake. The average recapture differential between control (61 percent) and test (50 percent) groups is attributed to turbine mortality.

(3) Louver Testing. Testing of louver deflectors for guiding salmon smolts aroung the Ruth Falls powerhouse intake was carried out for the third consecutive year. As in 1967 and 1968, hatchery-reared smolts were used in the tests. The 1969 tests were designed to further investigate the effect of bypass acceleration, which was revealed in previous years as the most important single factor affecting guiding efficiency. The results shown in Figure 6 indicate that the best guiding efficiency

was obtained with a by-pass velocity between 2.0 and 2.5 times the approach velocity. With the present design, such a high acceleration is difficult to obtain under most conditions and, as a result, modifications are being made to the facilities to provide for greater by-pass velocity.

(4) Smolt delays above hydro-power generating stations. At the Malay Falls powerhouse, migration delay in the forebay amounting to one to three weeks may be a much more significant hazard for smolts than turbine mortality. Delay is caused by the reluctance of smolts to "sound" the ten feet required to reach the turbine intake. A surface orifice (4 feet wide x 1/2 foot deep) was installed near the Malay Falls penstock in an effort to attract smolts away from the turbine intakes. This simple "Skimmer" system collected 35 percent of the smolts which had previously emigrated from Fifteen Mile Stream.

A skimmer system requires 75 percent less water than louvers and costs much less to construct and maintain. Since a guiding system will be needed at Malay Falls, studies are planned for 1970 to improve the skimmer system and to compare its guiding efficiency with that of the louvers at Ruth Falls.

3.12 La Have River Development

The first phase of the La Have River Development Program, involving construction of a concrete vertical-slot fishway at Morgan Falls, near New Germany, N. S., was completed in 1969.

Commencing in 1970, salmon fingerlings from Medway River stock will be planted in presently barren rearing areas upstream of Morgan Falls. This is expected to accelerate the development of a run homing to the newly accessible areas of the Upper La Have.

The fishway provides access for salmon over a 21-foot high natural rock falls to 35 miles of stream, comprising 50 percent of the salmon rearing area in the system. This project also included the removal of an abandoned timber dam at the site to provide for suitable water attraction and to reduce the overall height of the obstruction by twelve feet.

Fishway construction was also planned for a second obstruction located one mile upstream from Morgan Falls. This obstruction is a timber dam used to supplement box factory operations. Because the owners would not agree to continue maintenance of the dam for the design life of the fishway, construction activities were suspended and the Branch initiated negotiations toward removal of the timber dam.

The Morgan Falls fishway was not completed in time for salmon migration in 1969; however, a counting facility was installed and a velocity-discharge recording system was established to enable evaluation of its performance in 1970.

A hydrometric survey of the La Have River was carried

out as part of the continuing bio-engineering study.

3.13 Site Investigations

Engineering and biological investigations of sites and proposals with fisheries development possibilities are described below under three headings: (1) Nepisiguit River, (2) Flow Control, and (3) Other Investigations.

(1) Nepisiguit River. A survey of the Nepisiguit River system in northern New Brunswick, conducted during July and August, revealed approximately 6 million square yards of potential salmon rearing area in a river length totaling 80 miles. This area is presently inaccessible to salmon due to a 110 foot high obstruction consisting of a natural falls and a small hydroelectric dam.

Detailed engineering surveys were conducted in 1969 at a site selected for an adult salmon trapping and trucking facility.

The extension of salmon distribution to the upper Nepisiguit River could result in an increase in returning stock from the present level of 2,000 to 3,000 to an eventual level of 10,000 to 15,000 salmon, but development of this potential is largely dependent on the abatement of serious pollution from base metal mining operations in the watershed.

(2) Flow Control. Extreme low summer flows, which are characteristic of salmon streams on the south shore of Nova Scotia, may in some years severely limit the production

of juvenile salmon. Several river systems possess the physical characteristics required for reasonably economic flow control, but the benefits which may be derived from augmentation of low summer flows are not clear.

During the last two years, several river systems in southern Nova Scotia have been examined to determine their suitability as sites for a pilot flow control project. In 1969, investigations centred on Martins River, a watershed with an area of 40 square mile located near Mahone Bay, Nova Scotia. An engineering survey was completed and preliminary design of a flow control project is being prepared. The proposed biological study will evaluate the effects of flow control on juvenile and adult salmon production.

(3) Other Investigations. Engineering surveys of natural obstructions and general exploratory surveys were conducted on 14 streams in New Brunswick and Nova Scotia. The majority of these were found to have no fishery development potential. The surveys did show that natural obstructions near the mouths of the Digdeguash and Black Rivers in southern New Brunswick could be alleviated at relatively low cost, without fish passage facilities.

Hydrometric surveys were carried out on the Stewiacke and Shubenacadie Rivers as part of continuing bio-engineering studies.

3.2 Oyster Development

The oyster development group has as its primary objective

the development of methods for overcoming the main obstacle to expansion of the industry; viz, the inadequate supply of seed oysters. Emphasis is being given to evaluation of economical alternative to hatchery production of oyster seed. A secondary objective is to develop more economical means of off-bottom culture.

(1) Seed Production. Approximately one-third of the total Maritime oyster production is taken from Bedeque Bay, Prince Edward Island, and spat production from this area appears to be more regular than in many Maritime oyster producing areas. For this reason, Bedeque Bay was chosen as a site for evaluating the technique of planting scallop shell to increase the amount of bottom habitat suitable for spat settlement.

On three test plots shelled in 1968, spat settlement increased two to thirteen fold. Results were more variable in 1969, but again provided an indication that spat production could be greatly increased in certain areas of Bedeque Bay by the application of this technique. Oyster spat set on only three of the eight plots shelled in 1969. On two of these, spat settlement increased on a unit shell weight basis by five to ten fold, and on a unit bottom area basis by three to thirty-four fold. The increase in spat production per unit weight of shell indicates the scarcity and uneven distribution of presently available shell for setting larvae.

The true potential of the technique for production of advanced spat is within the ranges outlined, and although the exact magnitude is impossible to assess, there is little doubt that the production of Bedeque Bay could be increased several fold.

Other studies initiated at Bedeque Bay in 1969 included: hydrographic measurements at 16 stations; sampling in the main oyster producing area for the magnitude and size structure of the population; and transfer of one year old spat from Bedeque Bay to Bentick Cove and Conway Narrows in Malpeque Bay, and to the Percival River on Egmont Bay in order to evaluate their survival and growth at these locations and thus to determine the feasibility of large-scale transfers of spat or seed oysters from productive areas such as Bedeque Bay.

(2) Off-Bottom Rearing. The off-bottom rearing program was greatly expanded in 1969. Information collected will allow a comparison of oyster growth and survival on various tray designs, on scallop shell, and on various commercial collectors suspended from floats, racks, and long-lines. The shore-to-shore long-lines and the fibreglas-coated paper tube float designed and installed in 1968 at Gillis Cove, Cape Breton, both withstood winter ice conditions without damage. These two units along with a Japanese-type long-line will remain in the ice again for the winter of 1969-70.

3.3 Hatchery Evaluation

Primary objectives of the eight-year hatchery evaluation program launched in 1968 are: (1) to measure the contribution of hatchery-reared salmon smolts to sport and commercial fisheries of the Maritime Provinces, Newfoundland and the Northwest Atlantic, and (2) to provide the information base for improving and expanding the stocking program. Smolt tagging will be continued for a five-year period to determine the effects on contributions to fisheries of such factors as: smolt rearing location, location and timing of release, smolt age, size and condition, and stock origin. Wild salmon smolts, trapped during seaward migration, are also being tagged for comparative purposes.

In 1969, 88,300 Carlin-tagged smolts were released at five Maritime locations for the purpose of hatchery evaluation. This compares with the 1968 release of 59,700. The following table shows the numbers and distribution of tag releases in 1969.

	Number of Smolts	
	Hatchery-Reared	Wild Native
Restigouche, N. B.	10,400	--
Miramichi, N. B.	30,266	8,700
Big Salmon, N. B.	9,937	3,806
West (Sheet Harbour), N. S.	9,908	5,372
Philip, N. S.	9,946	--
Total	70,457	17,878

Adult salmon trapping and counting facilities at Big Salmon River, West River and River Philip enable the assessment of escapements of tagged salmon and the estimation of fishery exploitation rates.

3.4 Hatchery Engineering Services

Engineering services provided to the Hatchery Production and Maintenance Section included design of new or improved facilities and equipment and supervision of construction.

Twenty concrete ponds (each 180 feet long) at the Saint John Station were subdivided into 51 units, approximately 60 feet long, in order to improve fish distribution. The existing water supply within the Station was supplemented by pumping from a spring-fed stream on the property. Five earth ponds (each 90 feet long) were constructed and a new transite pipeline was installed at Yarmouth Station. Three additional ponds of this type will be completed in early 1970. These additions will increase the Station's salmon rearing capacity by 100,000 smolts and will enable an annual contribution of 250,000 smolts to the Saint John River program.

Facilities added to the new Mersey Station, which was constructed in 1968, included a new incubation and fry-rearing building and a truck garage. Gabions were also installed as bank protection against flooding. A new truck garage was built at Yarmouth Station.

The water supply system to adult salmon holding ponds at Hailes Brook, a Restigouche River tributary, was improved

by the construction of two control dams, one a wood crib structure and the other constructed of gabions. The 14 inch diameter pipe supplying pumped brackish water to the Miramichi salmon holding pond was extended by 100 feet in order to eliminate the problem of silting around the intake. A standby pump was also installed. The performance of this brackish water supply system, which is so critical to adult salmon holding success, was much improved over that in 1968. Summer holding mortality was reduced from the 20 percent level recorded in 1968 to 4 percent in 1969.

Modifications were made to a fiberglas 150 gallon fish transportation tank developed during the last two years. The tank is designed to carry 200 pounds of fish for up to three hours. After a full season of trials, a larger, three-compartment tank was manufactured.

An extensive renovation of incubation facilities was carried out at Saint John in order to enable the Station to carry an addition 1.2 million Saint John River salmon eggs. The renovation involved the installation of four 145 gpm water filters, complete PVC plumbing for 500 incubation jars, and 18 six-foot diameter fry holding tanks.

3.5 Mactaquac Fish Culture Station

During the past year, severe water pollution in the Saint John River has jeopardized the operation of the

Mactaquac Station. To offset the risk of losing a major portion of the Mactaquac production, other fish culture stations in the Maritimes Region are now also being used to rear salmon smolts and to incubate the particularly vulnerable eggs and fry. By 1971, the Saint John and Yarmouth Stations will supply one half million salmon smolts additional to the production from Mactaquac. The Antigonish Station is also being used to rear salmon eggs and fry for the Mactaquac operation.

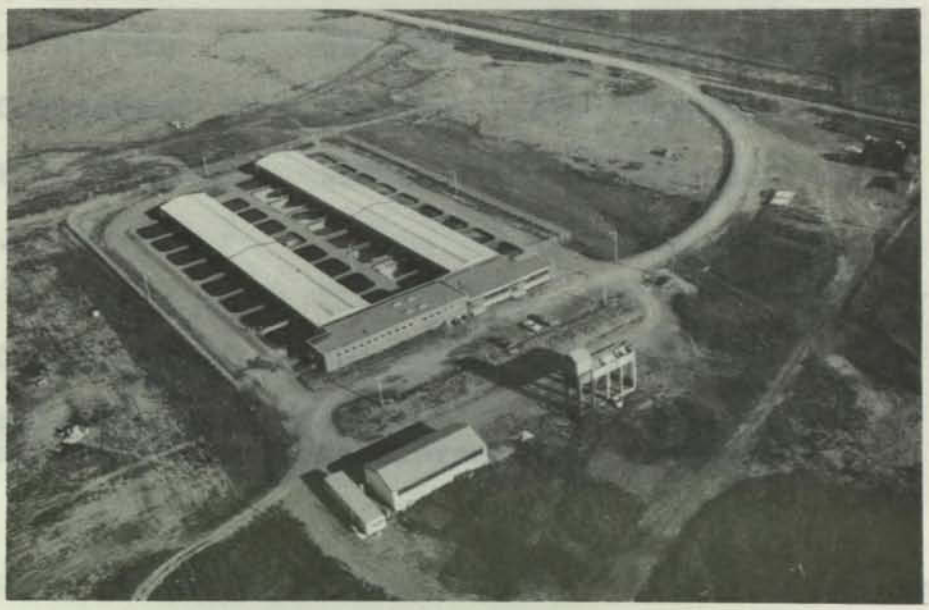

Figure 7. Mactaquac Fish Culture Station

3.51 Mactaquac Brood Stock Collection and Selective Breeding

The 1969 egg collection from Saint John River salmon stock trapped at Mactaquac Dam totaled 4.2 million. Details are summarized in Table 3.

Table 3. Saint John River Salmon Spawning Program and Egg Distribution, 1969..

	Spring Run	Summer Run*	Fall Run*
Date adults collected	June 10-July 2	July 5-Oct.3	Sept.16-Nov.13
Number of males spawned	57	146	31
Number of females spawned	146	377	63
Eggs Transferred to:			
St. John F.C. Station	329,750	686,200	155,500
Yarmouth F.C. Station	474,300	642,750	71,295
Antigonish F.C. Station	297,600	1,321,000	195,300
Mactaquac F.C. Station	-	39,630	4,000
Total Eggs Collected:	1,101,650	2,689,580	426,095

* Separation of Fall and Summer run fish during late September was based on differences in coloration.

The eggs transferred to Antigonish Station will be reared to the 8-week fry stage and transferred back to Mactaquac Station for rearing to smolt release.

The selective breeding at Mactaquac was changed extensively in 1969 to minimize interference with routine hatchery operations. The number of select groups was reduced to three from the twenty maintained in 1968. The three selected crosses consisted of groups with the following life history patterns:

Run Segment	Male		Female
Spring	3.2*	x	3.2
Summer	3.2	x	3.2
Summer	3.1 (grilse)	x	3.2

* Salmon spending 3 years in freshwater and 2 years at sea

Remaining brood stock were separated into spring, summer and fall runs and spawned at random within each group.

As in previous years, the ages of all brood stock were determined from scales. To determine age composition of the total escapement to Mactaquac Dam, scale sampling was extended in 1969 to include those salmon which were not used for brood stock and were released at points in the Saint John system upstream of the dam.

3.52 Mactaquac Rearing Operation

A total of 170,200 salmon smolts were released from Mactaquac Station during May and June of 1969. Yearling smolts (average size - 16/lb.) trucked from Kejimkujik Station in Nova Scotia comprised 40 percent of the total release. Mactaquac Station contributed 21,200 yearling (10/lb.) and 80,400 (6/lb.) age II smolts. The age II smolts were reared initially at either the Kejimkujik Station or the Saint John Station and were transferred to Mactaquac as yearlings.

The 1967 brood yearlings suffered abnormally high mortality (13%) during the July to October period due to an internal bacterial infection which was brought under control by antibiotic treatments. As of December, 1969, 351,000 pre-smolts were on hand at Mactaquac.

Eggs collected in 1968 and incubated at Mactaquac experienced very low survival, mainly the result of a nearly complete loss (90%) of fry in the initial feeding stage. Poor water quality in the Saint John River during the spring of 1969 necessitated the excessive use of groundwater and precluded control of embryo development through the use of river water. The high loss in the fry stage is believed due to the fact the development was greatly accelerated and feeding had to be initiated prior to the spring temperature rise at temperature levels somewhat below optimum. The following table summarizes mortality of 1967 and 1968 brood salmon incubated and reared at Mactaquac.

Year	Eggs Collected	Percent Hatched	Percent Fingerling Survival to Dec.	Percent Yearling Survival to Dec.
1967	1,609,220*	81.3	28.4	21.8
1968	1,634,123	53.9	4.3	--

* Incubated to the eyed stage at Miramichi Station.

3.53 Mactaquac Engineering Services

Because of the increased reliance of Mactaquac Station on groundwater, an additional well of 2,000 g.p.m. capacity was developed in late 1969 for operation starting in February, 1970. Total groundwater supply at the Station will then amount to approximately 8,000 g.p.m.

Modifications to the aeration tower were carried out by the New Brunswick Electric Power Commission in July. The water aeration screen on the river water side of the tower was raised 30 inches to improve its performance and piping arrangements on the groundwater side were altered to increase the capacity of the tower for groundwater.

A smolt release channel was constructed by the Power Commission in 1969, but on initial testing the asphalt surface was found to erode and undermine. To correct this problem, the bottom of the channel was subsequently lined with concrete.

An electric water quality monitoring system designed by Honeywell Company was installed to provide continuous recording of dissolved oxygen, temperature and pH levels in river water and groundwater at several points in the supply system; before and after aeration, after blending of the two sources, and on entrance into the main supply lines to both large and small ponds and the incubation facilities. The monitoring system will also provide a warning when the level of any one of the three factors

deviates from desirable limits.

Other projects completed at Mactaquac included: design and installation of automatic feeders for dispensing dry food to the fry rearing trays; and installation of drains at the ends of the main rearing pond water supply lines to enable flushing of sediment build-up.

4.0

HATCHERY PRODUCTION AND MAINTENANCE SECTION

4.0 HATCHERY PRODUCTION AND MAINTENANCE SECTION

The objective of the Hatchery Production and Maintenance Section is to ensure that adequate numbers of fish, particularly Atlantic salmon and speckled trout, are artificially reared to supplement natural stocks in the Maritime Provinces. In addition, increasing numbers of hatchery-reared fish are being provided for the Branch's expanding salmon development and salmon management programs, as well as for experimental use by other agencies.

In order to accomplish these objectives, this Section has undertaken to fulfill the current demand for hatchery production and at the same time implement a modernization program for all facilities. This program, which includes the elimination of non-productive hatcheries, began three years ago and has been referred to in earlier reports (c.f. Annual Reports, 1967 and 1968). During this period the labour force attached to our hatcheries has been reduced (Figure 13), whereas the benefits of automation and the acquisition of modern equipment is reflected in the increased fish production per man year (Figure 12).

A change in production (Figures 10 and 11) from large numbers of small fish (underyearling salmon and trout) in 1967 to lesser numbers of relatively large fish (late fall fingerling and yearling trout and salmon smolts) in 1969 has been effected without any significant reduction

in the total weight of fish produced.

Because of pollution in the Saint John River and its interference with the operation of the Mactaquac Fish Culture Station, three of the older stations will participate in a back-up program for Mactaquac by producing one-half million smolts annually for stocking in the Saint John River, thereby supplementing production at Mactaquac. By the reuse of water at Yarmouth and Saint John Stations and utilizing large earthen ponds, it is hoped this additional production can be accomplished without serious interference with the normal production of salmon and trout at these two stations. Antigonish Station will incubate and rear to the six weeks feeding stage all the salmon to be produced at Mactaquac.

The reuse of water and secondary earthen ponds is now in use at Cobequid Station and the program will be extended to include Charlo and Miramichi Stations in 1970. This will at least double the production capacity of these stations without any additional production costs except for fish food.

A very important part of the Hatchery Production and Maintenance program includes providing assistance to other agencies. While this contribution forms a relatively small part of our total production, the eggs and live fish supplied to numerous agencies, research institutions and universities (Tables 7 and 8) provide the tools for important research

and production programs that could not otherwise be undertaken. An example of this work was the salmon and trout supplied this year to the Halifax Research Laboratory and St. Andrews Biological Station for the emergency investigation of pollution in Placentia Bay, Newfoundland.

Total production for 1969 amounted to 5.1 million salmon and trout, with a total weight of 256,000 pounds (Table 10).

The remaining tabulations detail other aspects of production at our Fish Culture Stations: Table 4 includes egg collections; Table 5 gives the number and percent survival of fry; Table 6 shows the fish produced for stocking in 1969; and Table 9 gives the number and weight of fish produced for future stocking.

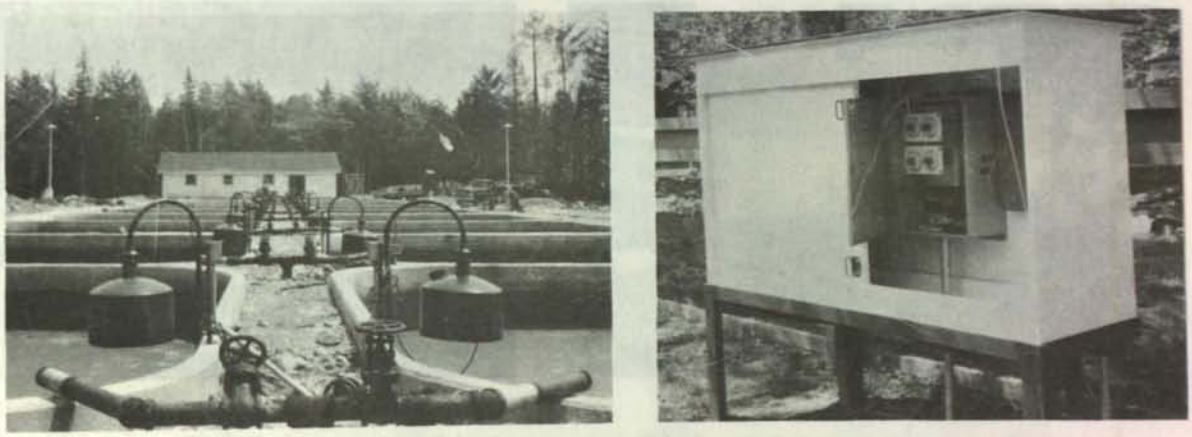

Figure 8. Automatic fish feeders installed at Mersey Fish Culture Station (left), and the timing and switching control board for these units (right).

Jar culture and chemical treatment systems have been supplied to all Stations and will be in operation in 1970. Fiberglas reinforced plastic distribution tanks (capacity: 150 gallons) have been supplied to six stations. These units incorporate a new circulating system that simplifies removal of undesirable gases from a closed tank and assists with water aeration.

Table 4. Eggs collected at Maritime Fish Culture Stations, 1969.

Species	Number	Weight
Speckled Trout	10,032,205	1710 lbs.
Atlantic Salmon	9,038,407	2966 lbs.
Landlocked Salmon	34,274	100 lbs.
	19,104,886	4936 lbs.

Table 5. Hatch of live fry at Maritime Fish Culture Stations, 1969.

Species	Number	Percent Survival
Atlantic Salmon	3,608,215	76.6
Speckled Trout	7,790,429	72.7
Brown Trout	157,009	22.4
Rainbow Trout	43,815	30.6

Table 6. Number and weight of fish at Maritime Fish Culture Stations produced for stocking in 1969.

Species	Size	Number	Weight
Atlantic Salmon	1" - 4"	514,241	4940
	4" - 6"	165,753	8052
	6" -	480,554	42,207
		1,160,548	55,199 lbs.
Speckled Trout	1" - 4"	800,504	5623
	4" - 6"	619,328	25,462
	6" -	247,529	47,995
		1,667,361	79,080 lbs.
Rainbow Trout	4" - 6"	7,304	830 lbs.
Brown Trout	1" - 4"	52,631	646
	4" - 6"	58,279	1388
	6" -	6,123	3615
		117,033	5649 lbs.
Landlocked Salmon	4" - 6"	18,881	321
	6" -	47,958	5018
		66,839	5339 lbs.
Grand Total:		3,019,085	146,297 lbs.

Table 7. Number of eggs supplied to outside agencies and universities from Maritime Fish Culture Stations, 1969.

Species	Number	Destination
Speckled Trout	15,000	Dalhousie University
Atlantic Salmon	514,710	Sea Pool Fisheries, Clam Bay
	8,000	F.R.B., Halifax
	116,000	Berlin, New Hampshire
	303,600	Hartford, Connecticut
	4,180	Univ. of Western Ontario
	946,490 Eggs	

Table 8. Number and weight of fish produced at Maritime Fish Culture Stations for Research, Provincial Agencies and National Parks in 1969.

Species	Size	Number	Weight	Destination
Atlantic Salmon	1" - 4"	2,625	2	F.R.B., Halifax
		13,822	53	R.D. Pollution Section
		1,400	12	F.R.B., St. Andrews, N. B.
		1,500	7	Univ. of N.B.
		19,347	74 lbs.	

Table 8 - continued

Species	Size	Number	Weight	Destination
Atlantic Salmon	4" - 6"	17,759	939	F.R.B., St. Andrews, N. B.
		25,238	2,067	F.R.B., Halifax
		300	3	Queens University Kingston, Ontario
		1,445	54	Univ. of N. B.
		44,742	3,063 lbs.	
	6" -	820	115	F.R.B., Halifax
		400	16	R.D. Pollution Section
		7,290	751	F.R.B. St. Andrews
		8,510	882 lbs.	
Landlocked Salmon	4" - 6"	50	5	Univ. of N. B.
		700	27	F.R.B., St. Andrews
		750	32 lbs.	
Speckled Trout	1" - 4"	100	2	Univ. of P.E.I.
		1,000	10	F.R.B., Halifax
		1,100	12 lbs.	
	4" - 6"	75,000	2,170	Prov. N.S. (Moser)
		7,000	634	Univ. of N.B.
		6,533	4,467	Prov. N.B. (F & W)
		900	57	F.R.B., St. Andrews

Table 8 - continued

Species	Size	Number	Weight	Destination
Speckled Trout	4" - 6"	255	16	Univ. of P.E.I.
		89,688	7,344 lbs.	
	6" -	28,000	2,554	C.B. Highlands National Park
		10,000	1,112	Fundy National Park
		2,000	202	Cavendish Nat. Park
		1,393	232	F.R.B., Halifax
		41,393	4,100 lbs.	
Rainbow Trout	6" -	35,923	3,801	Prov. N.S. (Charleston)
		107	9	F.R.B., Halifax
		36,030	3,810 lbs.	

Grand Totals:

Research	84,104	5,011 lbs.
Provincial Agencies	117,456	10,438 lbs.
National Parks	40,000	3,868 lbs.

Table 9. Number and weight of fish produced in 1969 at Maritime Fish Culture Stations for future stocking.

Species	Size	Number	Weight
Speckled Trout	4" - 6"	331,065	14,704

Table 9 - continued

Species	Size	Number	Weight
Speckled Trout	6" -	43,120	12,653
		374,185	27,357 lbs.
Atlantic Salmon	1" - 4"	892,008	8,616
	4" - 6"	61,663	1,521
	6" -	497,970	39,983
		1,451,641	50,120 lbs.
Landlocked Salmon	6" -	7,000	490 lbs.
		1,839,826	77,967 lbs.

Table 10. Total Production at Maritime Fish Culture Stations, 1969.

Species	Size	Number	Weight
Atlantic Salmon	1" - 4"	1,425,596	13,630
	4" - 6"	272,158	12,636
	6" -	987,034	83,072
		2,684,788	109,338 lbs.
Landlocked Salmon	4" - 6"	19,631	326
	6" -	54,958	5,535
		74,589	5,861 lbs.

Table 10 - continued

Species	Size	Number	Weight
Speckled Trout	1" - 4"	801,604	5,635
	4" - 6"	1,070,441	51,243
	6" -	344,802	73,668
		2,216,847	130,546 lbs
Rainbow Trout	4" - 6"	7,304	830
	6" -	36,030	3,810
		43,334	4,640 lbs.
Brown Trout	1" - 4"	52,631	646
	4" - 6"	58,279	1,388
	6" -	6,123	3,615
		117,033	5,649 lbs.
Grand Totals:		5,136,591	256,034 lbs.

5.0

POLLUTION ABATEMENT SECTION

5.0 POLLUTION ABATEMENT SECTION

The general aim of the Pollution Abatement Section is to protect the fisheries resource in the Maritimes from pollution caused by mining development, pulp and paper mills, municipalities, pesticides and a myriad of other water resource users. The expert personnel in this section interpret the biological effects of pollutants on the fisheries resource, evolve satisfactory pollution abatement procedures and assess the effectiveness of these procedures.

Pollution abatement is a necessary process when a river basin in considered from a multi-purpose point of view, for without it, a river might become so badly polluted that it is useful for only one purpose: that of waste disposal. This has already been demonstrated in more than one instance in the Maritime Provinces where increasing levels of pollution have limited the fisheries resource.

The Pollution Abatement Section is engaged in the detection of sources of pollution by means of river basin surveys and investigations of existing and proposed industrial and municipal waste disposal practices. As these sources are found, studies are initiated to discover the biological effects of the particular pollutants on the aquatic environment, with specific reference to the fisheries resource. Consultations are then carried out

with the offending industry or municipality to discuss the results of completed surveys and to decide on a favourable policy which should be followed to rectify the pollution problem.

The task of protecting the aquatic environment against potential pollution threats is also performed by this section. All new and expanding industries which could cause a pollution problem are contacted and asked to submit for approval plans of their operation process and waste treatment facilities. By analyzing these plans and performing laboratory experiments on wastes similar to that which will be discharged, decisions are made as to the acceptability of these processes. Recommendations are also made as to how the waste treatment process could be improved to meet Department of Fisheries and Forestry requirements.

5.1 Saint John River, New Brunswick

A concentrated effort was made in 1969 by a team of engineers and biologists to evaluate the impact of industrial and municipal pollution on the aquatic environment of the Saint John River. The river continues to be used as the principal waste disposal system for many industries and municipalities located on both sides of the Canada-United States Border.

Results clearly showed that the Saint John River is receiving a great deal more waste than it can assimilate,

and is in a highly polluted state.

The Grand Falls headpond, stretching from Edmundston to Grand Falls, contained high concentrations of organic material and low levels of dissolved oxygen because of the excessively high pollution load which was discharged, without any type of treatment, from a pulp mill at Edmundston and a paper mill at Madawaska, Maine. This portion of the river, 36 miles in length, is essentially a large stabilization basin and is at present unsuitable for any use but that of waste disposal.

The first 18 miles of the Saint John below the Grand Falls Dam is relatively shallow and fast flowing, giving the river a chance to recover from the pollution load imposed on it by the pulp mill at Edmundston and the potato processing and starch manufacturing plants at Grand Falls.

Our studies have shown that as the river enters Beechwood headpond, suspended material settles out causing a depletion of dissolved oxygen, particularly in the lower levels of the headpond. As in the rest of the river, conditions deteriorated as the summer progressed, reaching the worst state in late August to early September.

The river picks up oxygen below the Beechwood Dam where it is shallow and fast flowing, but at Florenceville a large food processing plant, which has only primary

waste treatment, discharges a high organic load usually resulting in a lowering of the dissolved oxygen level. The Big Presquille Stream, which was the subject of an international incident in 1968, when it was dammed by concerned citizens who termed it an open sewer, was of generally good quality during the summer of 1969, although it bore the scars of past pollution as evidenced by excessive algae growth, high diurnal dissolved oxygen fluctuations and the absence of juvenile salmon stocks.

Mactaquac headpond, stretching for 59 miles from Hartland to the Mactaquac Dam, is the third and largest man-made lake along the Saint John River. Although the primary purpose of these impoundments is hydroelectric, they also serve as waste treatment lagoons, exhibiting the general lagoon characteristics such as low dissolved oxygen values. Organic material is settled out in the Mactaquac headpond causing subsequent oxygen depletions. That part of the headpond opposite the planned pulp and paper mill at Nackawick displayed the lowest dissolved oxygen values, reaching zero ppm during August. These low dissolved oxygen values occur in this area mainly because of hydrological characteristics such as greater depths and widths which result in lower velocities and hence increased sedimentation.

Below Mactaquac, the river is affected by tides and is generally of good quality until the City of Saint John

complete absence of dissolved oxygen which was found at places in the river during the summer of 1968.

Preliminary studies were carried out employing infrared photographic techniques to determine the feasibility of using this process for industrial effluent studies. Results from the study are not yet available.

Additional information on the various facets of the Branch's Saint John River program is contained in sections 2.1, 2.33, 3.5, 3.51, 3.52, 3.53 and 6.3.

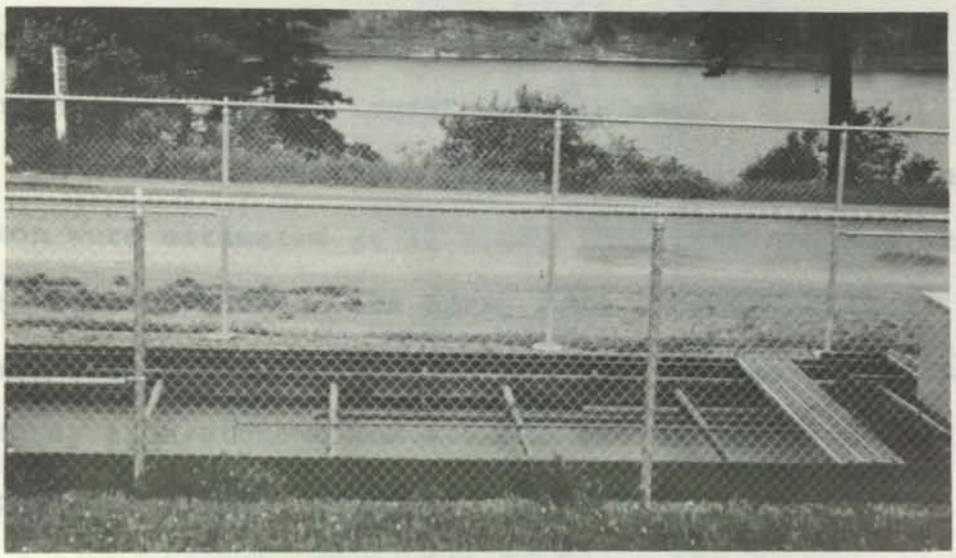

Figure 14. A small industrial effluent treatment plant on the Saint John River.

5.2 Forest Spraying

Fenitrothion (Sumithion) was sprayed on 3.1 million acres of New Brunswick forest in 1969. Most of this area was located on the Miramichi River drainage basin and the

remaining smaller portion on the Saint John River Basin. The insecticide was sprayed twice at the rate of 1/8 pound per acre over most of the area. Experimental plots were sprayed twice at the rate of one ounce per acre with the carbamate, Zectran.

In 1969, aquatic insect populations were measured weekly from mid-May to early September at three streams sprayed with Sumithion, at one stream sprayed with Zectran and at one unsprayed stream. In 1969 data indicate that neither Sumithion nor Zectran caused significant reductions in aquatic insect populations.

In August, population densities of juvenile Atlantic salmon were estimated at 17 spray area stations and at 8 stations outside of the spray area. Underyearling salmon were scarce, averaging 4.2 per 100 square yards at spray area streams and 4.0 per 100 square yards at unsprayed streams. Small parr were more abundant at spray area streams, averaging 16.5 per 100 square yards while the average density at unsprayed streams was 6.4 per 100 square yards. Large parr averaged 3.5 and 4.0 per 100 square yards on sprayed and unsprayed streams respectively. These data suggest that insecticide spraying had no measurable effect on the density of populations of young salmon.

5.3 Pulp and Paper

A bioassay monitoring program was started in June to

determine the effectiveness of chemical treatment in reducing the toxicity of Fraser Companies Limited bleached kraft mill effluent at Newcastle. September marked the beginning of a one year reliability test period. The Department has required the Company to provide a non-toxic effluent at 65 percent concentration in a 96 hour test. To date, the Company has been successful in meeting Departmental requirements one day in August, one day in September and two days in November; the mean survival time of juvenile salmon ranged between 20 and 30 hours. The results of these bioassay tests clearly indicate that chemical treatment is neither reliable nor adequate and that an alternative method of treatment is required.

Debarking effluent was found to be extremely toxic due to high resin acid content. Methods to treat this component are currently under study.

Effluent discharged by Acadia Pulp and Paper groundwood mill into the Miramichi River has been found to be extremely toxic to fish and to contain excessive quantities of suspended fibre. Chemical analyses have shown that lethal concentrations of both resin acids and phenolic compounds are present in the wastes and it may be these that account for rapid mortality of juvenile salmon observed in bioassay tests (mean survival time of 4.8 hours). Negotiations with the Company are being arranged.

Treatment facilities were installed by the Domtar

wood preserving plant at Newcastle at the insistance of the Department. Although the toxic components of their process are no longer discharged into the Miramichi estuary, creosote residues and pentachlorophenol derivatives are being leached from the banks of "Creosote" Brook and from the bog at its mouth. Solution of this problem involves the plans of the Municipality of Newcastle in locating sewage treatment facilities for the township in the bog.

Negotiations are continuing with Fraser Companies Limited concerning adequate effluent treatment facilities for the proposed new mill at Edmundston. Under the original proposal, the mill would produce 700 tons/day of bleached kraft, 300 tons/day of groundwood and 100 tons/day of liner board. The Department was advised a few months ago that the Company is presently conducting a study to determine its long range fibre requirements. This study will determine whether they change to kraft or to a recoverable base sulphite process.

The effluent treatment facilities were monitored periodically at Scott Maritimes Limited bleached kraft mill located at Abercrombie Point, Nova Scotia, to ensure that effluent quality is being maintained. We also requested the Fisheries Research Board to conduct a survey in the area to determine the effect of the effluent on lobster populations in the area. The results of these tests indicate that the average BOD reduction in the Boat

Harbour Lagoon during 1969 was 67 percent. Bioassay tests using young speckled trout indicate that the treated aerated effluent was non-toxic at 100 percent concentration. The survey by Fisheries Research Board indicate that there is no evidence for attributing poor lobster catches in that area to the effects of bleached kraft mill effluent.

The untreated effluent from Anil Canada Limited hard-board plant continued to cause problems in the Mahone Bay area throughout most of the year. Biological treatment was proposed for this effluent before the plant opened three years ago, but, because of problems encountered in sealing the quarry that was to be used as the retention pond, the system was not put into operation until November 1969. A biodegradeability study was conducted in May to determine the feasibility of using this method of treatment. Using a laboratory scale biological treatment unit, neutralized and unneutralized waste was aerated with activated sludge and removal efficiencies observed. The results indicate that 83 percent and 27 percent of the BOD was removed from the neutralized and unneutralized wastes respectively.

The effluent from the new St. Anne Pulp Mill located in Mactaquac headpond at Nackawic, New Brunswick, will receive both primary and secondary (biological) treatment. Because of the critical location of the mill, the Department has required that the effluent be non-toxic at outfall.

The mill is scheduled to go on line early in 1970.

Negotiations were held with Fundy Forest Products Limited concerning effluent treatment facilities for their proposed neutral sulphite semichemical hardwood mill to be located near St. George, New Brunswick. During the first phase, the mill will produce 250 tons/day of corrugating medium, expanding in about three years to 500 tons/day. Biodegradeability studies were carried out on a simulated effluent obtained from a mill in Berlin, New Hampshire.

An announcement was made recently that the Rothesay Paper Corporation, Saint John, New Brunswick, had been purchased by MacMillan Bloedel. The new company, MacMillan Rothesay Limited, will double the output of newsprint from the plant. Negotiations are underway concerning effluent treatment facilities for the mill.

Figure 15. Discharge of untreated pulp mill waste into a large Maritime river.

5.4 Base Metal Mining

Pollution originating from base metal mining operations continues to cause concern in New Brunswick. Production ceased at the Heath Steele Mine in June in order to expand their mill facilities. Despite this shutdown, containment and treatment of the highly toxic drainage from the mill site were not effectively carried out, and, as a result, extremely high toxicities were recorded in the Northwest Miramichi River below the mine. Monitoring programs by both Resource Development Branch and the Fisheries Research Board established, once again, the direct relationship between heavy runoff and copper-zinc toxicity in the Northwest Miramichi River. A meeting was held with the Company in November at which time they presented their expanded program of pollution abatement. This involved a tenfold increase in the water storage capacity at the mill site and an increase in the pumping capacity from the retention ponds to the tailing area. The Company was apprised of Department of Fisheries and Forestry toxicity criteria (108 ug/l zinc and 18 ug/l copper) that would be required at the mouth of the Tomogonops River. These levels were extrapolated from the Northwest Miramichi monitoring information.

Brunswick # 6 mining wastes seriously polluted the Nepisiguit River. A river survey involving water quality analyses and bioassay tests was carried out between the

mine and Bathurst. The results show that both Austin and Knight Brooks, which drain the mine property, discharge lethal concentrations of copper and zinc into the Nepisiguit. Toxicity persists in the river as far as Bathurst. A fish inventory of this section during the fall uncovered no spawning salmon or redds. Improvement to the treatment facilities leading to Knight Brook is currently underway; waste treatment of effluent to Austin Brook is to be negotiated.

Brunswick # 12 mine wastes continue to pollute Little River. A pilot plant treatment facility has been constructed and is being tested by Department of Energy, Mines and Resources personnel in an effort to gain a better understanding of this problem.

Development of the Anaconda Brass mine, located on 40-Mile Brook, is progressing rapidly; production is anticipated by late 1970. The size and location of the operation is a potential threat to the Nepisiguit River despite the fact that waste treatment facilities are to be provided. Recent plans for the development of the Restigouche mine presents a further threat to the Nepisiguit River. Proposals for waste treatment at this mine have recently been submitted to the Department and are being reviewed.

Preliminary investigations were conducted at three mining sites on Cape Breton Island; at Lake Ainslie (barite

and flourite), at Enon Lake (celestite) and at Catalone River (dolomite).

5.5 Agricultural Pesticides

The careless use of agricultural pesticides continues to cause problems in New Brunswick and Prince Edward Island. One of the largest fish kills recorded in this area occurred during August on the DeSable River, Prince Edward Island, when an estimated 20,000 speckled trout were killed. The provincial regulatory agencies in both Prince Edward Island and New Brunswick are considering the feasibility of enacting legislation to assist in controlling this problem. A constant temperature room for large-scale bioassays of agricultural pesticides was constructed at Coldbrook Fish Culture Station during the year.

5.6 Other Pollution Problems

(1) At the request of the Department of National Health and Welfare, a pollution survey was conducted on the Cheticamp River, Inverness County, Nova Scotia, below the National Park camp site. No evidence of pollution hazard to resident or migrating fish was observed.

(2) Bioassay tests were conducted to determine the feasibility of using N.T.A. to reduce the heavy metal toxicity problem associated with base metal mining in New Brunswick. Additional research is required before this material can be used in the field.

(3) A fish kill involving alewives occurred in Fletcher Lake, Halifax County, in early June. Investigations

indicated that this was a recurrence of an acidity problem originating from exposed pyritic ore in the vicinity of the Halifax International Airport.

(4) Reported fish kills associated with the discharge of untreated dairy waste into Yarmouth Harbour were investigated. The alledged kills were not supported by fact.

5.7 Marine Oil and Gas Explorations

Marine seismic surveys were conducted in the coastal waters of the Maritime Provinces by the following oil companies: Shell Canada Limited; Del-Rio Oils Limited; Hudson's Bay Oil and Gas Company Limited; Catalina Exploration and Development Limited; Chevron Standard Limited; Texaco Exploration Company; Amoco Canada Petroleum Company Limited; Elf Oil Exploration and Production (Canada) Limited; Mobile Oil Canada Limited and Banner Petroleums Limited. With the exception of one velocity survey conducted by Shell, non-lethal energy sources were used during these operations.

In addition to the marine seismic surveys, Shell Canada Limited commenced drilling operations during the fall in the Sable Island area and this Company will continue their operations with a second rig in 1970. Hudson's Bay Oil and Gas Company plan to drill two wells in the Gulf of St. Lawrence - Northumberland Strait area in the near future. The Department of Fisheries and Forestry has been apprised of these plans and the potential effect on

the fisheries resource in the two areas is being considered.

6.0

ENVIRONMENTAL PROTECTION SECTION

6.0 ENVIRONMENTAL PROTECTION SECTION

The aim of the Environmental Protection Section is to maintain the physical aquatic environment in a condition satisfactory for the natural perpetuation of fish stocks. A clear distinction is recognized between this Section and the Pollution Abatement Section in that the latter activity has the responsibility to detect, prevent and abate water pollution and the indiscriminate disposal of industrial, municipal and domestic wastes into fish-bearing waters. Environmental Protection personnel are required to deal with problems such as man-made obstructions, diversions, and other physical alterations to the fresh-water and marine environment. This phase of the Branch's work is particularly important when anadromous fish are considered because it encompasses such factors as access to spawning areas and to ocean feeding grounds, maintenance of suitable flow regimes for migrations and the rearing of young fish, and protection of bottom substrate and vegetation along stream margins. A bio-engineering approach is employed and important activities include on site evaluations of fish passage facilities, applied research studies, the physical maintenance of protective and passage facilities for fish, and the provision of technical guidance in the design and construction of such facilities.

6.1 Evaluation

Complex fish passage problems associated with tidal

installations, especially on rivers flowing into the Bay of Fundy, require more complete understanding of adult fish behaviour and migration habits before adequate protective measures can be applied. A comprehensive evaluation program was initiated in 1969 to acquire additional information on adult fish behaviour at tidal obstructions and to determine the effectiveness of past protective works.

Field evaluation studies were conducted at Great Village River aboiteau in Colchester County, Nova Scotia and Petitcodiac River causeway, Moncton, New Brunswick. Behaviour and movement of adult fish through these installed works were monitored by utilizing an ultra-sonic tagging device.

Figure 16. Equipment used to monitor salmon movements during fish passage evaluation studies; on the left an ultra-sonic tag being inserted into a salmon's stomach; on the right the shore-based receiving equipment in operation.

Passage of fish through the protective works was recorded along with water control gate positions, tide elevations and discharge relationships. This information is being analyzed and evaluated to establish definite criteria which will assist in the design of future installations in tidal areas.

Assessment of a steepass fishway design located on the Missaquash River, Nova Scotia, was undertaken during the year. This structure is the first of its kind in the Maritime Region and was constructed by the Regional Economic Expansion Department to facilitate movement of trout and gaspereau beyond a water control structure constructed for waterfowl habitat improvement. Although ideal entrance conditions to the steepass fishway were lacking, a tag and recovery study indicated that several gaspereau did use the facility. Regional Economic Expansion staff carried out improvements to the entrance area of the fishway during the year and assessment of this facility will be continued in 1970.

An assessment of the White Rock Fishway located on Gaspereau River, Nova Scotia, was conducted in 1969. The program included marking, tagging and recovery of substantial numbers of gaspereau. Delays and entrance attraction effectiveness were evaluated. Indications are that greater numbers of gaspereau and other species would be induced to enter the fishway if additional

attraction water was provided. To facilitate carrying out these assessment studies, a trapping device incorporating a vertical rising floor principle was designed and installed, and a new fish tag consisting of a small flourescent-painted paper fastener attached to a pectoral fin was employed.

Trapping facilities incorporating a vertical rising floor principle were designed and installed at Middle River and Pictou Harbour causeway installations. A problem of low water levels at the Middle River installation prevented the operation of the fishway until late in the year. Further studies regarding watershed discharge and industrial water use requirements are planned in order to determine if the scheduled fishway operating periods are realistic. Smolt sampling activities were carried out in the Middle River and Pictou Harbour reservoirs to determine the extent of smolt delays in these impoundments. Information to date indicates that a serious delay occurs in the Middle River flowage.

Evaluation of the Mactaquac collection and primary sorting facilities continued during 1969. Hydraulic conditions were recorded for various tailwater situations accompanied by periodic observations to determine the effectiveness of this facility to attract and collect fish; indications are that it is working well.

6.2 Protective Measures

Effort was directed towards providing adequate adult fish passage facilities for various water development projects. Functional design proposals were provided for Big Shaw Bridge and Beaver Lake storage dams on the Musquodoboit River watershed. These storage dams were constructed by the Regional Economic Expansion Department to prevent flooding of agricultural land on the lower reaches of the river. Negotiations were completed, providing adult fish passage facilities at Moore's Mill Lake Storage Dam, Charlotte County, New Brunswick; Sherbrooke Lake Dam, Guysborough County, Nova Scotia; and reconstruction of Milton Dam on the Mersey River.

Construction of two dumping sites to facilitate release of adult fish captured at the Mactaquac collection works were completed during the year. An access road and general site preparation were completed for a third dumping site.

Negotiations are continuing with the New Brunswick Electric Power Commission regarding the design and construction of secondary sorting and holding facilities at Mactaquac. Negotiations were concluded regarding the design of a retractable finger trap device for the Mactaquac primary sorting works located at the powerhouse. Agreement has been reached with the Commission to have this device installed prior to the 1970 migration season.

Staff effort was provided to review and edit draft copies of the comprehensive Atlantic Provinces Water Resources Study. A significant contribution was made in defining the fisheries demands for water in the region.

6.3 Investigation

Through co-operative consultation with the three provincial water authorities, a significant reduction in gravel removal from rivers and streams was achieved. Annual extraction of large quantities of construction aggregate from the North River, a tributary of Salmon River, Colchester County, was virtually eliminated. Efforts are now being directed towards the physical restoration of this important salmon and trout producing river to its former natural condition.

Log driving operations, although severely reduced in numbers and magnitude, are a serious concern of the Environmental Protection staff. Efforts were made to observe the effects of log driving operations on adult and juvenile species in the Nashwaak River, New Brunswick, during the year. Indications are that with proper scheduling and control of these operations little adverse effects to indigenous stocks of fish can be detected.

A number of stream alteration requests, including minor diversions and barrier removals, were investigated and, when necessary, solutions were provided to protect the fisheries resource. Environmental Protection staff

advised on and approved the installation of a number of water intake screens for various pumping and diversion installations. Several bridge and culvert installations were assessed and solutions to fish passage problems were provided.

Preliminary investigations were carried out regarding the development of an efficient and economical method of deflecting and by-passing Tobique River smolt run for overland transport to a point below Mactaquac flowage. Several possible sites were investigated and preliminary capital costs determined. Investigations are continuing and these will be intensified in 1970.

Surveys were conducted on Middle River, Victoria County, and Petite Riviere, Lunenburg County, both in Nova Scotia, in an effort to determine the scope and magnitude of adult fish passage problems. Frequent blockage of Middle River fish stocks as a result of natural obstructions has received attention during the past three years. Preliminary indications are that this problem will continue until a comprehensive watershed flow retention scheme is devised accompanied by elaborate bank protection structures for bank stabilization purposes. Fish passage problems associated with Petite Riviere stem mainly from an existing hydroelectric plant and associated storage dams and maintenance flow during plant shut down.

6.4 Applied Research

To assist in the design and method of operation of a secondary sorting and holding facility at Mactaquac, model studies were carried out by the Environmental Protection staff on various operating components of the proposed facility. Critical components of the proposed facility were modeled to determine if refinements to the original functional proposal were possible. The results of the model investigations provided justification for modifications in the overall design layout.

Figure 17. Testing the operation of a hydraulic model of the secondary sorting and holding facilities for Mactaquac.

Engineering feasibility studies were initiated and are continuing relative to a proposed field research facility. Precise information on the swimming abilities

and flow requirements of important fish species in this region are lacking, thereby seriously jeopardizing the Environmental Protection staff efforts to devise and implement improved fish passage devices. The applied research facility will provide an opportunity to determine behaviour patterns and tolerance limits for the more important species of fish. Exploratory studies will be expanded to include a number of potential locations and the respective capital costs for each will be determined.

6.5 Maintenance

Negotiations were concluded with the Nova Scotia Light and Power Company concerning rebuilding of the lower portion of the White Rock Fishway located on the Gaspereau River, Kings County, Nova Scotia. Reconstruction was completed prior to the 1969 migration season and included provisions to accommodate additional attraction water at the fishway entrance. Negotiations are in progress regarding the supply and installation of a facility to ensure an additional attraction flow of 7.5 c.f.s.

Negotiations are continuing with the Miramichi Lumber Company regarding suitable fish passage facilities at their mill dam located at Juniper, New Brunswick. Negotiations are also continuing with the St. Croix Pulp and Paper Company in connection with suitable fish passage facilities

at Forest City Dam situated on the St. Croix River. A hydraulic assessment of the newly constructed fishway is planned for early in 1970, and if serious hydraulic problems are detected, the Company will be requested to make the necessary changes in the fishway layout.

Negotiations were finalized with Sydney Steel Corporation regarding the reconstruction of the Sydney River Fishway. Functional design drawings for a concrete denil type fishway were developed by the Environmental Protection staff in co-operation with Company engineers. Construction of the fishway was completed late in the year.

Repairs were carried out on Indian Falls Fishway located on the East Branch of the La Have River, Nova Scotia. The repairs consisted of replacing several baffle sections and general concrete repair work on the main body of the fishway structure.

Negotiations are in progress with the New Brunswick Electric Power Commission concerning the breaching of the Kouchibouguac Dam located on the Kouchibouguac River, Kent County, New Brunswick. Present indications are that this work will be carried out prior to the 1970 migration season.