PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Marine Fish Division Project No.: 9765

Section: Central Shelf

Project Title: Groundfish Ecosystem - Harvesting Data

Project Leader: O'Boyle, R.

Other Researchers: Lambert, T.; Hurley, P.; Hunt, J.; Buzeta, M.; Trippel, E.; Van Eeckhaute, L.; Neilson, J.; Gavaris, S.

Work Activity: W.A.1.1.1.2

Key Words: groundfish; cod; research

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1. Project Description:

The forerunner of this new project was Project #1330: Cooperative Science-Industry Groundfish Research and Communication.

This program expands the scope of interaction between science and industry beyond the "index" fishing concept. The emphasis here will be on biological studies not directly tied to the assessment process. Joint work at this level will foster a new appreciation for the abilities of both groups in the study of fish biology. As such it will serve as a valuable medium for communications and education.

2. Long-Term Objectives:

Research carried on under this project will provide a good biological basis upon which to establish sound assessment of groundfish stocks. During the course of these studies, it is anticipated that by assisting in the set up of the programme and in the subsequent collection of data, fishermen will gain a better understanding of the research process.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. In consultation with fishermen, establish four or five inshore stations in Subdivision 4Vn and begin monitoring cod stocks on a bimonthly basis. (Lambert)

Regular groundfish sampling has been implemented in areas advised by fishermen as being trawlable. Seven cruises between April and November were carried out roughly monthly, and some fixed stations have been established in locations of particular interest; for example at one site where young-of-the-year and one-year old cod are found consistently.

2. Carry out ichthyoplankton survey to assess degree of fall-spawning of cod along inshore coast of eastern Nova Scotia. (Lambert)

Ichthyoplankton tows were taken in Bras d'Or Lake and on Smokey Bank in Sydney Bight during the months noted in #1 above. Spring spawning was documented in both places but no cod eggs were found in the fall, although cod in spawning condition were reported in Sydney Bight during early November.

3. Carry out juvenile survey for cod along inshore coast of eastern Nova Scotia in cooperation with a similar offshore survey as part of the Eastern Shelf Programme (ESP) and in support of the Ocean Production Enhancement Network (OPEN). (Lambert)

The offshore component of this project was cancelled due to lack of overtime funding for large vessel cruises. Therefore the inshore component to be carried out under this project was also cancelled. However, a site preferred by juvenile cod was located in Sydney Bight (see #1 above).

4. In cooperation with the inshore fishing fleet in southwest Nova Scotia, develop a program to determine biological and environmental factors that affect catchability and availability of groundfish in NAFO Division 4X and Subarea 5. (a) expand contacts with fishermen through meetings and interviews and develop research topics of mutual interest; (b) analyze existing IOP data from observer deployments in 4X+5; (c) implement program using fishermen to collect environmental data (surface and bottom temperature, wind speed and direction, tide state and direction of flow, bottom depth and type) in association with catch and location data; (d) use IOP observers to collect ancillary environmental data and biological data if observers are deployed in 4X+5; (e) use RV surveys in 4X+5 area on opportunistic basis to supplement environmental data to aid in characterization of water masses; (f) prepare a presentation on the program for FINS. (Hurley, Perry)

Contacts with fishermen expanded through FINS, informal meetings, and port technicians, and included site visits to BIO by several groups of fishermen. In some cases, research questions were explored through on-line data analysis. Preliminary analysis of IOP data conducted. Protective thermometer housings were constructed after consultation with fishermen. Trials with two thermometers indicate

they can be used successfully by draggers, longliners and gillnetters. Twenty thermometers have been placed in the field for the start of the '92 fishing season and the remainder will be placed as soon as it is confirmed that the first group are functioning properly.

5. Evaluate the influences of vessel and gear design and of fishing strategy on the efficiency of inshore fishing vessels in 4X+5. This will assist in future planning of an "index" fishing program with that fleet. (Hurley)

Concept discussed with fishermen, a marine architect and trawl designers. Data base of vessel and gear characteristics of draggers initiated. Trawl course attended.

6. Develop "fisherman's almanac" through interviews with fishermen and examination of fishing logs. (Hurley, Frank)

Information for 1990 extracted from port technician weekly progress reports. Fishing records of two dragger fishermen examined and partially extracted. No further progress made due to time constraints.

7. Observe commercial fishing operations. (Hunt, others)

No progress was made on this project.

8. Establish contacts with groundfish fishermen and make arrangements to go out to sea with them to document how commercial operations utilize sounders when groundfishing. (Vacant)

Staffing of this position was delayed. Contact was made but arrangements to participate on a fishing trip are pending.

4. Additional Accomplishments:

Information on cod, redfish and winter flounder distributions from RV surveys provided to fishermen on request. (Hurley)

5. Goals/Expected Outputs for 1992:

1. Undertake bottom trawl programe from April to November to monitor cod stock(s) in Sydney Bight particularly with respect to spawning runs. Collect otoliths of spawning fish from Bras d'Or Lake and Smokey Bank for use in shape analysis (see Project #1021). (Lambert)

2. Continue survey of juvenile cod; monitor fixed station for second year with the goal of developing an abundance index, and explore additional areas with trawl and other gear (beach seine, trap) to locate additional sites preferred by young cod. (Lambert)

3. Continue ichthyoplankton survey to measure cod egg production in subdivision 4Vn. (Lambert)

4. In cooperation with the inshore fishing fleet in southwest Nova Scotia, develop a program to determine biological and environmental factors that affect catchability and availability of groundfish in NAFO Division 4X and Subarea 5: (a) expand contacts with fishermen through meetings and interviews and develop research topics of mutual interest; (b) analyze existing IOP data from observer deployments in 4X+5; (c) continue program using fishermen to collect environmental data (surface and bottom temperature, wind speed and direction, tide state and direction of flow, bottom depth and type) in association with catch and location data; (d) use IOP observers to collect ancillary environmental data and biological data if observers are deployed in 4X+5; (e) use RV surveys in 4X+5 area on opportunistic basis to supplement environmental data to aid in characterization of water masses. (Hurley, Page, Perry)

5. Evaluate the influence of vessel and gear design and of fishing strategy on the efficiency of inshore fishing vessels in 4X+5. This will assist in future planning of an "index" fishing program with that fleet. (Hurley)

6. Observe commercial fishing operations. (Hunt, others)

7. Establish study of winter flounder exploitation rates (Neilson, Gavaris, Kearney (MFU), Neilson replacement). N.B. J. Neilson is taking a leave of absence for 3 years. It is anticipated that his replacement will pursue the winter flounder investigation.

   A four-year long study is envisaged. The first year will involve defining principal areas where winter flounder are harvested, identifying fishermen who are willing to participate in a study of catch rates, hiring a local coordinator, establishing liaisons with university investigators (Acadia University, G. Daborn) and, in general, ensuring that study preliminaries are well defined. After the study area has been well-defined from the preliminary investigation, subsequent years will be spent obtaining detailed catch and effort statistics for winter flounder. A special logbook will be compiled by the contractor who will supply DFO with information coded as to vessel, ensuring privacy for volunteering vessels and a reduction in possible biases in the data. Catch rate data will be used to derive exploitation rates and abundance trends.

8. Construct a plastic "Maturity Disc" that may be kept onboard fishing vessels as a hands-on device to educate fishermen of the vast differences in age and size at sexual maturity among stocks in this region. (Trippel)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

Interviewed and consulted with 15 fishermen who work mainly in the 4Vn subdivision. Close contact and ongoing cnsultation has been maintained with about four of these during the course of research work in the area. (Lambert)

iv. Contracts Administered -

Ichthyoplankton sample identification and data analysis with C. Parsons ($8k). (Lambert)

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Progress on this project has been very good and is following the intent of the AFAP initiative. It has led to a greater awareness of scientists in the industry and an appreciation by scientists of what fishermen can contribute. It is hoped that AFAP funding can continue.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Marine Fish Division

Project No.: 9766

Section: Gulf of Maine

Project Title: Groundfish Ecosystems: Research Information-Survey Data

Project Leader: Gavaris, S.

Other Researchers: Clark, D.; Buerkle, U.; Strong, M.; Hunt, J.; Gale, J.

Work Activity: W.A.1.1.1.2

Key Words: groundfish; abundance; hydroacoustic; index estimates; stock assessment; bottom trawl; surveys

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1. Project Description:

Research on developing groundfish abundance index estimates through the implementation of hydroacoustical techniques and a suitable survey design. Research on improving the comparability of trawl survey results by reducing variability introduced by gear performance.

2. Long-Term Objectives:

Provide more precise and accurate groundfish abundance index estimates suitable for stock assessment requirements than those currently available from bottom trawl surveys.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Become familiar with the hydroacoustic equipment and its capabilities. (Vacant, Buerkle)

Participated in a herring hydroacoustic survey and learned the operating practices for the available equipment.

2. Develop protocols to improve standardization of tow parameters which require assessment of the impact of trawling operations such as vessel speed, warp to depth ratios, bottom topography, etc. SCANMAR will be the principle source of these data.

Analysis of SCANMAR data was presented to CAFSAC and will be published as a Technical Report in 1992. New trawl speed sensor was added. SCANMAR course was completed which will allow better interpretation of data.

3. Evaluation of data acquisition software for research surveys with interactive data editing based on a UNIX Oracle version of existing software will be used to assess logistic and environmental limitations for field applications. (Strong, Gale, Hunt)

Branch plans call for the installation of a VAX/VMS system running ORACLE on the R.V. Needler in the coming year; therefore, plans for a UNIX PC based system were shelved.

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

1. Observe the use made of sounders by the commercial groundfish fishery. (Clark)

2. Deploy hydroacoustic gear during groundfish bottom trawl surveys, comparing suitability of season. (Clark, Buerkle).

3. Analyze and interpret hydroacoustic data collected during bottom trawl surveys, making recommendations on representativeness of abundance estimates for principal gadoids. (Clark, Buerkle)

4. Become familiar with uses of abundance indices in assessments of groundfish. (Clark)

5. Investigate means of measuring target strength for gadoids with a view to describing the degree of variation. (Clark)

6. Begin development of an at-sea data acquisition and editing system for bottom trawl surveys. (Strong, Gale, Hunt)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Staffing of the acoustics position in St. Andrews took considerably longer than anticipated. However, progress has been steady, particularly in the acquisition of a Dual Beam system. The stage is now set for a productive 1992.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Marine Fish Division Project No.: 9767

Section: Central Shelf

Project Title: Groundfish Ecosystems: Research Information - Geographic Distribution

Project Leader: O'Boyle, R.

Other Researchers: Mohn, R.; Zwanenburg, K.; Frank, K.; Trippel, E.; Van Eeckhaute, L.; Buzeta, M.; Gavaris, S.; Perry, I.; Waldron, D.; Showell, M.; Hunt, J.

Work Activity: W.A.1.1.1.2

Key Words: groundfish; distribution; ESP; SPANS; spatial distribution; migration; haddock; Georges Bank; cod; Gulf of Maine

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1. Project Description:

Analysis of geographically indexed data pertaining to groundfish on the Scotian Shelf to systematically study fish distribution in relation to environmental, biological and fishery factors. Examination of the distribution of fish within management units based on research vessel surveys and fishery distribution.

2. Long-Term Objectives:

To understand the distribution of groundfish and the responses to changes in population dynamics, the environment and the fishery.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Administer a contract to convert existing MFD geographically indexed data bases into SPANS format files. This will include RV surveys, surveillance records and commercial statistics. As well, a set of relevant base maps will be converted or created for coastlines and bathymetry. Additional base maps may be produced if data are available, eg. bottom type. (Fanning)

Due to Fanning's departure, August '91, the contract was not let. The failure to have this contract meant that the following 2 goals could not be achieved. Also, this project was inadequately funded, and the funding which was provided was delayed, which compromised any chance of success.

2. Analyze spatial data from surveys relating oceanographic water masses and distribution of 4VsW cod. This is contingent upon the successful completion of the data preparation (goal 1 above). This objective is a contribution to the Eastern Shelf Program. (Fanning)

Not undertaken as Goal 1 not done.

3. The interaction between the fleet distribution, based on surveillance or commercial data, and the distribution of resources (RV surveys) will be examined using SPANS. This is contingent upon the successful completion of the data preparation (goal 1 above). (Mohn)

Not undertaken as Goal 1 not done.

4. Contingent upon successful completion of objective 1, characterize the ichthyofauna of Emerald, Western, and Sable Island banks as parts of an overall comparison of the physical and biological characteristics of the submarine banks of the Eastern Scotian Shelf. This objective is a contribution to the Eastern Shelf Program. (Zwanenburg and Frank)

As no contract was let to convert MFD's geographically indexed data bases into SPANS format, no progress was made on this initiative. The analyses will require the use of a geographicall information system presently not available to the Division.

5. Study of the distribution of commercial catches of cod, haddock, pollock, silver hake, squid, redfish, flatfish species on the Scotian Shelf. Data from 1977-1990 from the IOP will be superimposed on the distribution patterns from available seasonal surveys. Analytical tools include SPANS or other GIS's. The first part of the analysis will focus on the general distribution of the catch regardless of the size of each species. The second part of the analysis will focus on the distribution of various size categories. Available IOP temperature data and bottom type information will also be used to define the possible habitat of each demersal species. No new data collections are expected. (Waldron, Showell)

Revised priorities during the year resulted in this project being deferred.

6. Monitor the distribution of commercial fisheries for silver hake, cod and haddock on the Scotian Shelf in relation to temperature. Data currently collected from the commercial fishery is dependant on the availability of commercial vessles with temperature recording devices. Study

of onshore migration of silver hake requires constant monitoring from the commercial fleet. In the past Observers have been trained in and supplied with MFD's XBT recorders. This has been expensive and difficult to maintain. The availability of smaller more portable and less costly alternatives such as the SEATEMP probe should provide a cost effective means of collecting some of the required data. The requirement for 1991/92 is to place 5 such probes in the domestic silver hake fishery (areas around Emerald Basin-Western Bank) and the foreign silver hake fishery (along the shelf edge). (Waldron)

Revised priorities during the year resulted in this project being deferred.

7. Describe the spatial distribution of Georges Bank haddock in relation to the potential for movement across the Canada/U.S.A. boundary. Age specific patterns and oceanographic effects will be considered. (Trippel, Van Eeckhaute, Gavaris)

Estimated haddock spatial distribution by age in relation to the transboundary line from U.S.A. research vessel survey data 186-90. Annual age specific migration rates across the boundary line were estimated from 1985-90. Preliminary results were presented to CAFSAC and final revisions are nearing completion. The findings have implications for management of the resource and were presented to GOMAC. (Trippel, Van Eeckhaute, Gavaris)

8. Conduct a study in the Gulf of Maine to assess cod and haddock interaction with adjacent areas. Tag releases, alternate capture methods, estimates of tag induced mortality, age specific migration patterns and investigation of alternative biological tags will be investigated. (Hunt, Van Eeckhaute, Buzeta)

See Goal 6 in Project No. 1013.

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

With resignation of the lead analyst (Fanning) and pressure of other work, the Central Shelf Section is abandoning this project.

1. Investigate use of tagging for determination of haddock migration rates. Initiate literature search and familiarization with topic. Determine what data is available from past tagging experiments and analyze if possible. Investigate possibility of using commercial longliners in tagging experiment and observe commercial longline fishing. (Van Eeckhaute)

2. Plan and conduct a cod tagging experiment in the Gulf of Maine area. (Hunt)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

It is evident that with the departure of P. Fanning, and the inadequate funding in 1991, this project was compromised. During the AFAP cutbacks, this was one of the projects targeted for further cuts. It was always planned that this project would draw heavily on A-base resources. During 1992, it will receive limited funding but the intent of the project is being met by A-base initiatives (see projects 1180 and 1250 for example). As well, a large element of Project 9765 is involved with stock structure issues.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Marine Fish Division Project No.: 9769

Section: Central Shelf

Project Title: Longliner Project - AFAP

Project Leader: Halliday, R.

Other Researchers: Vacant

Work Activity: W.A.1.1.1.2

Key Words: assessment research; groundfish

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1. Project Description:

This project, supported by AFAP funds, addresses Recommendation 17(a) of the Report of the Scotia-Fundy Groundfish Task Force which reads: evaluate the biological and economic effects of a longliner allowance fishery including examination of fish selectivity in relation to hook size, type and bait.

2. Long-Term Objectives:

This is a two-year project.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Provide a report on the current status of the regional longline fishery with regard to biological, economic and technological factors, as a basis for evaluation of potential responses to deregulation of hook and line fishing. (Halliday and Fanning)

The questionnaire survey of Regional longline fishermen, initiated in 1990, was completed in March 1991 and the contractor's report received. Approximately 350 fishermen were interviewed comprising about 30% of active longliners and 7% of inactives. The results of the questionnaire are now being analyzed, with a contractor's report expected early in 1992.

2. Conduct an experiment to compare size selection of hooks and trawl nets when fishing the same populations of fish. The experiment will be designed to yield data on at least two hook and two mesh sizes for both cod and haddock. (Fanning and Halliday)

The experiment was successfully conducted in October using two chartered vessels, the longliner Lady Sharrel and the otter trawler Lady Eileen. The selection properties of three hook sizes (#10, #12 and #14) and two mesh types (130 mm diamond and square netting) were tested against the catches by a small mesh (40 mm) trawl net for cod and haddock. The resultant data are now being computerized and edited for subsequent analysis.

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

1. Complete analysis of longline questionnaire survey by making results available in reports suitable for DFO managers and industry. (Halliday)

2. Conduct analysis of longline size selection experiment for cod and haddock, and provide provisional results to DFO managers and industry. (Halliday)

3. Additional hook selection experiments if money and personnel are available. (Fanning replacement)

6. Background:

Highlights:
Fanning's resignation in August has made completion of this work more difficult, and data analysis and reporting will continue through 1992. However, this AFAP science project was supported for a two year period only, and officially terminates March 1992. Additional hook selections experiments would be rewarding but their conduct depends on extension of funding for this project and success in hiring a replacement for Fanning.

Selected Involvements:

i. Collaborative Research -

C. Cooper and W. Hickey, Fisheries Development, FMB, Halifax, provided significant funding for the longline selection experiment additional to the Science budget, and provided invaluable advice and assistance in conduct of the work. (Halliday)

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

Analysis of questionnaire data - Gadus Associates ($20K); Vessel charters for longline/otter trawl selection experiment ($110K). (Halliday)

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Given the limited funding, progress on this project has been exceptional. During 1992, the focus will be on analysis and should wrap the initiative up by 31 March 1993.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Marine Fish Division Project No.: 9771

Section:

Project Title: Communications - Fishermen

Project Leader: O'Boyle, R.

Other Researchers: MFD Staff

Work Activity:

Key Words: consultation; organization; fishermen; FINS

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1. Project Description:

The Haché Task Force on the Scotia-Fundy groundfish fishery commented on the poor level of credibility that the fishing industry has of DFO scientists. Much of the problem lay in poor communication between scientists and fishermen. This program will provide a comprehensive communication strategy to rectify the problem. The groups targeted as part of this strategy include grade 9 high school students, new fishermen, experienced fishermen and the general public.

2. Long-Term Objectives:

To increase awareness and understanding of fisheries science at all levels of the Scotia-Fundy fishing community.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Finalization of grade 9 high school curriculum on fisheries. This will involve consultation with teachers to modify the proposal formulated in 1990/91 (O'Boyle)

In consultation with the Halifax District School Board, a course was defined and outlined. A pilot will be given in June 1992 with implementation in the classroom in the following fall.

2. Ongoing implementation of Masters Ticket Program (MTP) initiative with consideration of expansion to New Brunswick (O'Boyle)

Six lectures were given in the MTP series. Plans were made for the 1992 series. Also the presentations were compiled into a standard format.

3. Ongoing FINS exercise (MFD Staff)

The Nova Scotia Fisheries Exhibition was attended by a Divisional team. In addition, a number of smaller meetings were held with the various associations.

4. Ongoing production of newspaper articles, support of dial-a-scientist and industry report (MFD Staff)

Production of the industry report was limited to the section on cod, due to funding cuts. In St. Andrews, support was provided for the production of a chapter in Scott Parson's book on fisheries management.

5. Participate in FINS and other consultations with fishermen's organizations. (Gavaris, Neilson, Trippel, Hunt)

Staff met with fishermen's organizations in Yarmouth, Cape Sable and Grand Manan to discuss the status of groundfish resources and plans for research activities. Meetings well attended with good interchange of biological and fishery information.

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

This project will be incorporated into the existing A-base initiatives.

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

This project received limited funding and was the target of further cuts in 1991. The initiative is seen as a modest priority and will be pursued as much as possible using A-base funding.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Marine Fish Division Project No.: 9813

Section: Marine Mammals

Project Title: Seal/Sealworm Ecology - Diet/Parasite Studies

Project Leader: Bowen, D.

Other Researchers: McClelland, G.; Stobo, W.

Work Activity:

Key Words: seals; Atlantic Fisheries Adjustment Program; diets; sealworm abundance

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1. Project Description:

This project provides additional funding to meet the objectives of the Seal/Sealworm Ecology Program (SSEP) associated with studies on the diets of grey and harbour seals and the abundance of sealworm in seals and fish species which are either commercially important and/or are important foods of seals.

2. Long-Term Objectives:

To provide data on seal diets and sealworm abundance in seals and fish for use in developing models of the population dynamics of sealworm. The results from such modelling studies will be useful in providing advice to managers on seal/fisheries interactions.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Measure metabolic rate of adult female harbour seals on Sable Island, using doubly-labelled water, to determine total energy expenditures over the lactation period. (Bowen)

Doubly-labelled water was administered to 5 free-ranging adult harbour seal females to determine metabolic rate during early and late lactation on Sable Island in May 1991. Analysis of both water isotopes will be completed by the end of the fiscal year. Calculations to determine metabolic rates will be completed in 1992.

2. Continue a preliminary study on the proximate composition and energy density of seal prey and the use of fatty acid signatures of major seal prey to determine major components of the diet of grey and harbour seals using Sable Island. Work to be done in Dr. R. Ackman's laboratory at TUNS, Halifax. The work has two main objectives: a) to enable more reliable estimates of food intake of seals by determining seasonal variation in caloric content of seal food, and b) to provide a means of obtaining information on the diets of seals in offshore locations around Sable Island. (Bowen)

This work did not proceed as planned. AFAP funds were frozen before a contract could be arranged to conduct the work.

3. Complete identification and enumeration of nematodes from grey seal stomachs collected during the seasonal survey on Sable Island. (McClelland, Stobo, and Martell)

4. Identification of food and parasitic nematodes from stomachs of recently weaned grey seals on Sable Island to determine source of initial sealworm infection. (McClelland, Beck, Martell)

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

1. Collect addition seal stomachs, with emphasis on grey seals, from selected hunters at previously sampled locations in Scotia Fundy Region. (Bowen)

2. Determine energy requirements of free-ranging adult and juvenile male harbour seals using doubly-labelled water to provide data for models of population energy requirements of seals on the Scotian Shelf. (Bowen)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

Thesis supervisor of four graduate students at Dalhousie University: K. Glazebrook (formerly Barker) -isotope dilution estimates of food intake and ultrasound estimates of changes in body composition of captive harbour seals; M. Muelbert - lactation strategies in South American fur seals; P. Ross - immune function in harbour seals; B. Walker - reproductive ecology of male harbour seals. (Bowen)

Theses supervised - K. Glazebrook. 1991. The use of ultrasound and isotope dilution to estimate body composition and food intake in pregnant and non-pregnant captive harbour seals (Phoca vitulina concolor). M.Sc. Thesis, Dalhousie University, Halifax. (Bowen)

iii. Communications -

Interviewed by Canadian Geographic for a Geo Watch article. (Bowen)

iv. Contracts Administered -

Analysis of grey and harbour seal diets - J. Lawson ($5.2 and $6 K); Analysis of O-18 samples - Stable Isotope Lab, Boston University ($3.3 K). (Bowen)

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Progress on this project was good and complementary to the other elements of the program.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Marine Fish Division Project No.: 9814

Section: Marine Mammals

Project Title: Seal Population Monitoring

Project Leader: Stobo, W.

Other Researchers:

Work Activity: W.A.1.1.1.4

Key Words:

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1. Project Description:

Monitor population trends of grey seals on the Scotian Shelf.for the assessment of population status of grey seals and the provision of biological advice to managers.

2. Long-Term Objectives:

Monitor grey seal pup production trends on Sable Island and elsewhere on the Scotian Shelf (if new populations develop) to provide a basis for the sound management of this species. To develop and standardize a protocol for the regular estimation of pup production via aerial surveys or other techniques.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Develop the protocols and quality checks and issue a contract to analyze imagery of the 1989 and 1990 aerial surveys to estimate Sable Island grey seal pup production. (Stobo)

Contract to read aerial photographs completed, including calibration checks to ensure contractor was obtaining consistent readings.

2. Participate in annual meeting of SSEP to present progress survey analysis. (Stobo)

No SSEP meeting held. Attended meeting of CAFSAC Marine Mammal Subcommittee held in Feb/91 and presented estimates of Gulf pup production from tag resighting on Sable; attended second meeting of CAFSAC MM Subcommittee held in Oct/91.

4. Additional Accomplishments:

1. Paper on duration of pelage stages of grey seal pups submitted to Marine Mammal Science under revision. (Myers, Bowen, and Stobo)

2. Conducted helicopter survey throughout Bay of Fundy to count harbor and grey seals and obtain a ratio of species mix. (Stobo)

5. Goals/Expected Outputs for 1992:

1. Conduct analysis of 1989 and 1990 aerial surveys comparing estimates with known pup production from complete cohort tagging. (Stobo)

2. Conduct aerial photographic survey of 1993 grey seal pup production on Sable Island. (Stobo)

3. Participate in annual meeting of SSEP to present progress on survey analysis. (Stobo)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

Developed model of grey seal pup pelage stage progression as an element of estimating production from aerial surveys with Newfoundland Region scientist. (Myers, Bowen, Stobo)

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

Contract to read 1989 and 1990 aerial surveys and calibrate reading ($7.5k). (Stobo)

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

This project replaces the grey seal tagging component in the 1980 project 'Population Ecology and Assessment of Seals'. It represents an adaptation of the grey seal population monitoring requirement to deal with the practical difficulties of tagging over 10,000 seals annually. It was initiated under SSEP and it is anticipated that such a survey will be required at least once every 2 to 3 years.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 200

Section: Informatics and Administrative Support

Project Title: Informatics

Project Leader: Swetnam, D.

Other Researchers: Hunter, C.

Work Activity: W.A.1.1.1.3

Key Words: support; data processing; computer

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1. Project Description:

This project provides an essential support function to the research scientists and other BF&A Division staff. The provision of computing resources, training, development of specialized computer software, EDP planning, selection and procurement of EDP equipment and software, and consultation on data processing matters for the Division have been concentrated into this project. The project personnel also provide critical contacts with the fast moving computer field, making it possible for the scientific staff to accrue the benefits of recent developments and new techniques.

2. Long-Term Objectives:

To provide electronic data processing and analyses to scientific research and management projects of the BF&A Division by:

1. Computer programming, systems analysis, and consultative services to Division personnel.
2. Making available computing facilities and resources, both hardware and software, to the Division.
3. Designing and implementing data entry, storage and retrieval systems.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Supply day-to-day EDP service, support, development and training. (Hunter)

Goal met. Bulk of this service supplied by Hunter to members of the Division. Major accomplishments were; further design and implementation of the lobster fishery ORACLE data base. (Tremblay, Pezzack, D. Duggan, R. Duggan). Swetnam provided regular system and application maintenance and upgrades; Communication network extensions, maintenance upgrades and documentation. Installation of LAN E-Mail system some day-to-day assistance and program development.

2. Integration of the Halifax Lab LAN into Regional WAN including SQL*NET connectivity. (Swetnam)

Goal met. Lab was completely rewired using Ethernet 10 base T standards connecting to a 36 port concentrator. Ethernet cards were installed in Macs and PCs and configured to run both TCP/IP and Ethertalk protocols. Localtalk and Ethernet networks were integrated using TOPS and Liaison software. SQL*NET connectivity was accomplished to BIO (Cyber) and is expected to be installed at St. Andrews before December 31, 91.

3. Ensure laboratory personnel have converted files to NOS/VE format by March 31/91. Hire a term CS to assist with conversion. (Swetnam)

Goal met. All NOS/VE systems were converted or in a form that is accessible to the new operating system by the target date.

4. Instruct and train staff in the use of E-Mail and wide area networking. (DFONET, INTERNET, FTP, TELNET). (Swetnam)

Goal met. Individual staff were instructed in the use of Telnet and FTP. Courses were given for DFONET, E-Mail and Internet access. Telnet for the PC is planned for late December.

5. Do all possible to have in place the most suitable MA candidate by March 31/91. (Swetnam)

Goal met. A statistical consultant was hired in the ES category August 1, 1991. This was the earliest date possible due to delays in classification.

6. Introduce and train staff in the use of the ORACLE data base system. (Hunter)

Goal met. J. Tremblay, D. Pezzack, M. Eagles, D. Duggan, R. Duggan trained. M. Lundy to be trained before end of year.

7. Design creation and implementation of ORACLE data bases such as scallop and IOP invertebrate edits. (Hunter)

Goal partially met. Scallop for Bay of Fundy mostly complete to be finished and documented by end of December. IOP edits deferred until MFD implements IOP system.

8. Training of staff in use of NOS/VE & FSE. (Hunter)

Goal met. Documentation for FSE and NOS/VE produced. (C. Hunter)

9. Advise the Branch Executive and SIWC on EDP matters, if continuing as Chair of BSBCAC and Communications Subcommittee. (Swetnam)

Goal met. Continued in BSBCAC chairman capacity until December 31, 1991. Represented BSB on DFO/DEMR working group, SIWC and Communications subcommittee. Prepared Branch input into Cooperative Computing document and EDP workplans.

4. Additional Accomplishments:

1. The section assisted people from other Divisions; Freshwater and Anadromous, Habitat Ecology, and Marine Fish Divisions. Support was also given various graduate students, visiting scientists, summer students and other Branches of DFO.

2. Scallop edit systems were converted from COBOL to FORTRAN thus ending our involvement in COBOL.

3. All ORACLE databases were converted to version 6.0.

4. Documentation on the Lobster Logs and Bay of Fundy Scallop Log systems was prepared.

5. Manuscript describing the Oracle Lobster database was prepared, and is currently under review.

5. Goals/Expected Outputs for 1992:

1. To provide leadership to the Section with particular emphasis in 1992 on the new mathematics position. (Swetnam)

2. Supply day-to-day EDP service, support, development and training. (Hunter, Swetnam)

3. Integration of the Halifax Lab analyses systems via Regional WAN and SQL*NET to off site ORACLE databases. (Swetnam, Hunter, Black)

4. Evaluate, and implement if feasible extending, E-Mail services to the desktop in a real time fashion, train staff. (Swetnam)

5. Continued training of staff in the use of newly implemented systems such as ORACLE. (Hunter)

6. Design creation and implementation of ORACLE data bases such as IOP invertebrate edits. (Hunter, Swetnam,)

7. Conversion of Cyber systems to Cyber replacement(s). (Hunter, Swetnam)

8. Advise the Branch Executive and SIWC on EDP matters. (Swetnam)

6. Background:

Highlights:

The current year has been consumed by three major initiatives; implementation of the Halifax Lab IEEE802.3 Local Area Network, NOS/VE conversion and ORACLE data base implementation. The upcoming year will see another conversion effort begin as the Cyber lease expires, a continuing of ORACLE work and closer ties of the analysis systems to off site Oracle databases. Also a considerable amount of time will be spent training staff to use new software systems.

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

D. Swetnam administered the contract to have MT&T completely rewire the Laboratory's LAN.

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

The project is going well. The Section Head ended a 2.5 year stint as Chairperson of the BSBCAC where he served in an exemplary fashion. Another major task handled well, was the hiring of a mathematician. Project staff are frequently lauded for the service performed. A most valuable project for which full support should continue.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 201

Section: Population Biology

Project Title: Larval Ecology and Lobster Assessment (LFA 33)

Project Leader: Tremblay, J.

Other Researchers: Duggan, R. ; Pezzack, D. ; Sinclair, M. ; Hunter, C.

Work Activity: W.A.1.1.1.3

Key Words: fisheries ecology ; assessments ; population dynamics ; invertebrate larvae

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1. Project Description:

The project investigates the distribution and ecology of larval sea scallops in commercially-important areas, particularly Georges Bank. The broad scale horizontal distribution, and the vertical distribution of larvae in relation to physical and biological factors is emphasized. Techniques to assess larval condition and age in nature are studied, using laboratory reared larvae.

2. Long-Term Objectives:

To better understand the role of the larval period in the determination of recruitment and population structure in commercially-important invertebrates, and to provide biological advice in the management of the lobster fishery.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Submit for publication papers entitled: (1) The broadscale distribution and abundance of sea scallop larvae in the Georges Bank region; (2) The distribution of sea scallop larvae across the frontal zone of the Northern Flank of Georges Bank.

Goal met. A single paper combining (1) and (2) has been submitted to the Canadian Journal of Fisheries and Aquatic Sciences.

2. Communicate biological advice to fishermen at LFA 33 meetings and elsewhere as required. Provide reports on ongoing monitoring of catch-rates and size composition, and recent biological research.

Goal met. Biological information presented at two LFA 33 meetings.

3. Analyze recent catch-rates of lobster from logbooks in LFA 33. Examine variability due to fisherman, month and year.

Goal met. Working paper on above subject presented to Statistics, Sampling, and Surveys Subcommittee of CAFSAC.

4. Initiate study of the condition of lobster larvae. Measure the lipid class composition (by contract) in larvae obtained in the inshore in 1990. Compare with lipid levels in: (1) lab reared larvae (published); and (2) Georges Bank larvae. Consider the type of laboratory and field studies necessary to better understand the factors affecting larval survival. Potential collaboration with J. Castell.

Goal not met. No progress due to other priorities.

5. Continue development of lobster fishery data base. Improve form for input of logbook data (LOGDATA), develop form for input of length frequency data. Develop more end-user queries and revise documentation (with C. Hunter and D. Pezzack).

Goal met. Database improved substantially. A manuscript report describing its use (Hunter, C., and M. J. Tremblay. 1992. A database for catch and length composition data related to the Scotia-Fundy lobster fishery) is currently being reviewed internally.

4. Additional Accomplishments:

1. Gave overview talk to Offshore Scallop Advisory Committee (OSAC) on Biological Sciences Branch studies of planktonic sea scallop larvae (April)

2. Presented papers on distribution and ecology of sea scallop larvae at (i) American Society of Limnology and Oceanography Meeting, and (ii) National Shellfisheries Association Meeting.

5. Goals/Expected Outputs for 1992:

See Section 8. Review and Evaluation

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

I. Perry (MFD), G. Harding (HED), J. Loder (PCS), M. Sinclair (BSB): Georges Bank frontal study and GLOBEC.

ii. University Liaison -

External examiner of Dalhousie University M.Sc. thesis (Mr. Wei Ding).

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Tremblay, M. J. 1991. Sea scallop larvae (Placopecten magellanicus) in the Georges Bank region: distribution, abundance and condition. Ph.D. thesis, Dalhousie University, Halifax, N.S. 201 p.

iv. Popular and Miscellaneous -

Tremblay, M. J. 1991. Inshore-Offshore lobster problem still a problem. Weekly Scientific Briefing, Vol 10, No. 4, Jan 25, 1991.

Tremblay, M. J. 1991. Summary sheet 1991- Lobster, LFA 33, South Shore, N.S. Presented to IMP Subcommittee of CAFSAC, Feb. 1991.

Tremblay, M. J. 1991. Does the behaviour of sea scallop larvae influence their dispersal? (Abstract). J. Shellfish Res. 10: 273.

Tremblay, M. J., and M. Sinclair. 1991. Inshore-offshore differences in the distribution of sea scallop larvae: implications for recruitment (Abstract). ICES mar. Sci. Symp. 132: 39.

Tremblay, M. J. 1991. Factors affecting distribution (Workshop Report). ICES Mar. Sci. Symp. 132: 40.

8. Review and Evaluation:

Components of this project will be transferred to project no. 206 (scallop larval ecology) and 211 (lobster assessment for LFA 33) respectively.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 202

Section: Population Biology

Project Title: Lobster Resource Science

Project Leader: Hudon, C.

Other Researchers: Pezzack, D. ; Duggan, D.

Work Activity: W.A.1.1.1.2

Key Words: lobster biology ; early life history ; juvenile habitat ; recruitment

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1. Project Description:

Assessment and review of information currently available on lobster populations found inshore and offshore South West Nova Scotia. Elaboration of hypotheses on the possible relationships between inshore and offshore lobster "populations". Research into the ecology, growth, life history and population dynamics of lobster.

2. Long-Term Objectives:

Obtain and integrate information on the biology and ecology of lobster. Enhance understanding of factors determining lobster recruitment in the inshore and offshore areas of the northern Gulf of Maine.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Review of information on inshore-offshore lobster; following lobster review a long-term research plan will be developed. (Hudon)

Goal met. The information on inshore-offshore lobster was reviewed through participation to a special DFO Workshop on that subject and involvement with writing of the report (see publications). A long-term research plan for lobster resource science was developed. (Hudon)

2. Preliminary field exploration for juvenile lobster habitat and underwater observations of berried females. (Hudon)

Goal met. Preliminary field exploration for juvenile lobster habitat and underwater observations were carried out. A preliminary experiment to develop a postlarval and juvenile lobster collector was carried out in collaboration with the Quebec Region. (Hudon)

3. Participation in the survey on intensity and distribution of lobster fishing effort in the middle ground area of LFA 34 (South West Nova). (Pezzack)

This documented in Project No. 214.

4. Publication of previously collected data on northern Quebec fisheries research. (Hudon)

Previously collected data on northern Quebec fisheries research was analyzed and published in the primary literature (see publications). (Hudon)

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

1. Prepare and have reviewed a long-term research plan on lobster populations, by characterizing the physical conditions of inshore lobster fishing areas of Southwest Nova Scotia, with emphasis on seasonal and year-to-year variability of thermal regime.

2. Continue studies on juvenile lobster ecology and habitat preference by improving the prototype of lobster collector previously designed and testing its performance in the laboratory and in the field.

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

1. M. Jean-Paul Dallaire, DFO, IML, Mont-Joli. Development of a collector for postlarval and juvenile lobster.

ii. University Liaison -

Adjunct professor at the Dept. of Renewable Resources, McGill University.

Supervision and direction of 2 students: Raul Ugarte (Ph.D. candidate, Dalhousie University, Halifax) and Andrew Bauder (BSc Honours, Dalhousie University, Halifax). Mr. Ugarte's thesis deals with the behaviour of berried female lobsters as a factor regulating the timing of egg hatching in the natural environment. Mr Bauder's thesis deals with the yearly pattern of bottom water temperature in relation with the timing of stage I larval occurrence along the southern shore of Nova Scotia (LFA 33).

iii. Communications -

Seminar and Presentations:

Participation in APICS (First Annual Atlantic Student Citizens' Science Conference), as a scientific interviewee for the Student Media Challenge. November 1991.

Participation in the planning and collection of the Internal DFO Communication Survey. June 1991.

Speaker for primary grade school groups visiting BIO during the summer.

iv. Contracts Administered -

Mr. Raul Ugarte, Contract for the analysis of benthos samples from lobster collectors.

v. Other -

7. Publications:

i. Primary -

Hudon, C., P. Legendre, J.M. Lavoie, J.-M. Dubois and G. Vigeant. 1991. Effets du climat et de l'hydrographie sur le recrutement larvaire du homard américan (Homarus americanus) dans le nord du Golfe du Saint-Laurent. Can. Spec. Publ. Fish. Aquat. Sci. 113: 161-177.

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Henderson, M., Hudon, C. and D. Meerburg. 1991. Review of Atlantic salmon assessment programs in the Freshwater and Anadromous Division Biological Science Branch in Scotia-Fundy Region. 30 p.

8. Review and Evaluation:

The first year of this project was positive; a new direction was taken in lobster resource science and it was a delight to have such an enthusiastic field ecologist on staff. Research on the juvenile ecology of lobsters is of utmost importance to the understanding of the species biology and ultimately, fisheries management. Preliminary results on a postlarval/juvenile lobster collector are encouraging. Christiane has spent considerable time writing manuscripts from data collected elsewhere. This task should now take second place to her Regional project.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 203

Section: Population Biology

Project Title: Scallop Assessment and Research

Project Leader: Robert, G.

Other Researchers: Black, G. ; Butler, M. ; Thouzeau, G.

Work Activity: W.A.1.1.1.3

Key Words: assessments; assessment research; scallops; resource surveys

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1. Project Description:

Annual stock assessments of the scallop fisheries in the Scotia-Fundy Region (NAFO Divisions 4VWX and 5YZ) are conducted for management purposes (CAFSAC, advisory committees, and DFO fishery managers). A research program in support of these assessments is carried out and advice is interpreted for clients.

2. Long-Term Objectives:

Provide sound biological advice on the various scallop fisheries in the Scotia-Fundy Region and to conduct that research deemed most likely to improve this advice; effectively communicate this advice to industry and resource managers.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Perform a complete assessment of Georges Bank and Scotian Shelf scallop stocks (Scotian Shelf, and Georges Bank), and prepare research document. (Robert)

Scallop stocks were assessed and evaluations, including both TAC advice and experimentation with ADAPT, were presented at the CAFSAC Invertebrates meeting.

2. Conduct stock surveys, fishery analysis, and port sampling, for stock assessments. (Robert)

Research vessel surveys were conducted on the eastern and western Scotian Shelf and on Georges Bank. Insufficient ship resources reduced surveys. Fishing data such as scallop beds fished, effort, and CPUE were analyzed. Port sampling activities included the collection of gonad materials in addition to catch monitoring. Port sampling was expanded to cover all offshore enterprises involved in the fishery on an experimental basis.

3. Present biological advice to Regional Scallop Advisory Committees, prepare biologically based briefing documents when required, and participate in other DFO-sponsored activities pertaining to the resource management of scallops. (Robert)

Presentations made on the status of the resource, as required, to the Offshore Scallop Advisory Committee. Briefing made to the Scallop Working Group on variable meat count. Presentations made to the Scallop sector of the Seafood Producers Association of Nova Scotia on the variable meat count, survey logistics, and port sampling. A Scallop Science Day provided the industry with seminars on current research activities and the derivation of a TAC using catch-at-age data coming from port samples calibrated against research survey index and catch-rate information.

4. Complete the project on the ecology of juvenile sea scallops on Georges Bank. (Thouzeau)

Goal not met. Results have been published on the faunistic assemblages of Georges Bank scallop beds and on the distribution and variability of growth in juvenile scallops (see below). Another manuscript looks more closely at the distribution of age 1 scallops. G. Thouzeau attended the annual meeting of the Marine Benthic Ecology Society in March to give a summary of these findings.

5. Continue the analysis of scallop pro-rating factor and meat count as a management tool. (Robert)

Analysis was completed on the statistical validity of the meat count and findings presented at the annual meeting of American Statistical Association in August.

6. Carry out a study on the reproductive ecology of the offshore deep-sea scallop. (Robert)

With graduate student, C. DiBacco, sampling carried out to get monthly profiles; histological analysis kept pace with sampling. Techniques are being implemented to calculate the volume of gonadal components by image analysis. Presentations were made at the Marine Benthic Ecology Society meeting in March,1991, the National Shellfisheries Association meeting and the International Pectinid Workshop.

7. Software development and conversion in support of analytical programming for scallop stock assessments. (Robert)

The scallop analysis software was streamlined and the conversion from NOS to NOSVE completed.

8. Assess the Scotia-Fundy commercial shrimp fishery and report to the Advisory Committee. (Butler)

The shrimp fishery was evaluated through the analysis of log data and presented at the CAFSAC Invertebrates meeting. A TAC was set for the next three years. Biological advice was provided at the Advisory Committee annual meeting. Local fishermen's queries were replied to. A biological overview of Scotia-Fundy shrimps was given at a Shrimp Seminar for fishermen in February. The separator trawl is improving the prospects for this fishery; exploratory licenses landed 500 t in 1991.

4. Additional Accomplishments:

1. Presentation of two communications at the 8th International Pectinid Workshop in May on variability and growth of juvenile scallops and on reproductive ecology and its implications to stock recruitment.

2. Participation in a workshop with representatives of the French scallop fishing industry to discuss comparative management strategies between France and Canada.

3. Participation at the ICES Pectinid Working Group in June to discuss recruitment dynamics of pectinids and management strategies.

4. Updated (new biological knowledge, recent fisheries statistics, and editing) to the scallop atlas manuscript.

5. Collaboration with Conservation and Protection with respect to illegal fishing activities on Browns Bank by identifying point of origin of seized scallop samples.

6. Member of the PERD Georges Bank Steering Committee.

5. Goals/Expected Outputs for 1992:

1. Perform a complete assessment of Georges Bank and Scotian Shelf scallop stocks and prepare research documents. (Robert)

2. Conduct stock surveys, fishery analysis, and port sampling for stock assessments. (Robert)

3. Present biological advice to Regional Scallop Advisory Committee, prepare biologically based briefing documents when required, and participate in other DFO-sponsored activities pertaining to the resource management of scallops. (Robert)

4. Complete the project on the ecology of juvenile sea scallops on Georges Bank, with a paper on filter-feeding species competitive interactions. (Robert)

5. Complete the analysis of scallop pro-rating factor. (Robert)

6. Continue the study, with MSc student C. DiBacco, on the reproductive ecology of the offshore deep-sea scallop. (Robert)

7. Software development and conversion in support of analytical programming for scallop stock assessments. (Robert)

8. Assess the Scotia-Fundy commercial shrimp fishery and report to the Advisory Committee. (Butler)

6. Background:

Highlights:

In recognition of her great interest in scallop fisheries management issues, the French scallop fishing industry dedicated a vast scallop seeding project in Cherbourg Harbour "Operation Ginette".

Selected Involvements:

i. Collaborative Research -

S.J. Smith, MFD, on the statistical validity of the meat count procedure.

ii. University Liaison -

J. Grant, Dept of Oceanography, Dalhousie University. Masters student, C. DiBacco on the reproductive ecology of the deep-sea scallop.

iii. Communications -

Interviews on the English radio and French TV networks.
Enquiries from local newspapers and trade journals.
Submitted information for article on scallop spawning, Sou'wester Oct.1st.
Preparation of Weekly Scientific Briefings.

iv. Contracts Administered -

Commercial port sampling activities for the offshore fleet. Collection of gonad material for histological identification of maturity stages. Industry funding provided expansion of port sampling to cover the entire fleet as an experimental project.

v. Other -

7. Publications:

i. Primary -

Thouzeau, G., G. Robert, and R. Ugarte. 1991. Faunal assemblages of benthic megainvertebrates inhabiting sea scallop grounds from eastern Georges Bank, in relation to environmental factors. Mar. Ecol. Prog. Ser. 74: 61-82.

Thouzeau, G., G. Robert, and S.J. Smith. 1991. Spatial variability in distribution and growth of juvenile and adult sea scallops Placopecten magellanicus (Gmelin) on eastern Georges Bank (Northwest Atlantic). Mar. Ecol. Prog. Ser. 74: 205-218.

Thouzeau, G. and D. Vine. 1991. Offshore sampling of the megabenthos techniques applied on Georges Bank. Comptes-rendus Acad. Sci. serie III vol. 312 (12):607.

ii. Interpretive Scientific -

iii. Scientific and Technical -

Butler, M.A.E.and G. Robert. 1991. Update of the Scotian Shelf shrimp fishery - 1990. CAFSAC Res. Doc. 91/23, 15p.

Robert, G., G.A.P. Black, and M.A.E. Butler. 1991. Georges Bank scallop stock assessment - 1990. CAFSAC Res. Doc. 91/29, 34p.

Robert, G. and M.A.E. Butler. 1991. Scallop fishing grounds on the Scotian Shelf - 1990. CAFSAC Res. Doc. 91/25: 31p.

Robert, G. 1991. Report of the Working Group on pectinid stocks. Brest, France. ICES C.M. 1991/K: 43, 21p.

Smith, S.J. and G. Robert. 1991. Scallops, sampling, and the law. Proc. American Statistical Association annual meeting, 1991. Atlanta, Georgia.

iv. Popular and Miscellaneous -

Robert, G. 1991. (Abstract) Reproductive ecology of Placopecten on Georges Bank and its implications to stock recruitment. 8th International Pectinid Workshop, Cherbourg, France.

Robert, G. 1991. Un aperçu de la gestion de la pêche aux pétoncles au Canada. Presentation at a workshop with the French scallop fishing industry. Cherbourg, France, May, 1991.

Thouzeau, G. and G. Robert. 1991. (Abstract) Spatial variability of the distribution and growth of juvenile sea scallops in relation to environmental conditions on eastern Georges Bank. 8th International Pectinid Workshop, Cherbourg, France.

8. Review and Evaluation:

This project consists of three distinct parts; stock assessment; communication and provision of advice and resource science. Industry of late lost a little confidence in the biological advice leading to the annual TAC. Steps have been taken to improve the problem areas (gaps in port sampling and inaccurate vessel logs). As well, an enhanced biological science program will provide an improved understanding of recruitment. Work has been carried out to improve ADAPT to better suit the scallop cohort analysis, but further analysis is required to discern the usefulness of this procedure. As usual, communication with all groups of clients was superb and the resource science studies have gone extremely well. A couple of tasks were unfulfilled due to a health problem (chronic sciatic nerve) of the Project leader.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 204

Section: Population Biology

Project Title: Offshore Clams Assessment and Research

Project Leader: Roddick, D.

Other Researchers: Kenchington, E.

Work Activity: W.A.1.1.1.3

Key Words: clams; assessments; assessment research; scallops; resource surveys

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1. Project Description:

Conduct annual Scotian Shelf offshore clam assessments (Mactromeris polynyma and Arctica islandica) as required for management of the fishery. Research into the biology of the species and assessment methodology is conducted to improve the accuracy and precision of biological advice. Participate in industry/management meetings as required to explain or elaborate assessments and advice on alternate management strategies.

2. Long-Term Objectives:

To provide biological advice on Scotian Shelf clam stocks (Mactromeris polynyma and Arctica islandica), and improve the quality of advice as new information and/or methodologies become available through research and additional commercial data. To further develop the scientific information base for future management of currently underexploited and unexploited species.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Provide stock assessment for Scotian Shelf offshore clams. (Roddick)

Completed. Stock assessment presented to 1991 CAFSAC Invertebrates Committee Meeting. Landings are far below the TAC.

2. Present biological advice to Offshore Clam Advisory Committee and the Inshore Quahaug Working Group. Prepare biologically-based briefing documents when required, and participate in other DFO-sponsored activities pertaining to the resource management of clams. (Roddick)

Completed. Meetings of the Offshore Clam Advisory Committee and the Inshore Quahaug Working group were attended and presentations made, as required, on the status of the resource and the biological advice for management.

3. In cooperation with Dr. F. Tan of Physical and Chemical Sciences Branch use the oxygen isotope technique to verify the use of chondrophore rings for ageing offshore clams, if problems with their analytical procedures can be solved. (Roddick)

Incomplete. Physical and Chemical Sciences believe they have solved their problems with the analysis and have upgraded their equipment. They are presently working on a backlog of samples, but do hope to begin the analysis this winter.

4. Continue with analysis of samples from Banquereau Bank and inshore banks to determine the reproductive cycle and age-at-maturity of Mactromeris polynyma. (Roddick)

Sampling of Banquereau Bank had to be dropped when the commercial fleet, which supplied samples, changed it's fishing patterns. Samples are being routinely collected from the inshore area and a full year's worth have been processed. Sampling will continue until the late fall of 1992.

5. Continue the collection and ageing of Mactromeris polynyma to increase the accuracy of growth data. (Roddick)

Collection and processing of samples is continuing, emphasis is being placed on small and large specimens to increase accuracy on the tails of the growth curve.

4. Additional Accomplishments:

Conducted an exploratory survey for small surf clams on the Eastern Scotian Shelf with funding from Development Branch.

5. Goals/Expected Outputs for 1992:

1. Provide stock assessment for Scotian Shelf offshore clams. (Roddick)

2. Present biological advice to Offshore Clam Advisory Committee and the Inshore Quahaug Working Group. Prepare biologically-based briefing documents when required, and participate in other DFO-sponsored activities pertaining to the resource management of clams. (Roddick)

3. Write up report on exploratory surf clam survey. (Roddick)

4. In cooperation with Dr. F. Tan of Physical and Chemical Sciences Branch use the oxygen isotope technique to verify the use of chondrophore rings for ageing offshore clams if samples can be processed. (Roddick)

5. Complete sampling program for inshore stock to determine the reproductive cycle. (Roddick)

6. Finish analyzing samples and start writing up study on age-at-maturity of Mactromeris polynyma. (Roddick)

7. Continue the collection and ageing of Mactromeris polynyma to increase the accuracy of growth data. (Roddick)

8. Investigate cost of joint Scotia-Fundy:Newfoundland charter of the Delaware II from Woods Hole for a 4-6 week clam survey. (Roddick)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

F. Tan, Physical and Chemical Sciences Branch - Oxygen isotope analysis for ageing of bivalves;

S. Naidu, Biological Sciences, Nfld Region - Research on the biology and assessment methodology of Mactromeris polynyma;

T. Landry, Biological Sciences, Gulf Region - Survey and assessment methodology for offshore clams.

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

Three month contract for technical services with Gayle Hartlen for processing samples from Surf clam exploratory survey.

v. Other -

7. Publications:

i. Primary -

Cai, D., F.C. Tan and D.L. Roddick. 1990. Oxygen isotope studies on the growth rate of sea scallop, Placopecten magellanicus from Brown's Bank, Canada. Oceanologia et Limnologia Sinica 21 (6): 550-558.

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Roddick, D.L. 1991. CAFSAC Invertebrates Committee Summary Sheet - Banquereau Bank Arctic surfclam, Mactromeris polynyma, 1991.

8. Review and Evaluation:

This project is progressing nicely. An offshore exploratory survey took place last spring, which found areas of small-size. Basic biological information on ageing and the reproductive cycle is being gathered, which ultimately will enhance the understanding of offshore clam recruitment.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 205

Section: Population Biology

Project Title: Scallop Research

Project Leader: Kenchington, E. (nee Rice)

Other Researchers: Lundy, M. ; Roddick, D.

Work Activity: W.A.1.1.1.3

Key Words: scallop assessment ; morphometric analyses; scallop genetics ; ecology

1. Project Description:

Conduct annual assessment of the Bay of Fundy (Digby) scallop fishery. Research the population dynamics and ecology of Placopecten magellanicus.

2. Long-Term Objectives:

To improve the quality of advice on the Bay of Fundy scallop stock. To enhance the understanding of the biology of commercial scallop species.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Provide a stock assessment of the Bay of Fundy scallop resource. (Kenchington)

Completed. A stock assessment of the Bay of Fundy (Digby) scallops was presented at the 1991 CAFSAC Invertebrates Committee Meeting. A CAFSAC research document (91/26) was produced on the status of the resource. (Kenchington)

2. Present biological advice to Inshore Scallop Advisory Committee. Prepare biologically based briefing documents when required and participate in other DFO sponsored activities pertaining to the resource management of scallops. (Kenchington)

Completed. All meetings (3) of the Inshore Scallop Advisory Committee (ISAC) were attended and advice was presented at each of them. A biological presentation (both oral and written) was given to a meeting of the Offshore Scallop Advisory Committee (OSAC). (Kenchington)

3. Complete sequencing of the 18S rRNA gene in selected molluscan species and publish the results. (Kenchington)

Incomplete. Five species of molluscs have been sequenced. In light of interesting results, four additional species have been added to the study and are currently being processed. (Kenchington)

4. Complete, to publication, the morphometric study begun in 1989/90. (Kenchington)

Incomplete. All morphometric data has been analyzed and image data has been analyzed by traditional methods. Delays have been encountered in programming more sophisticated analyses, but progress has been made. (Kenchington)

5. Analyze DNA/RNA in samples collected off Digby and continue monitoring program in 1991. (Kenchington)

All 1990 samples have been analyzed and presented both at ISAC meetings and the Digby Scallop Days booth. 1991 monitoring samples have been processed and partially analyzed.

6. Participate in Exploratory Fishing Program and evaluate data from the fishing logs. Expand the Bay of Fundy scallop cruises to include a survey of Brier Island in 1991. (Lundy)

Complete. Activities of the Exploratory Fishing Program have been followed. A research cruise was conducted on the Brier Island and Lurcher scallop stocks in August. These data have been analyzed and results presented to ISAC. (Lundy)

7. Prepare a video presentation on scallops for viewing by fishermen. (Kenchington)

Complete. A video was prepared and presented to fishermen at a meeting of OSAC (Halifax) and at the Digby Scallop Days display. (Kenchington)

8. Examine spatial variation in growth rate in the Bay of Fundy scallop stock. (Kenchington)

Complete. Spatial variation in growth rate has been analyzed and mapped. These results were presented to ISAC. Several hypotheses have arisen from this analysis and further data analysis coupling the growth results to RNA/DNA is ongoing. (Kenchington)

4. Additional Accomplishments:

1. Initiated DFO representation at the Digby Scallop Days Festival in August, 1991. Co-ordinated and produced a Display Booth for the Festival.

2. Initiated bimonthly collection of scallop meats and shells for meat weight and RNA/DNA analyses through co-operation with one of the Digby scallop captains.

3. Attended ICES Benthic Ecology Meeting (Halifax) and invited to be a member of the working group.

4. Prepared a Manuscript Report on data collected on juvenile scallops at Sheet Harbour, NS (1990) and on surveys conducted by R. Mohn (1984-88).

5. Goals/Expected Outputs for 1992:

1. Provide a stock assessment of the Bay of Fundy (Digby) scallop resource. (Kenchington)

2. Present biological advice to Inshore Scallop Advisory Committee. Prepare biologically based briefing documents when required and participate in other DFO sponsored activities pertaining to the resource management of scallops. (Kenchington)

3. Provide a stock assessment of Brier Island and Lurcher Shoal scallop resource. (Lundy)

4. Participate in Exploratory Fishing Program and evaluate data from the fishing logs. (Lundy)

5. Conclude 18S rRNA gene sequencing of the scallop and clam species, including data analysis and publication. (Roddick, Kenchington)

6. Complete morphometric study of scallop shells. (Kenchington)

7. Continue RNA/DNA monitoring program. (Kenchington)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

Image Analysis of Scallop Shells: Assoc. Prof. W.E. Full, Geology Dept., Wichita State University, Wichita, Kansas.

Genetic DNA Analysis of Marine Algae: C. Bird, Dr. M. Ragan, NRC, Halifax, Nova Scotia.

ii. University Liaison -

Image Analysis of Scallop Shells: Assoc. Prof. W.E. Full, Geology Dept., Wichita State University, Wichita, Kansas.

iii. Communications -

Digby Scallop Days Booth. Digby, Nova Scotia, August 1991.

iv. Contracts Administered -

Commercial port sampling activities for the Bay of Fundy fleet.

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Kenchington, E., C. Tetu, and R. Mohn. 1991. Preliminary investigations of juvenile scallops (Placopecten magellanicus) in Nova Scotia inshore habitats. Can. Manuscr. Rep. Fish. Aquat. Sci. 2123, 38pp.

Kenchington, E. and M.J. Lundy. 1991. 1990 Bay of Fundy Scallop Stock Assessment. CAFSAC Res. Doc. 91/26, 28pp. iv.

iv. Popular and Miscellaneous -

Kenchington, E. 1991. (Poster) The Use of RNA/DNA in Monitoring Scallops Stock Health. Digby Scallop Days, Digby, Nova Scotia.

Kenchington, E. and M.J. Lundy. 1991. (Poster) Scallop Abundance in the Bay of Fundy. Poster. Digby Scallop Days, Digby, NS.

Kenchington, E. and M.J. Lundy. 1991. (Poster) Fishing Logbooks: The Value of Logbooks in Scallop Management. Digby Scallop Days, Digby, N.S.

8. Review and Evaluation:

The project has a nice balance of assessment related duties and innovative research. Participation in the Digby Scallop Days provided an excellent opportunity to communicate fishery-related scientific programs to clients. The project leader should place some emphasis on the scallop morphometric study in an attempt to bring it to fruition.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 206

Section: Population Biology

Project Title: Cape Breton Crustacean Assessment and Research

Project Leader: Tremblay, J.

Other Researchers: Eagles, M. ; Miller, R.

Work Activity: W.A.1.1.1.3

Key Words: crabs; lobster; assessments; assessment research

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1. Project Description:

This project conducts research, stock monitoring, and fisheries assessment of snow crab and lobster stocks on the Atlantic side of Cape Breton Island. Advice is also provided on other crab species as requested. The research commitment applies to all aspects of the biology and population dynamics of crabs and lobster ecology that will support crustacean assessment and management.

2. Long-Term Objectives:

Assess present and potential production of commercial crabs in the Scotia-Fundy Region and the possible effects of various management strategies; conduct research on all aspects of the life history, ecology, and environment of commercial crabs and lobsters relevant to understanding natural and man-induced fluctuations in stock size; develop methods of analysis and theoretical models for the above; and communicate results to industry, management, and science.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Continue biological monitoring of commercial snow crab in the Scotia-Fundy Region during 1991 and provide an assessment of the 1990 snow crab fishery to CAFSAC.

Completed. Port and sea sampling of the snow crab fishery completed. Presentations given at two snow crab advisory committee meetings (February and April). As a result of these meetings, fishermen in Area 23 voted to use a gauge on a trial basis for one year. CAFSAC did not require presentation of a 1990 assessment, but summary sheets were tabled.

2. Monitor the lobster fishery in LFA's 27-30, summarize the results and present to clients.

Completed. Port and sea sampling of the lobster fishery completed. A biological assessment presented to advisory committee meetings in December. Summary sheets of the lobster fishery in LFA's 27-30 were tabled at CAFSAC.

3. Details on new research projects will become available upon the staffing of a new crustacean scientist.

Since becoming project leader in April, J. Tremblay has reviewed the scientific literature, participated in port and sea sampling, and begun studies of: (i) snow crab fecundity, and (ii) changes in the geographic distribution of fishing effort in the snow crab fishery.

4. Additional Accomplishments:

Following requests from the Area Manager and Resource Allocation, provided advice on the snow crab fishery as follows: (i) the number of new licences which should be allowed in Area 24; (ii) a proposed offshore fishery; (iii) a proposed season extension. Advise also given on a proposed exploratory fishery for northern stone crab.

5. Goals/Expected Outputs for 1992:

1. Continue biological monitoring of commercial snow crab in the Scotia-Fundy region during 1992. Provide analysis of the effects of the experimental claw gauge to fishermen; table summary sheets of the snow crab fishery to CAFSAC. (Tremblay, Eagles)

2. Monitor the lobster fishery in LFA's 27-30, summarize the results and present to clients. (Tremblay, Eagles)

3. Complete manuscript report describing the lobster fishery database. (Tremblay, Hunter)

4. Produce report on the effect of logbook number on the precision of lobster CPUE estimates, and the ability to detect annual changes in CPUE. (Tremblay)

5. Produce preliminary report of seasonal and area differences in snow crab fecundity. (Tremblay)

6. Produce preliminary report of changes in the geographic distribution of snow crab effort since 1978. (Tremblay, Eagles)

7. Examine feasibility of obtaining estimates of growth and recruitment from juvenile surveys of snow crabs. (Tremblay, Eagles)

8. Assess the potential of an initiative to increase CL in LFA 27 stocks. (Tremblay)

9. To submit a long-term research proposal following monies provided in workplan. (Tremblay)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

See publications.

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

Beninger, P.G., R.W. Elner, and Y. Poussart. 1991. Gonopods of the majid crab Chionoecetes opilio (O. Fabricus). J. Crust. Biol. 11: 217-228.

Elner, R.W., and A. Campbell. 1991. Spatial and temporal patterns in recruitment for American lobster, Homarus americanus, in the northwestern Atlantic. Memoirs of the Queensland Museum 31:xxx-xxx. Brisbane.

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Eagles, M. and R. J. Miller. 1991. Summary sheets 1991- Lobster: LFA 27; LFA 28-29; LFA 30; Snow crab: Areas 2-4, Area 5, Area 6.. Presented to IMP Subcommittee of CAFSAC, Feb. 1991.

8. Review and Evaluation:

R. Elner left this project at the end of 1990 and publications based on his collaborative efforts continue. J. Tremblay became project leader in April, and several of the 1992 goals were begun under project 201. The transition between project leaders was effected smoothly and new initiatives are dynamically carried out.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 207

Section: Population Biology

Project Title: Marine Plants Assessment and Research

Project Leader: Sharp, G.

Other Researchers: Pringle, J.; Semple, R.

Work Activity: W.A.1.1.1.5

Key Words: marine plants; Irish moss; Chondrus; Ascophyllum; Laminaria; assessments; assessment research

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1. Project Description:

This project is an ongoing function dealing with research, monitoring and stock assessment of Maritime marine plant fisheries. Advice is given to a wide range of clients.

2. Long-Term Objectives:

To understand the relationship between marine macroalgal productivity and major abiotic and biotic variables; to determine the biological effects of long-term harvesting on marine plant productivity; to develop management models and harvesting strategies for the commercially important marine plant species in the Region; and to give sound stock assessment and biological advice to clients.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Compare alternate population models for Chondrus according to different recruitment processes. (Sharp)

Goal not met. Shelved for time being awaiting interaction with post doctoral fellow with expertise in modelling.

2. Assess Ascophyllum Resources in Scotia-Fundy and provide biological advice to management. (Sharp)

Goal met. Publication CAFSAC Res Doc:91/52. Provided advice to Resource Allocations Branch and the N.B. Department of Fisheries in the development of a management plan for Ascophyllum harvesting in N.B. Presentations to fishery managers, provincial agencies and industry groups.

3. Paper on the growth and mortality characteristics of a Chondrus population. (Sharp)

Goal not met.

4. Evaluate the productivity of Ascophyllum populations in southern New Brunswick. (Sharp)

Goal met. 27 sites sampled and analysis of samples 80% complete.

5. Initiate a study of life phase and frond condition indices for Chondrus crispus populations in southwest Nova Scotia. (Sharp)

Goal met. Technique development complete, sampling initiated.

4. Additional Accomplishments:

1. Completed assessment of St. Mary's Bay Ascophyllum stocks.

2. Initiated a study of the impact of harvesting on the population dynamics of Ascophyllum with 4 hand-harvesting methods and one mechanical method.

3. In conjunction with Land, Inventory, and Remote Sensing Institute (LIRS) acquired and analyzed satellite images of coastal New Brunswick to determine distribution of Ascophyllum resources.

4. Investigated and reported to the Director of Biological Sciences Branch, the causes for a severe build-up of storm-cast material on beaches in Lockeport Bay.

5. Investigated and made recommendations to the Director General on the condition of Dulse (Palmaria palmata) beds on Grand Manan Island following damage caused Hurricane Bob.

6. Carried out a consultancy for IDRC, which assessed a research proposal aimed at diversification of the Filipino seaweed industry. (Pringle)

7. Supervised Ph.D. student R. Santos. (Pringle)

5. Goals/Expected Outputs for 1992:

1. Assessment of Ascophyllum resources in Southwestern Nova Scotia. (Sharp)
2. Update the information on the abundance and distribution of New Brunswick Ascophyllum resources. (Sharp)
3. Evaluation of linear and non linear models for Chondrus population dynamics. (Sharp)
4. Develop an assessment and monitoring program for the Ascophyllum management plan in Southern New Brunswick. (Sharp)
5. Continue sampling Chondrus populations in SWNS for phase and condition indices. (Sharp)
6. Publish manuscript report on standing crop of Ascophyllum in N.B. (Sharp)
7. To co-chair a mini symposium on problems in the resource management of seaweeds, at the ISS., Brest, France. (Pringle)
8. To supervise Ph.D. student R. Santos. (Pringle)
9. To continue providing consultancy to IDRC on seaweed projects. (Pringle)

6. Background:

Highlights:

The marine plants program in Scotia Fundy has had a strong focus on Ascophyllum resources in 1991. The continuing high level of harvest in SWNS and the impending first time harvest in southern New Brunswick has created a heavy demand for resource information.

Selected Involvements:

i. Collaborative Research -

- With Dr. M.C. Mouchot of Canadian Center for Remote Sensing examined the use of a radar sensor for determination of algal coverage in the intertidal zone.

ii. University Liaison -

- Continued to serve on the Ph.D. committees of M. Lazo and R. Santos. (Sharp)
- Consultations with R. Rangely, McGill University, M.L.H. Thomas, U.N.B., ecological impact of Marine Plant Harvesting.
- Collaborated with Dr. T. Chopin, U.N.B. on chemical analysis of Chondrus populations.

iii. Communications -

- Provided biological expertise at three open houses on Ascophyllum harvesting in southern New Brunswick.

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Sharp, G. and R. Semple. 1991. An Assessment of Ascophyllum nodosum resources in Scotia/Fundy. CAFSAC Res. Doc. 91/52, 30 p.

iv. Popular and Miscellaneous -

Information sheets for public meetings on the biology of Ascophyllum nodosum.

8. Review and Evaluation:

A high level of interest in marine plant harvesting both in southwest Nova Scotia and southern New Brunswick monopolized a great deal of this project's resources; some planned activities (modelling, paper on Chondrus growth and mortality) had to be postponed. Answering the industry's need for resource information was a high priority. It is most important that this study place emphasis on the submission of publications in 1992.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 208

Section: Population Biology

Project Title: Marine Plants Assessment and Research - Gulf Region

Project Leader: Sharp, G.

Other Researchers: Semple, R. ; Pringle, J. ; Jones, D.

Work Activity: W.A.1.1.1.5

Key Words: marine plants , Irish moss , Chondrus , wireweed Furcellaria , assessments assessment research

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1. Project Description:

This project is an ongoing function dealing with research, monitoring and stock assessment of marine plant fisheries in the Gulf of St. Lawrence. Advice is given to a wide range of clients.

2. Long-Term Objectives:

To understand the relationship between marine macroalgal productivity and major abiotic and biotic variables; to determine the biological effects of long-term harvesting on marine plant productivity; to develop management models and harvesting strategies for the commercially important marine plant species in the Region; and to give sound stock assessment and biological advice to clients.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Provide biological advice to resource managers and industry.

Goal met. Met with representatives of the industry and P.E.I. provincial government discussing project plans and needs of the industry.

2. Establish the infrastructure and support for a field research station. (Sharp)

Goal met. A former residence was converted into a field station with facilities for diving support, vessel maintenance, analysis of samples. It became operational in early April 1991.

3. Assess changes in marine plant communities in Marine Plant District 1 over the past eight years. (Sharp)

Goal met. All commercially important marine plant beds in district 1 and 2 were sampled over the harvesting season. Detailed benthic surveys were used to isolate and describe the populations in one bed with historical records of marine plant distribution.

4. Develop techniques to separate the effects, on abundance, of harvesting and environmental factors in commercially harvested Chondrus beds. (Sharp)

Goal met. A device was developed to enable protection of study areas from harvesting to separate environmental factors on growth and development of populations and this was incorporated successfully in experiments.

5. Initiate studies on the competitive interaction between Chondrus and Furcellaria in commercially harvested beds. (Sharp)

Goal met. Detailed studies were initiated on the spatial relationships between Chondrus and Furcellaria. The seasonal population structure and biomass of each species was monitored at permanent stations to determine recruitment patterns and reproductive strategies. Growth studies were initiated with the tagging of 600 fronds of each species.

6. Monitor catch effort and harvest characteristics in the Chondrus harvesting industry. (Jones)

Goal met. A project to monitor harvesting effort and the composition of the harvest was successful and was correlated with detailed landing records from each company.

7. Publish a paper on the density and biomass of Chondrus and the impact of harvesting. (Pringle)

Goal met. Paper in press in Canadian Journal of Fisheries and Aquatic Sciences.

4. Additional Accomplishments:

1. Provided advise to the industry on the design and results of a survey of Furcellaria resources in District 1.

2. Designed and completed an experiment to determine the short term impact of dragraking on Furcellaria abundance.

3. Assisted IDRC in design of a seaweed project in Senegal.

5. Goals/Expected Outputs for 1992:

1. Provide biological advise to the resource managers and the industry. (Sharp)

2. Provide an analysis of the long-term changes in marine plant communities in District 1. (Sharp)

3. Examine the marine plant beds of District 6 and determine if any significant changes have occurred in the last ten years. (Sharp)

4. Integrate information on nutrient status of Chondrus and Furcellaria with growth studies. (Sharp, Chopin)

5. Initiate competition experiments based on manipulation of density of Furcellaria and Chondrus. (Sharp, Têtu)

6. Evaluate effort and landing trends in the harvesting industry. (Jones)

7. Publish primary publication on the distribution of Furcellaria in District 1, P.E.I. (Sharp)

6. Background:

Highlights:

1991 was the first full field season for the Marine Plant Unit in the Gulf Region. A very strong and diverse field program was initiated with the assistance of a term biologist, summer students and technicians. Results are limited since this was the first year of the program.

Selected Involvements:

i. Collaborative Research -

Collaborative projects (mapping surveys, biomass estimates, gorwth, and reporduction) on Chondrus and Furcellaria commercial beds of western Prince Edward Island with the P.E.I. provincial government.

ii. University Liaison -

In collaboration with Dr. T. Chopin of U.N.B., Saint John campus, a project was begun to examine the seasonal nutrient composition of Chondrus and Furcellaria in conjunction with measures of productivity.

iii. Communications -

iv. Contracts Administered -

One contract from the Prince Edward Island Department of Fisheries to supplement the Marine Plants Unit program.

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Report on the "Development of red seaweeds in Senegal" in collaboration with A. Tamba and T. Chopin. Prepared for the International Development Research Centre.

8. Review and Evaluation:

Although just begun, this project is addressing significant issues of the marine plants harvesting industry.

Job well done.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 210

Section: Population Biology

Project Title: Lobster Stock Assessment (LFA 40-41) and Related Research

Project Leader: Pezzack, D.

Other Researchers: Duggan, D.

Work Activity: W.A.1.1.1.3

Key Words: lobster biology ; assessments ; assessment research ; LFA 40-41 ; stock structure ; offshore lobster

1. Project Description:

This project is an ongoing function dealing with: (i) monitoring and assessment of offshore lobsters on the Scotian Shelf, Gulf of Maine and Georges Bank (LFA 41); (ii) determination of the relationship between offshore and inshore lobster and the impact of offshore fishing activity on other areas; and (iii) research into the life history, ecology, and environment of lobsters relevant to understanding the natural and man-induced fluctuations in lobster stock size.

2. Long-Term Objectives:

Monitor the offshore lobster stocks, carry out research relevant in determining stock structure, and improve stock assessments in order to provide the best possible biological advice to clients.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Assess the offshore lobster fishery through logbooks, sales slips and at sea sampling programs. (Duggan)

Complete. Log books and sales slips coded (100% coverage) and catch, effort and C/E calculated. Four at sea samples taken and data coded. Summary Sheet prepared and presented to CAFSAC.

2. Communicate assessment and research results to the fishing industry. (Pezzack)

Complete. An update on assessment and research presented to Offshore Lobster Advisory Committee. Permission obtained from industry to publish previously confidential data on the offshore lobster fishery. Information communicated to fishermen through informal conversation while at sea or recovering tags in port.

3. Produce papers/reports on lobster distribution on the Scotian Shelf and Gulf of Maine; and structure in the Gulf of Maine; of offshore lobster movements. (Pezzack)

Incomplete. Lobster distribution paper is in draft form. Offshore tag release recapture data file closed (>20,000 records) and data edited in preparation for transfer to Oracle data base which will allow greater flexibility in analysis of offshore lobster movements. Offshore lobster growth paper, using tagging data, is being reviewed.

4. Examine the possibility of a collaborative project with J. Idoine to develop lobster population model, and to examine relationships between NMFS biomass estimates and actual trap CPUE. (Pezzack)

Incomplete. Model was not undertaken due to other commitments by both parties. NMFS trawl survey lobster by-catch data obtained.

4. Additional Accomplishments:

1. Coordinated, edited and senior author on Inshore/offshore lobster workshop report. (Pezzack)

2. Participated in Atlantic States Marine Fisheries Commission's lobster working group review of lobster assessment methods and methods of estimating fishing mortality (Woods Hole, Mass., July 9-10). (Pezzack)

3. Participant in ICES Benthic Working Group (Halifax, May). (Pezzack)

4. Assessed observer needs for invertebrate fisheries and met with MFD representatives to arrange sampling protocols. (Pezzack)

5. Presented Poster "Movement of offshore lobsters displaced to coastal areas of Nova Scotia" at National Shellfish Association meeting in Portland, Maine (July 26-28). (Duggan, Pezzack)

5. Goals/Expected Outputs for 1992:

1. Assess the offshore lobster fishery through log books, sales slips and at-sea sampling programs. (Pezzack, Duggan)

2. To communicate assessment and research results to the fishing industry. (Pezzack, Duggan)

3. Publication of: a) Inshore/offshore lobster workshop report (early 1992); b) Lobster distribution paper (early 1992); c) Offshore lobster growth paper. (Pezzack, Duggan)

4. Analyze offshore lobster tagging data base and prepare a publication on offshore lobster distribution and movements in the Browns Bank Area. (Pezzack, Duggan)

5. Compare NMFS trawl data biomass estimates and actual fishery catch rates. (Pezzack)

6. Background:

Highlights:

The offshore lobster fishery is a small but controversial fishery. Since 1986 reporting of fisheries data was prevented because there were only two participants in the fishery. Agreement was reached with industry at the recent Advisory meeting which will allow publication of detailed fisheries data and assessments at the next overall evaluation of the fishery.

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

Dr. Irv Kornfield, Coordinator, Lobster Institute, University of Maine, Orono, Maine - Planning a lobster modelling workshop for 1992.

iii. Communications -

iv. Contracts Administered -

Contract to conduct at sea sampling during June-August.

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Pezzack, D.S. and D.R. Duggan. 1991. LFA 41 Lobster CAFSAC Summary Sheet.

8. Review and Evaluation:

Assessment obligations are well fulfilled. Preparation of three important papers (report of the Inshore/Offshore Lobster Workshop, and papers on lobster distribution and growth of offshore lobsters) were the focus of the year under review. Another one, on offshore lobster movements, will now concentrate on the Browns Bank Area. It is most important that the project leader concentrate on the publication of findings following years of data collection from the offshore fishery.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 211

Section: Population Biology

Project Title: Lobster Habitat Research and Assessment Methodology

Project Leader: Miller, R.J.

Other Researchers: Nolan, S.; Roddick, D.

Work Activity: W.A.1.1.1.3

Key Words: lobster; assessment research; habitat research

1. Project Description:

The interdependence of near-shore marine communities and exploited species are investigated. Methods for stock assessment and increasing fisheries yields are developed.

2. Long-Term Objectives:

To assess the following: the impact of macrophyte removal on exploited species; the selectivity of crab and lobster traps, and the interdependence of inshore and offshore lobster stocks. To apply the results to fisheries management.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Submit manuscript (with R. Mohn) on the Leslie method of determining fish stock size. (Miller)

Goal met. Manuscript submitted to North American Journal of Fisheries Management.

2. Submit manuscript (with D. Roddick) on the conflict between inshore scallop gear and lobster fisheries. (Miller)

Goal met. Manuscript submitted to Canadian Journal of Fisheries and Aquatic Science.

3. Submit manuscript on lobster catchability coefficients. (Miller)

Goal met. Manuscript to be included in ICES Rapports et Procès-verbaux des Réunions.

4. Submit manuscript (with F. Watson) on spatial and temporal variation of lobster size at sexual maturity. (Miller)

Goal not met. Unscheduled time was spent on activities 4.1 and in collaboration with a visiting scientist.

5. Submit manuscript on the interdependence of benthic invertebrates (or juvenile fish) and macroalgae. (Miller)

Goal not met. Unscheduled time was spent on activities 4.1 and in collaboration with a visiting scientist.

6. Coordinate the lobster research program at the Halifax Fisheries Research Laboratory. (Miller)

Goal met. A manuscript on juvenile lobster habitat was co-authored with A. Campbell, G. Sharp, and C. Hudon. Several discussions were held with lobster scientists Pezzack, Tremblay, and Hudon on future directions for lobster research, and the inshore-offshore lobster problem. Research plans and results were exchanged at a meeting with D. Robichaud and P. Lawton from the St. Andrews Station. Lobster research directions were outlined for management.

7. Provide advice to industry and resource managers on crustaceans, sea urchins and nearshore habitat. (Miller)

Goal met. Fisheries management and the fishing industry were supplied with requested information on:

Sea urchins; harvesting methods, population distribution, population survey methods, gonad cycle, and the 1991-92 management plan.

Lobsters; movement, growth, reproduction, relationship of inshore and offshore stocks, trap design, and longevity of wooden traps.

Snow crabs; a new method for measuring legal minimum size (project initiated by R. Elner), location and number of additional snow crab licenses.

4. Additional Accomplishments:

1. Initiated and supervised a touch tank of live marine animals located on the Halifax waterfront. The tank had 77,000 visitors between early June and early September, and was operated at a direct cost of $.07 per visit. Salaries for students who manned the tank were obtained from Tourism Halifax and the Waterfront Development Corp. by J.D. Pringle.

2. Lobster larvae were sampled at 430 stations on the South Shore of Nova Scotia.

3. The distribution of egg bearing females on the South Shore of N.S. in the spring of 1991 was recorded with the help of fishermen.

4. Responsible for management advice on Cape Breton snow crab and lobster fisheries until April, 1991.

5. Gauges for measuring claw sizes of snow crab were developed for fishermen and biologists.

5. Goals/Expected Outputs for 1992:

1. Make editorial changes required on manuscripts mentioned in 3.1 and 3.3 above.

2. Finish and submit manuscript mentioned in 3.4.

3. Review results of lobster larval sampling and collect a second year's data on fishermen's catches of egg-bearing females.

4. Continue advising on management of a new N.S. sea urchin fishery.

5. Continue as lobster research coordinator at the HFRL.

6. Assume responsibility for monitoring and advising on the LFA 33 lobster fishery.

7. Regional representative on DFO Science Subvention Committee.

6. Background:

Highlights:

The success of the touch tank; the pleasure of working with a visiting scientist; communicating with diverse groups; finishing 3 years sampling of lobster larvae.

Selected Involvements:

i. Collaborative Research -

Sixty lobster fishermen on the South Shore of Nova Scotia were involved in a study of the location of egg-bearing females.

A joint experimental study was carried out with Dr. Julian Addison of the Fisheries Laboratory, Lowestoft, England, from September through December.

See also sections 3.1, 3.2, and 3.6 above.

ii. University Liaison -

Thesis committee of a Dalhousie M.Sc student and co-sponsor of an honours student.

iii. Communications -

Oral presentation to DFO, Scotia-Fundy economists: Good times licenses for limited entry fisheries.

Two oral presentations to lobster fishermen: 1) The strengths of S-F lobster regulations, 2) Lobster research on ovigerous females and larvae.

Oral presentation to fisheries officers: The strengths of S-F lobster regulations.

Two oral presentations to Cape Breton snow crab fishermen: 1) Stock distribution in southern Cape Breton, 2) A new measure of legal minimum size.

Worked with a writer on contract to Communications Branch to develop a brochure on shellfish biology and fisheries, and two Sou'Wester articles on shellfisheries management.

Interviewed by media on the topics of high lobster landings (MITV), the spatial relationship of navy target practice to lobster catches (CBC TV), prospects for a growing sea urchin fishery (Financial Times), relationship of lobster landings to fall storms (Queens County weekly)

Supplied information for two media releases and two Pisces articles on the touch tank.

iv. Contracts Administered -

v. Other -

Member of the organizing committee, the editorial committee, and chaired a session at the MEES

workshop on "Juvenile stages: the missing link in fisheries research".

7. Publications:

i. Primary -

Roddick, D. and R.J. Miller. 1991. Spatial and temporal impact of inshore scallop fishing on lobsters. Can. J. Fish. Aquat. Sci. (in press)

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Eagles, M. and R.J. Miller. 1991. Stock summary sheets presented to CAFSAC, IMP subcommittee: 1990 snow crab, Area 2-3-4; 1990 snow crab, Area 5; 1990 snow crab, Area 6; 1990 lobster, Area 27; 1990 lobster Areas 28-29; 1990 lobster Area 30.

Miller, R.J., A. Campbell, G. Sharp, and C. Hudon. 1991. (Abstract) Are small juvenile lobsters habitat limited? Abstract of paper presented at MEES workshop.

Miller, R.J. and F. Watson. 1991. (Abstract) Spatial and temporal changes in lobster size at maturity in Nova Scotia. Abstract of paper presented at the National Shellfisheries Assoc. Ann. Meet.

8. Review and Evaluation:

An exemplary year. A wide diversity of tasks accomplished. Several manuscripts have been submitted by the project leader and collaborators. Another well accomplished task was the evaluation and research planning for lobster resource science. Responsibility for biological advice on the LFA 33 lobster fishery is added to this project for 1992.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 212

Section: Population Biology

Project Title: Lobster Resource Science - Larval Biology

Project Leader: Harding, G.C.; Pringle, J.

Other Researchers: Vass, W.P.; Duggan, R.; Miller, R.

Work Activity: W.A.1.1.1.3

Key Words: lobster; assessment research; larvae; recruitment

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1. Project Description:

Studies designed to further understanding of lobster larval ecology and thereby the recruitment process of the American lobster through field studies and laboratory experiments.

2. Long-Term Objectives:

Provide scientific advice required to improve management of the lobster fisheries in the near-shore and offshore regions of Atlantic Canada based on results of research on larval lobster ecology, production, and recruitment.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Write and submit for primary publication manuscripts on: a) the vertical migration of lobster planktonic stages (Harding) and, b) the temporal and spatial distribution of lobster larvae in St. Margarets Bay, N.S. (Pringle)

Goals not met. Some progress has been made however:

a) a paper was presented to the American Society of Limnology and Oceanography (meeting - June 10-14, 1991) (Harding);
b) a manuscript on lobster larval morphometrics from both the inshore and offshore has been through internal review (Harding); and
c) a paper was presented to the National Shellfish Association (June 23-27) demonstrating lobster larval dispersion off Georges Bank into the Gulf of Maine. (Harding, Pringle)

2. Submit a note for primary publication on the temporal and spatial distribution of lobster larvae in Jeddore Harbour, N.S. (Pringle)

Goal met. Technical report published and manuscript accepted for publication in Journal of Shellfish Research.

3. Submit for internal review, a manuscript on the spatial distribution of the planktonic lobster life history stages in relation to Georges Bank. (Harding)

Goal not met.

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

1. Write and submit for primary publication manuscripts on: a) the vertical migration of lobster planktonic stages (Harding) and, b) the temporal and spatial distribution of lobster larvae in St. Margarets Bay, N.S. (Pringle)

2. Submit for internal review, a manuscript on the spatial distribution of the planktonic lobster life history stages in relation to Georges Bank. (Harding)

3. Prepare a manuscript on the evidence for lobster larval dispersal from Georges Bank. (Harding)

4. Conduct a study to track the dispersal of lobster larval patches from NW Browns Bank using Loran-C drifters and Vass-Tucher trawl. (Harding)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

Papers presented at the ASLO and NSA meetings. (Harding)

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

DiBacco, C. and J.D. Pringle. 1991. Larval lobster (Homarus americanus Milne Edwards) distribution in a protected Scotian Shelf bay. Can. Manuscr. Rep. Fish. Aquat. Sci. 2110: 26pp.

iv. Popular and Miscellaneous -

Harding, G.C., J.D. Pringle, K.F. Drinkwater, A.J. Fraser, I.R. Perry and W.P. Vass. 1991. Offshore studies of larval lobsters (Homarus americanus) in the Georges and Browns Bank region. Abstract, National Shellfish Association, meeting, Portland, Me., June 23-27, 1991.

8. Review and Evaluation:

The full analysis of the results of this project are important to future planning of the overall lobster research program. Until such analysis is completed and submitted for publication, no new field work should be initiated.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 213

Section: Population Biology

Project Title: Lobster Resource Science and Assessment - LFA 31 and 32

Project Leader: Pringle, J.

Other Researchers: Duggan, R.

Work Activity: W.A.1.1.1.3

Key Words: lobster; assessments; LFA 31-32; assessment research

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1. Project Description:

Ongoing assessment of the lobster fishery along Nova Scotia's eastern shore, developing assessment techniques, carrying out resource science, providing biological advice to industry and the resource manager.

2. Long-Term Objectives:

To provide the best possible advice on which to base sound lobster management by employing the most efficient methods for gathering and analyzing stock assessment data and by carrying out pertinent research.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Assess the lobster stocks in LFA 31-32 and provide biological advice to the resource manager and industry. (Duggan)

Goal met. Meetings attended and biological advice presented (see Publications). Data were presented on CPUE, and characteristics of lobsters within the catch. Biological advice presented in support of the current management plan's levels of effort and exploitation rates.

2. Write and submit a manuscript on aspects of lobster reproductive ecology. (Pringle)

Goal not met. Effort placed elsewhere.

3. Provide biological advice, via CAFSAC, on lobster growth and dispersion in the southern portion of LFA 32. (Pringle)

Goal not met. Effort placed elsewhere.

4. Give advice on the impact of season on tagging results. (Duggan)

Goal not met. Effort placed elsewhere.

5. Assist and supervise graduate student R. Ugarte. (Pringle)

Goal met. R. Ugarte passed his admittance-to-candidacy exam (see publications) and initiated research in the Canso area on the ecology of egg-bearing female lobsters. The study involves an assessment of embryo development in relation to local physical conditions. Fishermen play a key role in this study. A field station was set up in Canso and experimentation continues from May through December.

4. Additional Accomplishments:

1. Supervised BSc. Honours student Taja Lee's thesis, "Molting and mating behaviour in Homarus americanus, a field experiment." Lobster molting and mating behaviour has previously only been studied in the laboratory. This study employed cage-held lobsters placed in the wild. The study has confirmed observations made in the laboratory regarding the role of males in the protection of post molt females. It was also shown that dominant females will cannibalize subordinate, early post-molt females.

2. Co-edited (with Dr. S. Cobb) two issues of The Lobster Newsletter (TLN).

3. Co-organized (with Dr. L. Incze) a mini symposium, at the NSA conference, on current issues in lobster resource science. See TLN 3(2) for conclusions.

4. With co-author L. Burke, revised chapter on lobster management for S. Parsons' book on Canadian Fisheries Management. Now accepted for publication.

5. Goals/Expected Outputs for 1992:

1. Assess the lobster stocks in LFA 31-32 and provide biological advice to the resource manager and industry. (Duggan)
2. Write and submit a manuscript on aspects of lobster reproductive ecology. (Pringle)
3. Provide biological advice, via CAFSAC, on lobster growth and dispersion in the southern portion of LFA 32. (Pringle)
4. Give advice on the influence of tagging data on tag retention. (Duggan)
5. Assist and supervise graduate student R. Ugarte and Honours BSc. student T. Lee.
6. Co-edit The Lobster Newsletter.

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

Co-supervising graduate students R. Ugarte and R. Santos with Dalhousie University Biology Department faculty. (Pringle)

iii. Communications -

Seminar prepared by student R. Ugarte for presentation at Dalhousie University on the impact of temperature on embryo development in lobsters.

Presented the annual stock assessment to LFA 31/32 advisory committee. (Pringle)

Interpretation of video on lobster trapping to fishermen of Canso area. (Duggan)

Chaired the Round Table Discussion at the NSA Conference on lobster ecology and resource science. (Pringle)

iv. Contracts Administered -

Personal service contract with Dr. R. O'Dor.

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Volume 3 (1&2). The Lobster Newsletter, with coeditor J.S. Cobb.

Annual stock assessment - LFA 31/32, 8pp.

Behaviour and ecophysiology of late-stage female lobsters [Homarus americanus (Milne-Edwards)] along Nova Scotia's eastern shore. Research proposal by R. Ugarte.

Molting in Homarus americanus; A field experiment. BSC Honours thesis proposal submitted by T. Lee.

8. Review and Evaluation:

This ongoing project is progressing well. The contacts with the fishing industry are well-developed, and the cooperative research project, with students at Dalhousie, enriches the scope of the work.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 214

Section: Population Biology

Project Title: Lobster Assessment and Related Research in LFA 34

Project Leader: Pezzack, D.

Other Researchers: Duggan, D.; Hudon, C.

Work Activity: W.A.1.1.1.3

Key Words: lobster biology ; assessments ; assessment research ; LFA 34 ; stock structure ; inshore lobster ; Gulf of Maine ; Southwest Nova Scotia

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1. Project Description:

The project has the ongoing functions of: 1) monitoring the lobster fishery in LFA 34; 2) advising on management, and 3) carrying out research relevant to understanding population dynamics and assessment methods.

2. Long-Term Objectives:

To provide and promote advice and carry out research relevant to improving stock assessments leading to improved management.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Monitor the lobster fishery in designated ports in LFA 34 and summarize results for management and industry. (Duggan)

Complete. Annual sampling and collection of logbooks completed, and data coded. Summary sheet of LFA 34 fishery prepared and presented to CAFSAC, and update of fishery presented to the LFA 34 advisory committee.

2. Provide biological advice on management related issues at the LFA, and Regional and Zonal levels. (Pezzack)

Complete. Provided advice to management on biological bases of lobster trap limits in LFA 34, and the need for a review of the limit. Compiled lobster summary sheets for Scotia-Fundy and for CAFSAC. Provided advice on minimum sizes to managers, and researchers in Economics branch.

3. Present paper on the voluntary logbook system to CAFSAC SSSS (Statistics, Sampling and Survey Subcommittee) for review and assessment of methodology. (Pezzack)

Complete. CAFSAC working paper presented with M.J. Tremblay, to CAFSAC SSSS. The subcommittee examined design, uses and problems in voluntary logbook systems and made comments on further analysis.

4. Investigate the possibilities of a multi-year project to assess seasonal levels and distribution of lobster fishing effort in the 'midshore' (25-50 miles) areas of LFA 34 using remote sensing and the interview technique. (Duggan)

Complete. Conducted flights over the midshore area on an opportunistic basis using the DFO helicopter. Determined the geographic extent of inshore effort, but no quantitative estimates of effort were made. No surveys were undertaken due to budget and overtime restraints.

5. Carry out NOS VE conversion of lobster programs. (Duggan)

Completed.

6. Continue work on improving accessibility to lobster fishery data by incorporating length frequency data into Oracle Database. (Pezzack)

At-sea sample data for LFA 34 was prepared and edited; to be incorporated into length frequency data base. The data was entered and analyzed with existing size frequency programs.

4. Additional Accomplishments:

1. Participated in special lobster workshop at National Shellfish Association meeting in Portland, Maine (July 27). (Pezzack)

2. Participated in workshop discussion on lobster research at Maritimes Fishermen Union Annual

meeting (Yarmouth Feb. 16). (Pezzack)

3. Initiated literature search of information on lobster predators as part of investigations into the cause of the lobster recruitment pulse in the 1980's. (Pezzack)

4. Provided information on lobster fishery and the biological basis of trap limits to the Crown Prosecutor in a case involving fishermen exceeding the trap limit. (Pezzack)

5. Participated in CAFSAC-MESS Workshop on Juveniles Stages and Fisheries (Halifax Oct. 1-2). (Pezzack)

6. Tagged berried female lobsters in Barrington Bay (May) to determine movements and usefulness of site for future research. (Duggan)

7. Monitored bottom temperatures at a monitoring site established in Pubnico Harbour and Barrington Bay. (Duggan)

8. Met with Clearwater Lobster representatives, reviewed their scientific sampling proposal and established the protocol for fulfilling the requirements of a scientific permit to sample lobsters for molt stages during the LFA 34 closed season in 1992. (Pezzack)

9. Modified and tested a yield/recruit program to generate estimates of population size structure information for Economics Branch study of the effects of increases in minimum sizes. (Pezzack)

5. Goals/Expected Outputs for 1992:

1. Monitor the LFA 34 lobster fishery by sampling the catch at sea, and using a voluntary logbook program in designated ports in LFA 34, and summarize results for management and industry. (Duggan, Pezzack)

2. Provide biological advise on lobster management and related issues at the LFA and regional and zonal levels, and coordinate production of CAFSAC summary sheets into document for public. (Pezzack)

3. Coordinate a review of - 1) purpose and expectations of voluntary logbook information; and 2) logistic requirements (quantity, deployment within and between LFA) of voluntary logbook data collection. (Pezzack)

4. Estimate recent changes in midshore effort, using flights of opportunity on DFO helicopter and interviews with fishermen. (Duggan, Pezzack)

5. Oversee the monitoring lobster molting period(s) at two sites in LFA 34 using pleopod and blood protein methods. Sampling and analysis to be done by Clearwater Lobsters, under a scientific permit. (Pezzack)

6. Tag berried females during late May, in Barrington Bay to determine over wintering grounds. (Duggan, Pezzack)

6. Background:

Highlights:

Inshore lobster landings continue to increase and in many areas are at or near all time records. Many requests were made by industry, press, scientists, and managers for an explanation of the explosion in landings. Though scientists have been unable to explain it, the wide spread nature (Quebec–Mass.) suggests an environmental mechanism. Initiated work to examine potential causes including predation and temperature.

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

1. Interviewed by press for information/article/broadcast –Portland Press Herald, Portland Maine (Jan.30), CBC-TV (April 10 and Dec. 19), Globe and Mail (S. Strauss May 3), Daily News, Halifax (May 7), Seafood Newsletter, Seattle Wash. (Sept. 9), Broadcast News (Nov.6), Saint John Telegraph Journal (Nov. 27); CBC Radio (Dec. 3). (Pezzack)

2. Responded to many enquiries from fishermen and public on lobsters and the state of the stock. (Pezzack)

3. Staffed the DFO booth at the Lunenburg Fisheries Exhibition (August) and provided biological expertise to queries from visitors. (Duggan)

iv. Contracts Administered -

- Tag recovery contracts to agents in Port Hebert and Port Maitland to recover tags.

- Contract to conduct at sea sampling during spring and fall season.

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Pezzack, D.S. and D.R. Duggan. 1991. LFA 34 Lobster CAFSAC Summary Sheet.

8. Review and Evaluation:

Although considerable impromptu demands were made upon investigators's time, they managed to fulfil their assessment obligations and continued projects to improve the quality of advice they provide (adequacy of voluntary logbook system, accessibility of lobster fishery data). The project leader is nicely filling his role as Branch lobster coordinator.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 220

Section: Informatics and Administrative Services

Project Title: Statistical Consulting

Project Leader: Rodger, R.

Other Researchers:

Work Activity: W.A.1.1.1.3

Key Words: statistical analysis; sampling; experimental design

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1. Project Description:

Collaborate with and advise other researchers on projects requiring experimental design and\or statistical analysis and modelling.

2. Long-Term Objectives:

To act as the mathematical and statistical consultant for the Benthic Fisheries and Aquaculture Division. To provide advice on appropriate techniques used in the assessment and research of benthic populations and develop sound sampling techniques and experimental design.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

New Project. No goals were established last year.

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

1. Collaborate with and advise other researchers on projects requiring experimental design and\or statistical analysis and modelling.
2. Assisting Dr. J. Castell in the design and analysis of his experiment on various dietary equivalents for lobsters and their attractant properties.
3. Assisting J. Kean-Howie in the analysis of her data on nutritional requirements of lobsters.
4. Assisting Dr. R. Miller in the design, analysis and interpretation of his experiments on the effect of 'strangers' and of local population density on the capture rate of crabs.
5. Advising B. Jessop on the analysis and interpretation of his data on fecundity in anadromous alewives and blueback herring.
6. Assisting Dr. C. Hudon in her analysis of the advection of lobster in Iles de la Madelaine.
7. Assisting K. Freeman in the analysis and interpretation of his data on condition indices for mussels.
8. Advising R. Santos on the analysis and interpretation of his data on the distribution of seaweeds.
9. Advising Dr. Tremblay on sample-size and power for his data on assessment of catch.
10. Advising R. Ugarte in the analysis and interpretation of his data on the colony of berried females and experimental design of laboratory studies.
11. To advise T. Lee (Honours BSc) on the analysis and interpretation of his data on lobster molting and sexual behaviour.
12. If time and priorities permit, plan and implement a workshop on multiple contrasts, power and sample size.

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

This new project began the last quarter of 1991. The concept was to employ a mathematician who was happy to contribute to the success of others' research, while doing little personal research. From all reports, we chose wisely and the project is off to a great start.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 225

Section: Population Biology

Project Title: Section Administration

Project Leader: Robert, G.

Other Researchers:

Work Activity: W.A.1.1.1.3

Key Words: administration

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1. Project Description:

The Section is responsible for providing biological advice on the management of commercially important invertebrate and marine plant resources and carry out research deemed to improve the biological advice. Administrative and scientific leadership is provided to Section personnel.

2. Long-Term Objectives:

Provide an environment conducive to high quality biological advice and excellent science given the resources available. Provide accurate and timely administration.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. The provision of accurate and timely biological advice by Section staff, in a manner comprehensible to the client.

Section staff have attended numerous meetings of pertinent Advisory Committees, ad hoc meetings dealing with local issues of multi-resource usage, environment, and habitat. They have also participated in sessions on the Halifax Harbour Clean-Up, jurisdiction of the marine plants resource and a Scallop Science Day. They were involved as DFO representatives at the Yarmouth and Lunenburg Fishery Exhibitions and the Digby Scallop Days.

2. Scientific projects that are deemed most important to improve biological advice.

A review of lobster resource science has been completed to establish directions with respect to inshore-offshore and other pertinent questions. An overtime budget allocation scheme was developed so that projects get adequate coverage according to needs.

3. To provide opportunities for development and temporary assignment to section personnel and fill present section PY vacancies with the best individuals available.

Section personnel were provided with opportunities for development by scientists visiting the Halifax Laboratory: Julian Anderson, MAFF, Lowestoft, crustacean trapping behaviour; Put Ang, University of British Columbia, marine plants population modelling; and Peter Beninger, Université de Moncton, snow crab reproductive physiology.

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

1. To provide leadership in the management of all Section resources.
2. The provision of accurate and timely biological advice by Section staff, in a manner comprehensible to the client.
3. That the scientific project carried out are those deemed most important to improve biological advice.
4. To provide Section personnel with opportunities for career development.
5. To assist in the management of both the Division and Laboratory, and in 1992-93, to provide advice on choosing a creative mechanism for allocating meagre O&M resources.

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

Section personnel were approached on many occasions to provide scientific background information to journalists in charge of articles for fishery trade publications (scallop, lobster, marine plants, etc).

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Ginette has been stalwart in budgeting Section fiscal resources in a year of tight monies. She is now familiar with Section programs and more comfortable and confident in the role of Section Head. Despite personal illness, she has met most deadlines and assisted with Division matters. The coming fiscal year will require the development and deployment of concepts, hitherto untried, to satisfy project leader's fiscal expectations and meet the Section's mandate.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 226

Section: Division Chief/Laboratory Director

Project Title: Division/Laboratory Administration

Project Leader: Pringle, J.

Other Researchers: Field, B. ; Covey, M. ; Shellnutt, S. ; Wentzell, C.

Work Activity: W.A.1.1.2.1 ; W.A.1.1.1.3 ; W.A.1.1.2.3

Key Words: administration ; planning

1. Project Description:

The Division has three equally important, areas of responsibility, all of which involve the provision of biological advice: first, Regional (excluding the Bay of Fundy) stock assessment advice is provided on commercially important, invertebrate and marine plant resources; secondly, advice is provided on the disease and nutrition of commercially important finfish and invertebrate species; and thirdly, advice is provided on those species of invertebrates important to aquaculturalists along the southern and eastern shores of Nova Scotia. Division personnel carry out that research deemed most important to upgrade the advice. This project is responsible for ensuring that Division personnel have sound scientific leadership and that the HFRL provides good administrative support for all occupants.

2. Long-Term Objectives:

Maintain a Division whose scientific personnel provide the best possible biological advice to clients, and conduct the research most pertinent for improving the quality of advice given. Maintain the best possible research environment for laboratory personnel that available resources can provide. Maintain an administrative team that provides the best possible service to scientific personnel and completes administrative tasks in a timely and accurate fashion.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. To ensure the Division is financially solvent through the fiscal year.

Goal not met. The Division Chief extended budget expenditures to accommodate what were deemed necessities. Additional monies were required to complete a room to accommodate new microscopic equipment. Facilities Management could contribute nothing to its actual construction. The Division Chief chose to construct the room. Other unexpected costs resulted in a deficit situation in January, 1992.

2. To ensure the Division meets its administrative and advisory responsibilities in a timely and professional manner.

Goal met.

3. To ensure significant improvements in the publishing record of certain Division members.

Goal partially met. Steps taken were successful in two cases, but were unsuccessful in another.

4. To assess, and where deemed appropriate, implement the recommendations of the reviews on disease research and diagnostics and lobster research.

Goal partially met. Monies were scavenged to support a PDF in disease research, but resources were unavailable to do more. The offshore/inshore lobster research assessment is yet unavailable.

5. To organize and/or chair meetings, both of the Division Management Committee and Staff, and attend meetings of the Building Management Advisory Committee, Tuesday Club, Branch Advisory Committee and others as arranged.

Goal met. Meetings were attended and/or chaired and contributions made. Chair of the Lab Management Advisory Committee was transferred to the Division's Administrative Assistant. About six laboratory staff meetings were held and deemed successful by lab personnel.

6. To take a course in science leadership (possibly at the Canadian Center for Management Development).

Goal not met. Cancelled due to insufficient funds.

7. To perform the duties of Core Member of the CAFSAC Invertebrates and Marine Plants subcommittee.

Goal partially met. Attended one meeting, but sent a substitute to the other.

4. Additional Accomplishments:

1. Encouraged the development of the successful "touch tank" by soliciting operating expenses from both the City of Halifax and the Halifax Waterfront Development Corporation.

2. Organized with J. Castell, a DFO sponsored fund raiser for the Schizophrenic Society of Nova Scotia.

3. A review of Dr. J. Castell's longterm research proposal was organized and acted upon. John will be moving into the field of lipid nutrition with emphasis on candidates for groundfish aquaculture.

4. Innovative plan put in place to use a one-half time, FTC py to hire a much needed mathematician.

5. Goals/Expected Outputs for 1992:

1. To ensure the Division is financially solvent through the fiscal year.

2. To develop a unique plan for the funding of stock assessment and resource science projects based on an O&M budget insufficient to continue the use of past practices in the dispersion of monies.

3. To ensure the Division meets its administrative and advisory responsibilities in a timely and professional manner.

4. To ensure significant improvements in the publishing record of certain Division members.

5. To organize and chair meetings, both of the Division Management Committee and Staff, and attend meetings of the Building Management Advisory Committee, Tuesday Club, Branch Advisory Committee and others as arranged.

6. To take a course in science leadership (possibly at the Canadian Center for Management Development).

7. To perform the duties of Core Member of the CAFSAC Invertebrates and Marine Plants subcommittee.

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

In spite of the budget difficulties in 1991, the administrative functions at the Halifax Laboratory have been handled well. Morale is very good and is due, in part, to the communication efforts of the Laboratory Director.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 229

Section: Population Biology

Project Title: Wild Mussel Resource Assessment and Research

Project Leader: Sharp, G.

Other Researchers: Semple, R.

Work Activity: W.A.1.1.1.3

Key Words: mussels; assessments; assessment research; Mytilus edulis; lobster

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1. Project Description:

This is an ongoing project concerned with stock assessment, research and the provision of biological advice on the Region's wild mussel harvest.

2. Long-Term Objectives:

Determine the distribution and resource characteristics of wild mussel stocks; describe and assess the developing mussel harvest industry and its impact on the resource and associated species; develop management models and strategies for the resource; and provide clients with resource information.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Monitor and assess the fishery. (Sharp)

Goal not met. This fishery was not active in 1991.

2. Publish the results of side scan sonar and abundance survey. (Sharp)

Side scan sonar results were published separately as a report of the Geological Survey of Canada. Abundance information will be correlated with the distribution of substrate type.

3. Examine earlier survey samples for 'new' mussel species (Mytilus trossulus) identified in aquaculture research. (Sharp)

Goal not met.

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

1. Unless this fishery becomes active in 1991, assessment will not be carried out.
2. Examine samples previously collected for the presence of a "new" mussel species (Mytilus trossulus) that has been found in aquaculture research.

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

The lack of activity in this particular fishery prompted the project leader to focus on other Divisional projects that required more attention.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 235

Section: Population Biology

Project Title: Resource Mapping and Special Projects

Project Leader: Black, G.

Other Researchers: Robert, G., Branton, R., Hunter, C.

Work Activity: W.A.1.1.1.3

Key Words: resource surveys; mapping; data processing

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1. Project Description:

Conducts the Branch Resource Mapping Program. Undertakes projects requiring specialized computer graphics skills and methods, and provides support to other projects with mapping or computerized graphics requirements.

2. Long-Term Objectives:

Provide a vehicle in which the Branch's research results will receive wider distribution in support of the DFO goal of increasing the visibility of the Science Sector programs.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Conduct work toward additional publications on aquatic resources in the special publication series initiated with the squid and scallop publications. The subject may be cod, herring, or some other branch research area. Final determination of the subject matter has yet to be determined. (Black)

Goal not met. Postponed pending the completion of the scallop resource atlas. This publication is now scheduled to be published early in 1992.

2. Extend the graphics software program ACON to include support for 3D visualization, iconic tool sets, ORACLE access, presentation of variance estimates, and vector/matrix operators. (Black)

Goal partially met. ACON now supports 3D visualization, and ORACLE access. Other features added, superseded implementation of the additional planned enhancements.

3. Participation in the 5ze scallop assessment as required. Document existing assessment techniques used more fully. (Black)

Goal met. Participated in the 5zc Scallop assessment.

4. Improve the interface and documentation for the Graphical Tuning Assessment software. (Black)

Goal partially met. An enhanced graphic stock projection and VPA were implemented.

5. Improve the interface for the VAX version of ACON, and implement PC compatible version (with COGS). X Window System implementation (with consultant). (Black)

Goal partially met. Updated versions of ACON were ported successfully to the St. Andrews VAX, BIO Cyber, and PCs. The X Window version implementation was not attempted.

6. Research and analysis as mandated by line management during the year. (Black)

Goal met. Conducted analysis and development as required on other collaborative projects.

4. Additional Accomplishments:

The project leader continued to be involved in unplanned related work which impacted the completion of expected outputs. (support role to users of sophisticated graphical packages; development of software modules in C and object-oriented languages where the project leader has superior technical expertise)

5. Goals/Expected Outputs for 1992:

1. If the Atlas publication series is continued, conduct work toward an additional publication. The subject may be cod, herring, or some other Branch research area. Final determination of the direction has yet to be determined. (Black)

2. Extend the graphics software program ACON to include support for interprocess communication,

presentation of variance estimates, and vector/matrix operators. (Black)

3. Participate in the 5zc scallop assessment as required. Document existing assessment techniques used more fully. (Robert, Black)

4. Improve the interface and documentation for the Graphical Tuning Assessment software. (Black)

5. Support the VAX and PC implementations of ACON as directed. (Black, Branton)

6. Integration of Lobster and Scallop databases and ACON using imbedded SQL scripts for automated graphical analysis. (Black, Hunter)

7. Research and analysis as mandated by line management during the year. (Black)

6. Background:

Highlights:

Participation in the 5zc scallop assessment remained a challenging task for this review period.

ACON has proved successful in providing the required functionality to fill a number of application niches not currently supported by commercial software. Development of this tool will continue as necessary to meet new requirements for scientific visualization when appropriate.

Selected Involvements:

i. Collaborative Research -

R. Mohn, M.F.D.: refinement of assessment techniques using interactive graphics.

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

This year will likely witness the publication of the scallop atlas. Important graphical developments came to full deployment during the review period (high degree of versatility and portability of ACON; graphic tuning interface). Such specialised graphic skills are a significant asset to the Biological Sciences Branch.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 241

Section: Aquaculture

Project Title: Administration - Aquaculture Section

Project Leader: Scarratt, D.

Other Researchers:

Work Activity: W.A.1.1.2.1; W.A.1.1.2.3

Key Words: administration; data processing

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1. Project Description:

Manage administration of research and service unit comprising 16 PYs and $256K.

2. Long-Term Objectives:

Overall effective management of section programs within budget allocations.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Provide effective administrative and scientific leadership to the section. Emphasis will be placed on bringing a backlog of data to publication stage. (Scarratt)

Goal partially met. There are yet research personnel who have not resolved their backlog of unpublished work.

2. Contribute to Division and Laboratory leadership. (Scarratt)

Contribution effective. Morale within the section is high notwithstanding budget and staffing constraints. Successful applications were made to AFAP for additional funding in the early part of the year, although success has been less marked latterly with the determination that federal labs are not eligible for AFAP research funding. A successful joint venture was arranged with Seafarm Canada for an additional technician in the Fish Health Unit.

3. Review format and organize the 14th Regional Fish Health Workshop. (Scarratt)

The 14 Regional Fish Health Workshop was held successfully in Halifax, November 7 - 8, 1991. There were 140 registrants. 32 papers were presented. A special session was held on Amendments to Fish Health Protection Regulations.

4. Co-chair the Laboratory Safety Committee. (Scarratt)

This committee meets regularly and contributes significantly to the awareness of safety issues among the staff. Nevertheless, inadequate funding has resulted in many safety issues remaining unaddressed or unresolved.

5. Coordinate reviews of lease and permit applications for Branch (Project 247 1989/90). (Scarratt)

Forty-five applications for aquaculture leases reviewed to mid-November 1991. Five ACOA applications received and evaluated. Three AFAP applications received and evaluated.

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

1. Provide effective administrative and scientific leadership to the section. Emphasis will be placed on bringing a backlog of data to publication stage. (Scarratt)

2. Contribute to Division and Laboratory leadership. (Scarratt)

3. Review format and organize the 15th Regional Fish Health Workshop. (Scarratt)

4. Co-chair the Laboratory Safety Committee. (Scarratt)

5. Coordinate reviews of lease and permit applications for Branch (Project 247 1989/90). (Scarratt)

6. Background:

Highlights:

Highlights have been somewhat mixed. The loss of a technical position in Histology has only partially been made up by a combination of student and part time positions. This will curtail production of the Cod Atlas and delay re-orientation of that program. There is a chronic lack of operating funds as evidenced by the inability within the Section, Division, or Branch to provide adequate funding for reconstruction of the microscope suite, and other outmoded laboratories.

The budgetary constraint on the working of overtime has exacerbated the problems of maintaining adequate care of experimental animals over weekends and on Holidays.

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

With Darcel Williams: To provide assistance in the transfer of Phage Typing technology from the Research Unit to the Diagnostic Unit. Funding from AFAP, A Base funds, and Seafarm Canada.

With Mallet Research Services: To provide electrophoretic analysis of Mussel populations in Atlantic Canada. Funding from AFAP.

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

For the second successive fiscal year the section experienced significant budgetary problems in the last quarter. This was inspite the Section Head's success in attracting some outside monies during 1991/92. In part, the problem was exacerbated by the acquisition of a much needed PDF in disease research and the assistance given to the construction of an electron microscope suite. For fiscal year 1992/93 the section must, via the Workplan exercise, develop fiscally sound priorities. The Section Head has done a great deal in the promotion of aquaculture, witness his successful organization of the annual Fish Health Workshop. Dave has often given wise council to the lab Director and has done an exemplary job in promoting lab safety.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 242

Section: Aquaculture

Project Title: Invertebrate Nutrition

Project Leader: Castell, J.

Other Researchers: Boston, L.

Work Activity: W.A.1.1.2.3

Key Words: lobster; nutrition; scallops; aquaculture; marine fish; algae; lipids; essential fatty acids; metabolism

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1. Project Description:

The nutritional requirements of marine invertebrates are studied by conducting feeding trials using diets varying in one or more specific nutrients such as vitamins, lipids, or amino acids and by using radio tracers and short-term physiological studies. The growth, survival, metabolism, feed conversion, and other indices of nutritional quality are monitored.

2. Long-Term Objectives:

Establish the nutritional requirements of important marine invertebrates such as lobsters, scallops, and oysters; determine the nutritional composition of locally available raw materials that could be used in formulated diets; formulate nutritionally adequate, economical feeds for use in lobster and other marine invertebrate research and culture; and acquire a basic understanding of the role of essential nutrients in the metabolism and physiology of marine invertebrates.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Scientific Publications. A special effort will be devoted to completion of several outstanding manuscripts including: Protein/Energy requirement studies with Homarus americanus, Astacus astacus, Penaeus orientalis (Castell); Nutritionally induced molt death syndrome studies (Castell); Crustacean Feed Attractants Review (Castell); Essential fatty acid studies with Homarus americanus and Penaeus orientalis (Castell).

Goal partially met. A paper on the protein/energy (P/E) ratio of diets for Astacus astacus has been accepted for publication in Aquaculture, a second P/E paper is in draft form and two others are in outline. The review of feed attractants has not yet been written. The papers on essential fatty acid (EFA) requirements will be based on the research of two Ph.D. candidates.

2. Laboratory Studies: Commence collaborative studies with other scientists in the Halifax, DFO, Laboratory on the importance of lipids in larval fish, crustacean and/or mollusc nutrition. (Castell)

Goal partially met. Collaborative projects have been initiated with the Halibut culture project in St. John's Newfoundland (Dr. Joe Brown and Dr. Greg Goff), and with Dr. Robert Miller to evaluate the possibility of using distinctive fatty acid composition patterns to distinguish lobster eggs or larvae from offshore stocks.

3. Develop a long-term research plan in a broad area that has been agreed upon through discussions with Section Head and Division Chief.

Goal met. A detailed 5 year proposal for research into nutritional requirements of non-salmonid fish species was completed and has been reviewed by an administrative committee (October 30, 1991). This in turn has led to a branch-wide review of aquaculture research projects and is reflected in the program outlined in 5 below.

4. Additional Accomplishments:

Two fish nutrition projects were completed in cooperation with Dr. Santosh Lall: (1) Lipids in diets of tropical fish (this was basically a training project for visiting scientist Jayantha Chandrasoma) and, (2) lipids and fatty acid composition of several fish meal samples (with Bob Keith), this was part of a more complete assessment of the nutrient composition of several commercially available fish meals, the results are being compiled and will be available from Dr. Lall.

The lobster feed attractant study deferred from last year due to a shut down of the heated seawater system and renovations to the wet lab facilities, was commenced in July and completed in December 1991.

5. Goals/Expected Outputs for 1992:

Based upon the approved five-year research proposal (noted in 3), we will begin studies on the nutritional requirements of non-salmonid marine species.

New Project Description:

In order to support long-term development opportunities in the aquaculture industry the nutritional requirements of marine finfish species other than salmon are studied by; analyzing the nutrient composition of natural, live and formulated feeds; conducting feeding trials using live or formulated diets varying in specific nutrients such as vitamins, lipids, amino acids or mineral elements; and by using radio tracers and short-term physiological experiments in which growth, survival, metabolism, feed conversion and other indices of nutrition are monitored.

New Long-Term Objectives:

1. Establish the nutritional requirements of marine species which have potential for aquaculture.

2. Analyze the nutrient composition of phytoplankton and zooplankton which might be used to feed larval stages or that could be used in formulated diets.

3. Develop feeds for research and commercial applications.

4. Acquire a basic understanding of the role of essential nutrients (particularly lipids) in the metabolism and physiology of marine organisms.

Specific Objectives:

1. Scientific Publications:

Completion of outstanding manuscripts on crustacean nutrition research will continue to be a priority. (Castell and Boston)

a) Effects of feed attractants in diet of lobster;
b) Design and techniques for crustacean nutrition research;
c) Standard experimental diets for lobsters;
d) Vitamin B and Manganese, in lobster molt death syndrome;
e) molt death syndrome in lobster; and
f) fatty acid patterns of lobster eggs and larvae.

The work on crustacean nutrition will be phased out during the review year and be replaced with the Non-Salmonid Nutrition Project.

In cooperation with other members of the marine fish culture task force, it is anticipated that a complete bibliography of marine fish culture and nutrition will be prepared and published. (Castell, Waiwood, et.al.)

First draft manuscripts on lipid composition of halibut eggs, larvae and food organisms. (Castell) should also be completed in the next review period and on the possibility of using fatty acid markers in distinguishing geographic origin of lobster larvae. (Boston)

2. Laboratory Studies:

This year will principally involve lipid analyses, including analysis of 30 lobster egg samples supplied by Dr. Robert Miller and numerous halibut egg, larvae and food organisms from the marine fish culture project at St. John's, Newfoundland. If time permits, samples of algae cultured in the Halifax laboratory will be analyzed to determine effects of culture conditions on their lipid content and quality.

3. Education and Training:

Linda Boston will learn new techniques in lipid analysis by hands-on experience in the laboratory, and possibly by taking a University Course on lipid chemistry. John Castell will gain experience in lipid research techniques during a 10 month developmental leave at the University of Stirling, Scotland, February to December, 1992.

6. Background:

Highlights:

Major effort this year has been spent in developing long-term research plan as agreed upon through discussion with Section Head and Division Chief.

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

Continuation of cooperative research with Dr. Hans Ackefors, University of Stockholm, Sweden an Astacus astacus nutrition. The current study involves establishing long-term growth and survival pattern for laboratory reared crayfish fed formulated diets.

Lipids of cultured halibut eggs and larvae with Dr. Joe Brown and Dr. Greg Goff at the Memorial University of Newfoundland.

Supervision of Ph.D. students Kim Harrison (degree awarded fall 1991) and Xu Xueliang; and M.Sc. student Danny Jackson (successful defense of M.Sc. January 1992), all in the Biology Department of Dalhousie University.

Gave Aquaculture lecture to International Development Class at the Technical University of Nova Scotia.

iii. Communications -

iv. Contracts Administered -

v. Other -

Expert witness for Revenue Canada and the Department of Justice in research credit case against local lobster wholesale/retail company.

Played a key role in establishing the International Working Group on Crustacean Nutrition as an official working group of the World Aquaculture Society; and coordinating the program for the Crustacean Nutrition Workshop in Singapore October 26-30, 1992.

7. Publications:

i. Primary -

Ackefors, H., J.D. Castell. L.D. Boston, P. Râty, and M. Svensson. 1991. Standard Experimental Diets for Crustacean Nutrition Research. II. Growth and Survival of Juvenile Crayfish Astacus astacus (Linné) fed Diets Containing Various Amounts of Protein, Carbohydrate and Lipid. Aquaculture (in press).

ii. Interpretive Scientific -

Castell, J.D. 1990. Reference diets for Crustaceans: principles of experimentation. In: Barret, J. (Ed.), Advances in Tropical Aquaculture. Advances in Tropical Aquaculture: Workshop held in Tahiti, French Polynesia, Feb. 20-Mar. 4, 1989. Actes Colloq. IFREMER 9: 339-354.

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Baisre, J.A. and J.D. Castell. 1991. Aquaculture in Cuba. World Aquaculture. 22(3):000-000. In Press.

Baum, N., D.E. Conklin, H.D. Castell and L.D. Boston. 1991. Nutritionally Induced Molt Death Syndrome in Aquatic Crustaceans: III. The Effect of Varying Levels of Calcium in the Reference Diet, BML 81S for Juvenile Homarus americanus. The Crustacean Nutrition Newsletter 7(1):115-118.

Castell, J.D., L.D. Boston, D.E. Conklin and N. Baum. 1991. Nutritionally Induced Molt Death Syndrome in Aquatic Crustaceans: II. The Effect of B Vitamin and Manganese Deficiencies in Lobster (Homarus americanus). The Crustacean Nutrition Newsletter 7(1):108-114.

Castell, J.D. and Linda D. Boston. 1991. (Abstract). The effect of feed attractants on feeding behaviour and growth of juvenile lobsters. 14th Fish Health Workshop, Halifax, N.S., November 1991.

Castell, J.D. and K.E. Corpron. 1991. (eds.) Crustacean Nutrition Newsletter. Vol. 7(1). pp. 126.

Conklin, D.E., N. Baum, J.D. Castell, L.D. Boston and Li Hafung. 1991. Nutritionally Induced Molt Death Syndrome in Aquatic Crustaceans: I. Introduction to the Problem. The Crustacean Nutrition Newsletter 7(1):102-107.

8. Review and Evaluation:

Over the year the project leader extracted himself from a number of international science tasks, which has allowed him to place greater emphasis on more local concerns. The completion of a long-term research proposal was developed, reviewed and accepted. This proposal will permit his project to concentrate on immediate problems of the Canadian aquaculture industry. Training in Scotland will assist this process. The number of completed manuscripts was disappointingly low.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 243

Section: Aquaculture

Project Title: Fish Nutrition

Project Leader: Lall, S.

Other Researchers: Keith, R.

Work Activity: W.A.1.1.2.3

Key Words: salmon; aquaculture; fish food; nutrition

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1. Project Description:

Investigate the nutritional requirements of salmonids and marine fish in relation to growth, development, general health, reproduction, and other physiological functions. Present research is concerned with nutrition of salmonids to provide essential information for government and private culture operations, the feed industry, universities, fisheries management, and assessments.

2. Long-Term Objectives:

Determine the nutrient requirements of salmonids and marine fish for commercial operations; develop analytical and biological techniques to characterize the nutritional deficiencies in cultured and wild fish; provide information on nutritional requirements of salmonids, feed formulations, micronutrient losses in feed, and feed manufacturing techniques to other segments of government, universities, and the private sector; and develop a biological basis for determining salmonid culture potential for economic projections.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Submit the following manuscripts for primary publication:

    1. Vitamin B_6 requirement of Atlantic salmon;
    2. Vitamin E and immune response;
    3. Digestibility of feeds.

Goal partially met.

    1. M.S. drafted for internal review for submission to Aquaculture.
    2. Internal review complete and ready for submission to Can J. Fish. & Aquat. Sci.;
    3. Accepted for publication in J. Sci. Food & Agr.;

2. Continue research on the role of micronutrients in immune response and disease resistance in Atlantic salmon with emphasis on dietary folic acid. (Lall)

It was determined that the folic acid requirement of Atlantic salmon fingerlings can be met by including 4 mg folic acid per kg of diet based on growth, feed utilization, survival and folic acid deposition in tissue. Folic acid deficiency symptoms include: anemia, pale gills, large immature and segmented erythrocytes. Dietary folic acid supplementation has no significant effect on resistance to furunculosis. The analytical work is nearing completion.

3. Start preliminary work to measure the availability of dietary phosphorus in fish feed and to minimize losses of phosphorus to water and sediment. (Lall)

Project on track. The availability of phosphorus to salmon fish feeds and meals ranges from 50-84 %. Although digestibility of menhaden and whitefish meal was significantly better than herring and capelin meal, the total phosphorus excreted by salmon fed menhaden and whitefish meal was relatively high. Various soluble and insoluble phosphorus fractions of feeds and feces were also identified. Results presented at the Int'l Fish Nutrition Symposium, Biarritz, France and Fish Health workshop.

4. Coordinate fish hatchery nutrition programs. Continue to provide advice to private aquaculture operations, feed industry, and universities and maintain a suitable communication link with these agencies. (Lall)

Twenty five commercial feeds were analyzed to determine the quality of feed supplied to federal and private hatcheries and fish farms; several cases of nutritional deficiency were diagnosed; numerous inquiries by from fish culturists, feed industry and aquaculture personnel were answered. Evaluation of silage based feeds for the aquaculture industry was completed and shows silages can be incorporated successfully into salmon feeds. Active participation in aquaculture industry - sponsored courses and seminars continued.

5. Initiate preliminary work to determine the nutritional value of live organisms for halibut

larvae and development of diets for juvenile fish. (Lall) (Degree of involvement subject to the availability of technical support)

Halibut nutrition research program has been transferred to Dr. J. D. Castell.

4. Additional Accomplishments:

1. Conducted preliminary investigation on "Cold water winter lesions in Atlantic salmon" in co-operation with New Brunswick Department of Fisheries and Aquaculture, Connor Brothers Ltd. and Atlantic Veterinary College. The findings were reported in the Can. Vet. Journal.

2. Completed a project in co-operation with the Atlantic Veterinary College and Abbott Laboratories to evaluate several feed attractants and feed supplements to improve the acceptability to Atlantic salmon of feeds incorporating antibiotics. The diet was successful in a pharmokinetic study of oxytetracycline.

5. Goals/Expected Outputs for 1992:

1. Continue research on the nutrient requirements of Atlantic salmon specifically emphasizing the role of polyunsaturated fatty acids in immune response and disease resistance specifically of salmon to Vibrio anguillarum. (Lall, Keith, Olivier)

2. Develop and test experimental protocols for determining amino acid requirement of Atlantic salmon in sea water, with emphasis on the role of dietary arginine. (Lall, Keith, Kaushik)

3. Co-ordinate fish hatchery nutrition programs. Continue to provide advice to private aquaculture operations, feed industry, and universities and maintain a suitable communication link with these agencies. (Lall)

4. Submit manuscripts on research completed or nearing completion on (a) phosphorus utilization by Atlantic salmon and (b) folic acid requirement of Atlantic salmon. (Lall, Keith)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

1. Dr. D. Anderson, Truro Agriculture College - Protein quality of fish meals produced in Atlantic Canada.

2. Dr. R. G. Ackman, Technical University of Nova Scotia. - Lipid digestibility; tocopherol and astaxanthin deposition in salmon flesh.

3. Dr. G. Goff, Memorial University & Fisheries Resource Development Ltd. - Halibut nutrition and feeding.

4. Dr. R. L. Saunders, DFO, Biol. Station, St. Andrews, N. B. - Feeding rate and sexual maturation in Atlantic salmon.

ii. University Liaison -

1. R. G. Ackman, Technical University of Nova Scotia.

2. Dr. D. Anderson, Truro Agriculture College.

3. Dr. D. Rainie, Dr. G. Johnston and Dr. M. McNiven, Atlantic Veterinary College.

4. Dr. C. B. Cowey, University of Guelph.

iii. Communications -

iv. Contracts Administered -

v. Other -

Progress reported on fish nutrition research at the following scientific meetings and workshops:

1. IV Int'l. Symposium on Nutrition and Feeding of Fish, Biarritz, France.

2. Aquaculture Association of Canada 8th Annual Meeting, St. Andrews, N. B.

3. Fish Health Workshop, Halifax.

4. Aquaculture mini-symposium, Vancouver.

7. Publications:

i. Primary -

Polvi, S. M., R. G. Ackman, S. P. Lall and R. L. Saunders. 1991. Stability of lipids and omega-3 fatty acids during frozen storage of Atlantic salmon. J. Food Sci. Pres. 15: 167-181.

Takeuchi, T., R.G. Ackman and S.P. Lall. 1991. Differences in fatty acid composition of fish faeces as determined by two extraction methods. J. Sci. Food Agric. 56:259-264.

ii. Interpretive Scientific -

iii. Scientific and Technical -

Lall, S. P. 1991. Concepts in the formulation and preparation of a complete fish diet, p. 1-12. In S. S. De Silva (ed.) Fish nutrition research in Asia. Proc. Fourth Asian Fish Nutr. Workshop. Asian Fish. Soc. Spec. Publ. 5, 205. Asian Fish Soc. Manila, Phillipines.

Lall, S. P. 1991. Salmonid nutrition and feed production. *In* R. H. Cook and W. Pennell (eds.) Proc. Special Session on Salmonid Aquac., World Aquac. Soc. Meet., Feb. 12-16, 1989. Los Angeles, Ca. Can. Tech. Rep. Fish Aquat. Sci. No. 1831: 107-123.

Lall, S. P. 1990. Nutritional value of fish silage in salmonid diets. Bull. Aquac. Assoc. Canada. 91-1:63-74.

O'Halloran, J., E. Saulnier, K. Were, D. Groman and S. Lall. 1991. Cold water winter lesions in Atlantic salmon. Can. Vet. J. 32:312.

Ackman, R. G., S. M. Polvi, R. L. Saunders and S. P. Lall. 1990. Human health implications of Atlantic salmon fed different fats. Bull. Aquac. Assoc. Canada. 90-4:45-49.

Sigurgisladottir, S., S. P. Lall., C. Parrish and R. G. Ackman. 1990. Method to determine the digestibility of dietary lipids in Atlantic salmon. Bull. Aquac. Assoc. Canada. 90-4:41-44.

iv. Popular and Miscellaneous -

Lall, S. P. 1991. Role of micronutients in immune response and disease resistance in fish. IV Int'l Symp. Fish Nutrition and Feeding. Biarritz, France, June 24-27, 1991, #3.1 (Abs.)

Lall, S. P. and R. A. Keith. 1991. Biological availability of phosphorus in fish meal for Atlantic salmon. IV Int'l Symp. Fish Nutrition and Feeding. Biarritz, France, June 24-27, 1991, #5.4 (Abs.)

Anderson, J. S., S. P. Lall, D. M. Anderson and M. McNiven. 1991. Lysine requirement of Atlantic salmon. IV Int'l Symp. Fish Nutrition and Feeding. Biarritz, France, June 24-27, 1991, P-8-01 (Abs.)

Lall, S. P. and G. Olivier. 1991. Role of ascorbic acid in Atlantic salmon nutrition. Aquac. Assoc. Can. 8th Ann. Meet., St. Andrews, N. B., June 10-13, 1991, p.44 (Abs.)

Anderson, J. S., D. M. Anderson, S. P. Lall and M. McNiven. 1991. Nutritional and chemical characteristics of Canadian fish meal. Aquac. Assoc. Can. 8th Ann. Meet., St. Andrews, N. B., June 10-13, 1991, p.44 (Abs.)

Lall, S. P. and R. A. Keith. 1991. Dietary phosphorus in fish: Requirement, Metabolism and Excretion. 14th Regional Fish Health Workshop, November 6 - 8, 1991,#8 (Abs.)

Ackman, R. G., S. Sigurgisladottir and S. P. Lall. 1990. Effects of tocopherol and astaxanthin on quality of Atlantic salmon, *Salmo salar*. 14th Regional Fish Health Workshop, November 6-8, 1991. p.9 (Abs.)

Anderson, J. S., S. P. Lall, D. M. Anderson and M. McNiven. 1991. Biological availability of amino acids from fish meals for Atlantic salmon, *Salmo salar*. 14th Regional Fish Health Workshop, November 6-8, 1991. p.9(Abs.)

8. Review and Evaluation:

This program continues to produce at 110% capacity. This is reflected in the continued involvement with the aquaculture and aquaculture feed industries as a whole, and the continued demand for advice and assistance. The Research program per se is evolving on schedule and the transfer of responsibility for lipid research to the non-salmonid nutrition program (P242) should allow this group to concentrate on the improvements of diets and feeds for salmonids. The total number of papers and presentations completed in the last year is a significant improvement, but it should be noted that the stress on technical presentations reflects pressure from the industry for promptness in transferring technical information; primaries therefore tend to be tackled less promptly.

The program is making good use of opportunities for collaboration with other scientists and the industry. It's contribution to the field of salmonid nutrition cannot be matched.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 244

Section: Aquaculture

Project Title: Fish Disease Research

Project Leader: Olivier, G.

Other Researchers: Moore, A.; Fildes, J.; Daly, J.

Work Activity: W.A.1.1.2.1

Key Words: fish disease; diagnostics; immunology; aquaculture; salmon; BKD; furunculosis

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1. Project Description:

Using in-vitro and in-vivo techniques and the study of wild and cultivated stocks, investigate the bacteriological diseases of fish to determine their epidemiology and etiology, and conduct research leading to the development of eradication techniques and the development of vaccines.

2. Long-Term Objectives:

Develop a full understanding of the common and rare diseases of fish and methods of control to protect both wild and cultivated stocks.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Complete analysis and publish the comparative efficacy of various diagnostic methods to detect BKD. We will also challenge new fish to confirm our earlier findings that the Margaree stock of Atlantic salmon is more resistant to this disease. (Fildes)

Project partially completed, analysis of the different diagnostic techniques is finished and one paper has been submitted and accepted (see primary publication), a second paper has also been sent for publication. The challenge of additional fish from Margaree and Liscomb stocks is not yet done and is planned for the winter of 91/92.

2. Complete our experimental work on the role of A-layer and LPS in the phagocytosis of A. salmonicida strains by peritoneal macrophages of salmonids using non-cytotoxic strains of A. salmonicida. Prepare manuscript for primary publication. (Moore)

Partially completed. Experimental work is done, but statistical analysis is required before the manuscript can be completed.

3. Determine if antibodies and complement are able to opsonize (i.e. enhance) the phagocytosis of A. salmonicida by peritoneal macrophages of salmonids sing non-cytotoxic strains of A. salmonicida. (Olivier)

Project ongoing. The work with complement is complete, but additional assays with new anti-Aeromonas salmonicida sera are required.

4. Determine the Minimal Inhibitory Concentration (MIC) of 60 selected strains of A. salmonicida and correlate the MIC with zones of inhibition obtained by the disk-diffusion method. (Fildes)

Partially completed: the data needs to be analyzed and the manuscript prepared.

5. Investigate the effects of surface components (A-layer and LPS) on the complement system of salmonids using phenotypically characterized strains of A. salmonicida. (Olivier)

Project ongoing, results need to be analyzed before we can determine if additional experiments are required.

6. Determine if strains of the family Vibrionaceae (Vibrio sp., atypical A. salmonicida) are cytotoxic for salmonid macrophages. (Moore)

Project not done due to enhanced workload, see additional accomplishments.

7. Publish manuscript on: Effect of iron on susceptibility of Atlantic salmon to disease. (Olivier)

Insufficient data for manuscript preparation.

4. Additional Accomplishments:

As part of our current epidemiological study of furunculosis using bacteriophage typing, over 100 strains of A. salmonicida were received and the antibiogram and phage typing was carried out on all isolates. Designed an experiment to test the effectiveness of I_2 as a biocide in the labs quarantine facility.

5. Goals/Expected Outputs for 1992:

1. Using brook trout, determine the survival in vivo of cytotoxic and non-cytotoxic strains of the three phenotypes of A. salmonicida. (Fildes, Olivier)

2. Using live vaccines, we will investigate if protection against furunculosis in brook trout is correlated with survival of the vaccine strain in vivo. We will also determine antibody titers in immune fish to verify the role of humoral immunity in protection. (Fildes, Olivier)

3. Investigate the bactericidal activity of brook trout peritoneal macrophages against the various phenotypes of A. salmonicida by adapting the MTT bactericidal assay described by Graham et al. (1988) who were using rainbow trout kidney leukocytes. This assay will be used to investigate the role of cellular immunity in fish vaccinated with live vaccines. (Daly, Moore)

4. Continue and complete our experiments on the role of antibodies and complement on the phagocytosis of A. salmonicida by brook trout and Atlantic salmon peritoneal macrophages. (Moore, Olivier)

5. Investigate the BKD resistance of Atlantic salmon from Margaree. If time and tank space are available, we will repeat the experimental infection of these fish with BKD. (Olivier, Fildes, Daly)

6. Using the MTT assay described earlier, the killing capacity of Peritoneal and Kidney macrophages towards A. salmonicida phenotypes will be compared. (Moore, Daly)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

Dr. Carol Mackie, University of Glasgow, visited our laboratory for three weeks during which time she was able to induce the production of a gamma-interferon-like activity using our macrophage culture techniques and stimulation of the cells with the mitogen PHA.

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

Transfer of phage typing techniques to Diagnostic Unit - supervised contractor, D. Williams.

v. Other -

7. Publications:

i. Primary -

Griffiths, S.G., G. Olivier, J. Fildes and W.H. Lynch. 1991. Comparison of Western blot, direct fluorescent antibody and drop-plate culture methods for the detection of Renibacterium salmoninarum in Atlantic salmon (Salmo salar L.). Aquaculture 97:117-129

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Bacro, A., G. Olivier and J. O'Halloran. 1991. (Presentation). Preliminary studies on the transmission of bacterial diseases between cultured salmon and wild marine fish. 14th Regional Fish Health Workshop, Halifax, Nova Scotia, November 1991.

Mackie, C., A. R. Moore, G. Olivier and T. H. Birkbeck. 1991. (Poster) The effect of Phytohaemmaglutinin on Atlantic salmon (Salmo salar) peritoneal macrophages.14th Annual AFS/FHS Meeting, Newport, Oregon August 1991, p. 63.

MacKinnon, A. M., J. Cornick and G. Olivier. 1991. (Presentation). Atypical Aeromonas salmonicida in a wild population of eels (Anguilla rostrata). 14th Regional Fish Health Workshop, Halifax, Nova Scotia, November 1991.

Moore, A. R. and G. Olivier. 1991. (Presentation). The role of A-layer on phagocytosis of Aeromonas salmonicida. 14th Regional Fish Health Workshop, Halifax, Nova Scotia, November 1991.

Olivier, G. and A. R. Moore. 1991. (Abstract) The role of A-layer in the phagocytosis of Aeromonas salmonicida cells by salmonid macrophages. The Fifth Congress of the ISDCI (International Society of Developmental and Comparative Immunology), Portland, Oregon, August 1991, F10 p. S73.

Olivier, G., R. Claveau, J. O'Halloran, J. Fildes, B. Zwicker and J. Cornick. 1991. (Abstract) Multiple antibiotic resistance profiles of Aeromonas salmonicida in two hatcheries experiencing recurrent furunculosis outbreaks. Aquaculture Canada 91, St. Andrews, N.B. June 6-11, 1991.

Olivier, G. 1991. Survol des principales maladies bactériennes des salmonidés: bactériologie et immunologie. VIe Conférence annuelle en santé animale, Sherbrooke 8-9 mai. 1991 pp. 18-19

Olivier, G., R. Claveau, J. O'Halloran, J. Fildes, B. Zwicker and J. Cornick. 1991. (Abstract) Multiple antibiotic resistance profiles of Aeromonas salmonicida in two hatcheries experiencing recurrent furunculosis outbreaks. 14th Annual AFS/FHS Meeting, Newport, Oregon August 1991. Abstract p. 36.

Olivier, G. Research on bacteriology and immunology of fish at the Halifax Laboratory: a review. Dalhousie Seminar Series, Dalhousie University, Octobter 17th, 1991.

8. Review and Evaluation:

This investigation continues to perform at the cutting edge of fish disease and immunology research, and provide a needed consultation service to the Diagnostic Unit. The demand for information on diseases considerably exceeds the Research Unit's capacity to respond, and the addition of PDF, Dr. J. Daly enhances their capability, but at significant financial cost to the Unit , Section and Division. The Independent Review of Disease Research, conducted one year ago, clearly supported this program and suggested other areas where research was urgently required. Nevertheless, the A-base budget was not enhanced. The Division extended its O&M budget by funding a PDF and can do no more. Disease is an important but neglected discipline in DFO's overall research program. More attention is urgently required to permit the expected growth in aquaculture and to resolve problems with wild stocks.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 245

Section: Aquaculture

Project Title: Parasitology

Project Leader: Morrison, C.

Other Researchers: Marryatt, V., 6Leger, J. (summer student)

Work Activity: W.A.1.1.2.1

Key Words: fish disease; diagnostics; parasitology; aquaculture

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1. Project Description:

Histology, histopathology and parasitology of finfish and shellfish.

2. Long-Term Objectives:

Develop a series of histological atlases of cod; provide support to the diagnostic group; and conduct taxonomic studies of protozoan parasites in marine fish.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Complete and publish Cod Atlas, Part 4 - Larval Development. (Morrison)

Goal not met. Completion delayed because the larval studies more complex than anticipated, and the histology technician, V. Marryatt, retired. (Morrison, Marryatt, Leger)

2. Start Cod Atlas, Part 5 - Supportive Tissues (cartilage, bone, notochord, and muscle), and skin and scales. (Morrison)

Goal not met. See above and enhanced workload. (Morrison)

3. Process and examine cases from diagnostic unit as required. (Morrison)

Two cases from diagnostic unit and two of fish parasites from Dr. Gary McClelland were processed for histology. (Morrison, Marryatt, Leger)

4. Complete work on Goussia gadi in cod and haddock. (Morrison)

Goal not met. See 3.1 and enhanced workload. (Morrison)

4. Additional Accomplishments:

1. By researching the literature, companies, potential S.E.M. (scanning electron microscope) users in this laboratory and S.E.M. users in other laboratories, ordered the most suitable S.E.M. for Halifax Laboratory. (Morrison)

2. E.M. suite for T.E.M. (transmission electron microscope) and S.E.M. at Halifax Laboratory planned in conjunction with DPW, Facilities Management personnel and the Hitachi Company. Construction begun. (Morrison)

5. Goals/Expected Outputs for 1992:

1. Start Cod Atlas, Part 5 - Supportive Tissues (Cartilage, bone, notochord, and muscle), and skin and scales. (Morrison)

2. Complete work on Goussia gadi in cod and haddock. (Morrison)

3. Process cases from Diagnostic Unit and Dr. McClelland as required. (Morrison)

4. Start survey and study of ultrastructure of prokaryote organisms in bivalves. (McGladdery and Morrison)

5. Start study of life-cycle of Pleistophora hippoglossoideos in American plaice. (McClelland and Morrison)

6. Start collaborative SEM study with Mark Powell, Research associate at AVC, on defense mechanisms of trout gill. (Powell, Burka, Morrison)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

J. Neilson, Marine Fish Division, St. Andrews, N.B.

ii. University Liaison -

Member of committee for graduate student, Patrick Wells at Dalhousie University.

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

Morrison, C.M. 1991. Further observations on the sporogony of Eimeria sardinae in the testis of the herring, Clupea harengus L. Canadian Journal of Zoology. 69: 1017-1024.

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Morrison, C. 1991. The digestive tract of the cod eleutheroembryo ("yolk-sac larva") and larva. SCR Doc. 91/105, Serial No. N1997

Morrison, C. 1991. The reproductive stages of cod. Gross and anatomy and histology. SCR Doc. 91/106, Serial No. N1998.

Morrison, C. 1991. (Abstract) The ultrastructure of the microsporidian parasite Pleistophora hippoglossodeos in the American Plaice Hipoglossoides platessa. Fish Health Workshop, Halifax, Nova Scotia, November 1991.

8. Review and Evaluation:

The project has been reasonably successful, notwithstanding the delays to the production of the Cod Atlas, caused in part by its length, and in part by lack of technical assistance. Production and publication of the atlas itself will be a considerable drain on the Section's monetary resources, so the delay is not entirely unwelcome. Much attention has been given to the selection of a new Scanning Electron Microscope, and the design of a laboratory suite to house it and the older Transmission EM. The suite, when finished, will provide a valuable resource for other workers as well as for the histology program. The planned inclusion of new work on bivalves is a welcome augmentation to the scope of the program.

This is the only project with histological expertise in DFO in the Atlantic Zone and thus must be nurtured with sufficient funds to make good use of the skills and equipment available.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 246

Section: Aquaculture

Project Title: Molluscan Culture and Phytotoxin Research

Project Leader: Scarratt, D.

Other Researchers: Freeman, K.; Kean-Howie, J. (see P247); Bradford, B.

Work Activity: W.A.1.1.1.7; W.A.1.1.2.2

Key Words: domoic acid; aquaculture; mussels; oysters; scallops; phytotoxins; nutrition; molluscan culture

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1. Project Description:

Research into the physiology and ecology of invertebrates in support of the development of the aquaculture industry in the Scotia-Fundy Region. In collaboration with Inspection Branch, Habitat Ecology Division, and Physical and Chemical Oceanography, determine rates of uptake and depuration of marine toxins by commercial molluscs.

2. Long-Term Objectives:

Apply scientific knowledge and information to the development of an economically viable invertebrate culture industry in Scotia-Fundy. Describe the dynamics of toxin uptake and depuration by molluscs and develop protocols for depuration.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Technical report published on work carried out under contract with M. McInerery-Northcott. (Scarratt)

Goal not met. A bibliography and an incomplete outline of the discussion of this MS was received from the contractor in November 1990. Since then nothing further has been received and the matter has been referred back to DSS for failure of the contactor to complete the contractual obligations. DSS will attempt to persuade the contractor to complete the contract, or, if she remains non-cooperative, to recover all notes, written material, photocopies, samples, and drafts of reports relevant to the study. The hold-back would be forfeited. DSS may attempt to recover some of the principle.

2. Publish in the primary literature, work on domoic acid protocol development.

Goal not met (see Goal 11).

Goal not met. Collaborative paper (Scarratt, Freeman) with Gulf Region staff (Smith, Angus) awaits section on experimental Domoic acid budgets and chlorophyll measurements.

3. Publish two manuscripts on bay scallop studies.

Goal not met (see Goal 12). Preliminary results presented at Fish Health Workshop.

Goal not met. Data on growth of two year classes of bay scallops under laboratory conditions and at different sites around Nova Scotia are assembled and ready for analysis.

4. Complete construction of wet-laboratory facilities for molluscan culture and depuration research. Refurbish existing dry-labs. (Scarratt)

Goal not met. Wet-lab fully completed and operational with the exception of assembly of second ultra violet sterilisation unit, which is under construction. Dry labs re-allocated but not refurbished due to lack of funds.

5. Examine breeding of F1 generation of M. edulis/trossulus crosses, including seasonality of spawning of adults. (Freeman)

Goal not met. Animals held and fed in the laboratory failed to reach sexual maturity. Intense field sampling of both species for both condition and gametogenic indices conducted from spring to late fall; results partially analyzed. (with K. Perry, B.Sc. Honours student)

6. Publish manuscript on fecundity of M. edulis and the relationship of egg size to larval survival. (Freeman)

Goal not met. Some of the eggs used in this study are now believed to be from M. trossulus. A reassessment of data will be required before this manuscript can be completed.

7. Publish manuscript on distribution of M. edulis/trossulus in a single lease. (Freeman)

Goal not met. Manuscript extended to incorporate data from larval rearing experiments and is in internal review stage.

8. Preparation of manuscript on juvenile feeding, larval feeding, and proximate analysis of scallops. (Kean-Howie)

Transferred to P 247

9. Continue determination of optimal conditions for presentation of microparticulate diets to bivalve larvae and juveniles, in collaboration with R.K. O'Dor and D.J. Wildish. (see collaborative programs). (Kean-Howie)

Transferred to P 247

10. Measure digestibility of microparticulate diets in collaboration with Dr. C. Langdon, Oregon State U. (Kean Howie)

Transferred to P 247

11. Complete pilot scale experiments on the elimination of domoic acid from mussels and bay scallops and the preparation of protocols. (Scarratt)

Goal not met. Pilot scale depuration requires there to be a significant domoic acid outbreak since production of Nitzschia in ultra large volumes is not possible in laboratory conditions. One small scale run with mussels has been possible during a brief Nitzschia bloom at New London, PEI, but not with bay scallops since the bloom was too short. Outerbridge has submitted text of M.Sc. thesis from which a progress report can be prepared. (Outerbridge and Scarratt)

12. Attempt to develop protocols for breeding Perkinsus-free larvae of Argopecten irradians. (Scarratt)

Goal not met. Bay scallop eggs and infective parasite stages appear to be released synchronously. Surface disinfection may cause high larval mortality. Surviving scallops will be examined when fully mature.

13. Editing and publishing of two reports written under contract by C. Enright. (Scarratt)

Goal met. Both Manuscripts (Scallops, and European Oysters) are now in final draft and choice of figures is being finalised. Estimated completion date: late January.

14. Breed F2 generation of introduced bay scallops, Argopecten irradians, and introduce new scallops into quarantine from the U.S. to establish 3rd genetic line. Continue performance trials of existing strains. (Scarratt)

Project continued. F2 generation has been retrieved from the field (October 1991) and will be conditioned for spawning in early spring. (See also 3,2. above) Attempts to bring in a second breeding stock were deferred due to lack of time. (Bradford and Scarratt)

4. Additional Accomplishments:

1. Collaboration with Working Group on Introductions and Transfers of Fish and Shellfish to Prince Edward Island. Matrix developed to identify species, purpose of transfer, source of stock and appropriate control measures to minimize, disease, genetic, ecological and environmental threats. (Scarratt)

2. National Working Group on Development of Manual of Compliance for Shellfish Health Protection Regulations; Identifications of vulnerable species, diseases of concern, diagnostic protocols for lobsters, shrimps and crabs; first draft completed. (Scarratt)

3. Completed preparation of Sector Development plans for Mussels; Bay scallops; Alternate Species, for N.S. Aquaculture Co-ordinating committee. Assisted with drafting plan for European Oyster (with C. Enright)

5. Goals/Expected Outputs for 1992:

1. Complete and publish manuscript on Mytilus edulis and trossulus morphs. (Freeman et al)

2. Reevaluate and publish data on fecundity, egg size and larval viability of Mussels. (Freeman)

3. Evaluate fertility of M. edulis x trossulus hybrids, including gametogenic index and publish results. (Freeman, Perry)

4. Evaluate settling times of larvae of M. edulis and M. trossulus on a commercial lease where both species exist. (Freeman, Bradford) (Requires contract with S. Hancock for Mpi analysis)

5. Test protocols for depuration of domoic acid from naturally and artificially contaminated mussels, bay scallops and american oysters. (Scarratt)

6. Breed F3 generation of introduced bay scallops, Argopecten irradians, and continue performance trials of existing strains. (Scarratt, Bradford) Continue attempts to develop a Perkinsus-free strain.

6. Background:

Highlights:

Positive Highlights include the completion of the larval rearing and molluscan nutrition wet laboratories.

Negative Highlights (lowlights) centred on the overall failure of larvae to survive in laboratory conditions. This appears to have been a common problem in all East Coast hatcheries in 1991 and may be related to general water conditions rather than being a specific feature of this laboratory.

The failure of expected AFAP funding to be awarded to related integrated projects has set the edulis/trossulus study back a year.

Selected Involvements:

i. Collaborative Research -

Isoenzyme characterization of Maritime Mussel stocks, (AFAP proposal with Mallet Research Services). This study is partially complete and awaiting continuance of AFAP funding for completion.

ii. University Liaison -

Freeman with Drs. Zouros, Pogson and Ball, Dalhousie University. Assessment of mitochondrial DNA in within and between matings of Mytilus edulis and M. trossulus; first round of analyses on genome heritability is almost complete.

Freeman, committee member and supervisor for Katharine Perry, Honours student, Mt. Allison University, Sackville N.B. on spawning of mussel species, viability and growth of crosses, seasonality of maturity and spawning. For completion 1992.

Scarratt, committee member and supervisor for Renata Outerbridge, Masters student at Dalhousie University, uptake and elimination of domoic acid. For completion December 1991.

iii. Communications -

The Occurrence of Mytilus edulis and M. trossulus in the Canadian Maritime Provinces and the Implications for the Mussel Culture Industry, by K. Freeman, A. Mallet, C. Carver, S. Hancock and D. Scarratt. Presented by D. Scarratt at European Aquaculture Conference, Dublin. June 1991.

Aquatic Toxicology - The Wider Implications of Eastern Canadian Shellfish Toxins, by D.J. Scarratt. Presented at the Aquatic Toxicology Workshop, Ottawa, October, 1991.

A laser diffraction technique for measuring shell growth of Blue Mussels: A potential bioassay application, by K. Freeman and H. Sushko. Presented by K. Freeman at the Aquaculture Workshop, Dalhousie University, July 1991.

Reproductive aspects of Mytilus edulis and M. trossulus from a Nova Scotia mussel farm, by K. Freeman. K. Perry and B. Bradford. Presented by K. Perry at the 14th Regional Fish Health Workshop, Halifax, November, 1991.

Dynamics of Perkinsus karlssoni, (Apicomplexa) in Bay Scallops (Argopecten irradians) imported from Cape Cod, Mass. and held in quarantine, by S. MacGladdery, B. Bradford, R. Outerbridge and D.J. Scarratt. Presented by B. Bradford at 14th Regional Fish Health Workshop, Halifax, November, 1991.

iv. Contracts Administered -

With South West Nova Aquaculture Association: Production of Proceedings of Workshop on Integrating Aquaculture with Traditional Fisheries. (Bradford and Scarratt) AFAP funding.

With Mallet Research Services: Identification of M. edulis and M. trossulus populations in Atlantic Canada. (Freeman and Scarratt) AFAP funding.

With Corlan Research (Dr. G. Jones): Pathology of Mussels and Bay Scallops exposed to domoic acid. Two manuscripts complete, diagrams and figures nearing completion, estimated completion date for manuscript: Dec 1991. (Scarratt)

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Sushko, H and K. R. Freeman. 1991. The Use of laser diffraction in measuring the effect of suspended sediment on the shell growth of mussels Mytilus edulis. Can.

Manuscr. Rep. Fish. Aquat. Sci. No. 2121: 28 p.

iv. Popular and Miscellaneous -

"...from the lab" by D.J. Scarratt. Newspaper column on aquaculture related matters published monthly in Atlantic Fish Farmer:

January	The need for Shellfish Health Protection Regulations.
February	The Value of Aquaculture Training Courses.
March	Vaccination Experiment runs into Medicated Feeding Snag.
April	Communications in Aquaculture
May	Retirements, and the Newfoundland Aquaculture Workshop
June	The 1991 European Aquaculture Conference, Dublin
July	Shellfish Culture in Ireland
August and	Further outbreaks of DSP in Nova Scotia Aquaculture and the Environment
September	Oyster Culture in Australia
October	Announcing the Fish Health Workshop
November	Review of the 1991 Regional Fish Health Workshop

8. Review and Evaluation:

This project has a large number of incomplete tasks, which does not bode well, given a possible major personnel change in the offing. It is most important that this project take seriously it's scientific writing commitments. A plan will be put in place to relieve the project leader of certain responsibilities, to permit the placing of emphasis on scientific writing. Considerable effort has been expended on ancillary tasks such as working group introduction, manuals of compliance, sector development plans, etc. Time spent on these have prevented the completion of goal set under the projects long term objectives.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 247

Section: Aquaculture

Project Title: Molluscan Nutrition

Project Leader: Kean-Howie, J.

Other Researchers: Bradford, B.

Work Activity: W.A.1.1.2.2

Key Words: bivalve; shellfish; microparticle; synthetic diets; nutrition; ecophysiology

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1. Project Description:

Investigate the nutritional requirements of bivalve molluscs in relation to their ecophysiology and life history with a view to development of a successful nutrition protocol for bivalve hatcheries.

2. Long-Term Objectives:

Plan and implement a molluscan nutrition research program; determine specific nutrient requirements of bivalve molluscs; monitor and evaluate the information needs of shellfish producers with respect to nutrition physiology; develop and test new research tools, especially synthetic diets and measure indices of response to these tools; determine suitable protocol for experiments with synthetic diets; evaluate existing and develop new analytical techniques for biochemical analyses.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Preparation of manuscript on juvenile feeding, larval feeding, and proximate analysis of scallops.

Project incomplete. Data acquisition complete, analysis and MS started.

2. Continue determination of optimal conditions for presentation of microparticulate diets to bivalve larvae and juveniles, in collaboration with R.K. O'Dor and M.A. Silva (see collaborative programs).

A molluscan nutrition wet lab facility has been constructed to a design based on information acquired during experiments conducted at Dalhousie and Oregon State Universities. Two feeding experiments have been completed with giant scallop (Placopecten magellanicus) larvae and data reduction is in progress.

3. Measure digestibility of microparticulate diets in collaboration with Dr. C. Langdon., Oregon State U.

Preliminary results indicate procion dyes can be used successfully in determining digestibility of synthetics diets by bivalve larvae.

4. Additional Accomplishments:

1. Completed measurements on larvae of Manilla clams and Pacific oysters from experiments conducted in Oregon. Presented seminar on these data to Halifax lab personnel.

2. Collected field samples for proximate analysis of juvenile sea scallops (with M. Dadswell).

3. Completed course in Priority Management.

5. Goals/Expected Outputs for 1992:

1. Completion and successful defence of dissertation by March 31. (Kean-Howie)

2. Complete the preparation of manuscripts based on PhD thesis. (Kean-Howie)

a) Feeding trials with juvenile bay scallops and sea scallops using microparticulate diets.
b) Changes in proximate composition of juvenile sea scallops over their first two years.

3. Review and evaluate the requirements of bivalve culture operation with respect to nutrition management and practises. (Kean-Howie)

4. Plan and conduct experiments on food presentation protocol for larval studies, specifically the use of shakers to retain diets in suspension. (Kean-Howie)

6. Background:

Highlights:

Rigorous examination of the nutrient requirements of bivalve molluscs can be accomplished only through the use of microparticulate diets. The Biocogent bivalve diet has been accepted and digested by larvae of manilla clams and Pacific oysters. Construction of a wet lab facility suitably equipped for controlled nutrition experiments has permitted successful experimentation with scallop larvae at the Halifax lab.

Selected Involvements:

i. Collaborative Research -

1. Dr. R.K. O'Dor and A. Silva, Dalhousie University; larval feeding studies.

2. Dr. C. Langdon, Oregon State; procion dye.

3. Dr. M Goldstein, Biocogent, Long Island; production of microparticulate diets.

4. Dr. R.G. Ackman, TUNS; lipid analysis.

5. Dr. M. Dadswell, Acadia University; field program.

ii. University Liaison -

iii. Communications -

Attended and assisted with registration for meeting sponsored by APICS Aquaculture Committee;

Organized meeting for Canadian delegates attending the National Shellfisheries Association annual meeting (denied permission to attend);

Chaired session on Bivalve Culture during annual Fish Health Workshop.

iv. Contracts Administered -

Nancy Irwin; with project leader: successful completion of hundreds of biochemical analysis of field and laboratory specimens.

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Kean-Howie, J.C.; D.J. Scarratt, R.K. O'Dor. (in press) The Evolution of Feeding Strategies Throughout the Life History of Bivalves with Emphasis on Ontogeny and Phylogeny. ICES Publication. Rapport et Proces-Verbaux.

iv. Popular and Miscellaneous -

Harrison K.E. and J.C. Kean Howie. 1991. Study Guide on Crustacean Reproduction for Aquaculture Graduate Program, Deakin University; Australia.

8. Review and Evaluation:

The completion of the major task within this project is now one year past the date set by the project leader. Poor health, technical limitations within the building, and limited access to technical assistance have adversely impacted the study. It is most important that the study be brought to fruition as soon as possible (the project leader has set March 31, 1992 as completion date). We look forward to the project beginning a new thrust following a carefully planned, long term research proposal which will take advantage of the new wet lab facility now in place.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Benthic Fisheries and Aquaculture Project No.: 248

Section: Aquaculture

Project Title: Fish Health Services Unit

Project Leader: Cornick, J.

Other Researchers: Zwicker, B. (to June 91); McMenemy, M.; MacKinnon, A-M. (contract to Aug 91, then indeterminate September 91); Williams, D. (contract)

Work Activity: W.A.1.1.2.1

Key Words: diagnostics; fish health; fish disease; furunculosis; BKD; aquaculture; salmon

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1. Project Description:

This project 1) provides diagnostic service, formulates and administers quarantines, and regulates movements of salmonids and their products under FHPR; 2) provides diagnostics and implements Regional Fish Health Guidelines for intra-provincial salmonid movements; 3) is responsible for fish health matters related to federal fish culture systems; 4) investigates disease aspects of fish kills in the wild; 5) provides diagnostic and counselling service to government agencies and the aquaculture industry with respect to both finfish and shellfish; 6) assists in the transfer of technology in fish disease diagnosis by providing informal training as well as workshops and seminars with the industry; and 7) develops, in cooperation with industry, disease control programs to eliminate specific health problems.

2. Long-Term Objectives:

To: 1) prevent introduction of foreign disease agents into the Maritime provinces; 2) control the spread of the diseases such as Furunculosis, ERM and BKD between watersheds within provinces; 3) prevent or minimize the impact of disease on hatchery-reared fish and provide counselling service; 4) pinpoint the effects of disease agents in fish kills in the wild; 5) minimize the effects of disease and provide counselling on fish health matters to the aquaculture industry; 6) strengthen private sector disease control capability through technology transfer; 7) reduce economic losses related to specific health problems; and 8) study the distribution of fish diseases throughout the Maritime provinces.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Administer FHPR, in Nova Scotia and New Brunswick in order to prevent introduction and transfer of disease agents into and between provinces. Provide advice on changes to the FHPR including Manual of Compliance. (Cornick)

Project completed satisfactorily. 32 Import Permits (authority as Local Fish Health Officer) issued and 61 inspections (authority as Fish Health Official) completed. M.I. Campbell (Gulf Region) collected samples and assisted in lab for Gulf Region cases. No foreign disease agents detected despite considerable movement of salmonid fish and eggs into and between provinces. Input to revision in the FHPR initially to the Technical Committee and again during discussion on revision at the Local Fish Health Officers Meeting in Halifax. Agreement in principle on adoption of zoning concept for administration of FHPR. Involvement in design of standardized FHPR Import Permit.

2. Administer Regional Fish Health Policy to control intra-provincial movement of furunculosis ERM and BKD and continue the revision of existing guidelines toward making the Policy a Regulation. (Cornick)

Successful completion of diagnostics in support of 155 intraprovincial, interwatershed transfers under this program with no disease outbreaks recorded. Existing guidelines under review for promulgation as a regulation in 1992.

3. As appointed U.S. Title 50 certifying Official, provide certification for fish transfers into the U.S. (Cornick)

A total of 56 U.S. Title 50 permits were issued to Maritime salmon and trout growers.

4. Provide diagnostic and counselling service to federal hatcheries in the Scotia-Fundy Region. (Cornick, MacKinnon, McMenemy)

No major disease outbreaks were recorded. No furunculosis was detected at Mactaquac FCS during the monitor program this year. Swim bladder fungal infection appeared periodically at low prevalence and with low loss. Stocks from all hatcheries were examined and passed under the Regional Fish health Policy for stocking intraprovincially.

5. Investigate disease as a cause of wild fish kills. (Cornick, MacKinnon, McMenemy)

22 lots of various species examined in 1991 and reports filed. No significant infectious disease associated with any kill.

6. Provide diagnostic and counselling service to other government agencies and private aquaculturists, as resources permit. Encourage and strengthen private sector capability to detect and control disease by providing advice and counsel and referring appropriate cases to private diagnosticians. (Cornick, MacKinnon, McMenemy)

Demand for services at same level as last year. Although specific demand for FHPR certification increased (mostly FHPR III [meat fish]) this is expected to be reduced in the coming year for FHPR III inspections dropped. All cases accepted were effectively handled. Typical furunculosis was diagnosed in Atlantic salmon at 3 marine cage sites in Bay of Fundy in New Brunswick. Mortality was low and effectively controlled by drugs. Atypical furunculosis was identified in association with skin lesions and mortality in a population of wild eels in Bras D'or Lake. Work continuing on this problem. Bacterial kidney disease, identified in 3 marine cage sites and 3 freshwater hatcheries in N.B., was effectively controlled. Attempts to withdraw services covered by private sector diagnosticians continues. More control over cases accepted was exercised, resulting in more referrals. Diagnostic information exchange is still a problem, but this will improve with the adoption of revised FHPR.

7. Conduct surveys on private fish culture facilities and wild populations, in order to establish a disease profile for the Maritime Provinces. (Cornick, MacKinnon, McMenemy)

Incomplete. Had anticipated initiating this as FHPR III schedule inspection demands decreased. However, this did not materialise so survey work was not note.

8. Cooperate with N.B. Department of Fisheries in the control of vertical transmission of BKD in N.B., by advising on the conduct of the brood stock screening program. Continue the Carrier testing program for Furunculosis for both private and Government sector facilities. (Cornick MacKinnon, McMenemy)

We had more consultation with N.B. Dept of Fisheries and Aquaculture this year re broodstock BKD monitoring program, in an attempt to reduce spread of BKD. In spite of this, BKD was again a particular problem last year with outbreaks occurring at one major smolt producer and 3 marine cage sites. The situation is now under review with NBFA. We participated, with good results, in meetings of the N.B. Disease Advisory Control Committee to address the immediate problem. With Dr. Olivier assisted Sea Farm Canada Inc. in evaluation of their BKD broodstock monitor programme.

9. Develop protocols for examination of shellfish to minimize transfer of disease in native and introduced species. (Cornick, MacKinnon, McMenemy)

In collaboration with S. McGladdery of Gulf Region, examined 13 lots of shellfish to determine disease status. As part of a National Exercise, contributed to an ongoing review of shellfish diseases and diagnostics to determine basis for new regulations.

10. Provide Diagnostic services as required for DFO, Gulf Region. (Cornick, MacKinnon, McMenemy)

Under a memorandum of understanding, 154 cases were referred to FHDU and satisfactorily completed. An annual report of work conducted in 1990-91 submitted. Work load increased by 10%.

11. Provide other services as required. (Cornick, MacKinnon, McMenemy)

Other services have included certification (FHPR II) of one facility for Newfoundland Region and diagnostics (with Dr. Olivier) for one culture facility in Québec Region experiencing severe furunculosis.

In addition, contributed to review of 12 proposals for introduction transfers of various finfish and shellfish stock under the Introduction and Transfer Committee.

4. Additional Accomplishments:

1. Two experimental transfers, under Section 4, permits for salmon parr movements from Québec and N.B. into N.S., were organized, evaluated, and associated diagnostics completed.

2. Two other experimental transfers of salmon smolts from N.B. to N.S. were organized, isolation facilities inspected and broodstock monitored.

3. Contributed to review of 12 proposals for introduction and/or transfer of various finfish and shellfish stocks under authority of S-F Region Introduction and Transfers Committee.

4. Provided, on job diagnostic training for one veterinary medical student for course requirement.

5. Phage typing technology successfully transferred from research to routine diagnostic use by Fish Health Unit. (D. Williams under contract)

5. Goals/Expected Outputs for 1992:

1. Administer FHPR, in N.S. and N.B. in order to prevent introduction and transfer of disease agents into and between provinces. Provide advice on revisions to the FHPR including Manual of Compliance. (Cornick)

2. Administer Regional Fish Health Policy to control intra-provincial movement of furunculosis, ERM and BKD and continue the revision of existing guidelines toward making the Policy a Regulation. (Cornick)

3. As appointed U.S. Title 50 Certifying Official, provide permits for fish transfers into the U.S.A. (Cornick)

4. Review proposals and make recommendations based on disease considerations for finfish/shellfish introductions and/or transfers under authority of Introduction and Transfer Committee and supervise associated quarantines. (Cornick)

5. Provide diagnostic and counselling service to federal hatcheries in the S-F Region. (Cornick, MacKinnon, McMenemy)

6. Investigate disease as a cause of wild fish kills. (Cornick, MacKinnon, McMenemy)

7. Provide diagnostic and counselling service to other government agencies and private aquaculturists, as resources permit. Encourage and strengthen private sector capability to detect and control disease by providing advice and counsel and referring appropriate cases to private diagnosticians. (Cornick, MacKinnon, McMenemy)

8. Conduct surveys on private fish culture facilities and in the wild, in order to establish a disease profile for the Maritime Provinces. Reallocate resources formerly assigned to FHPR III certifications to this function. (Cornick, MacKinnon, McMenemy)

9. Cooperate with N.B. Department of Fisheries and Aquaculture and N.S. Dept. of Fisheries in the control of vertical transmission of BKD in N.B., by advising on the conduct of the brood stock screening programs. Continue the Carrier testing program for Furunculosis for both private and government sector facilities in N.B., but gradually phase out involvement as NBFA capability comes on line. (Cornick, MacKinnon, McMenemy)

10. Develop protocols for examination of shellfish to minimize transfer of disease in native and introduced species. (Cornick, MacKinnon, McMenemy)

11. Provide Diagnostic services as required for DFO, Gulf Region. (Cornick, MacKinnon, McMenemy)

12. Provide other services as required. (Cornick, MacKinnon, McMenemy)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

N.B. Fisheries and Aquaculture staff - BKD and furunculosis control programs in N.B. (Cornick, Zwicker, MacKinnon)

N.B. Fisheries and Aquaculture staff - Investigation of vibriosis outbreaks in Bay of Fundy. (Zwicker/MacKinnon)

Dr. Olivier (BFAD Project 244). Characterization of Aeromonas salmonicida isolates to strain by phage typing; transfer to routine use in FHU completed (Cornick, Zwicker, Williams) and investigation of atypical furunculosis in wild eel population in Bras D'Or Lakes, N.S. (MacKinnon and Cornick).

Gulf Region: Provision of diagnostic services and collaboration on shellfish health inspections with Gulf Region Staff (Cornick, Zwicker, MacKinnon, McMenemy).

ii. University Liaison -

iii. Communications -

Fish Health Disease Diagnosis and Control (Cornick, Zwicker) lecture to N.S. Community College Course on The Business of Aquatic Farming, Shelburne, N.S., Jan. 1991.

iv. Contracts Administered -

Sea Farm Canada Joint Venture Agreement - Disease diagnostics including BKD broodstock monitor. (Williams, July-Dec/91)

v. Other -

Co-chair (Cornick) with G. Olivier. Technical Session on Diseases Aquaculture Assoc. of Canada 8th Annual Meeting, St. Andrews, N.B., June 1991.

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Cornick, J.W. and G. Olivier. 1991. Fish Health in Aquaculture in Science Review 1988 and 1989, pp. 44-47, 1991.

Cornick, J.W., A.M. MacKinnon, and M.M. McMenemy. 1991. (Abstract). Current Status of Important Diseases Affecting Finfish Culture in the Maritime Provinces. DFO Scotia-Fundy Region 14th Regional Fish Health Workshop, November 1991.

MacKinnon, A.M., J.W. Cornick, and G. Olivier. 1991. (Abstract). Atypical Aeromonas salmonicida in a wild American eel Anquilla rostrata population. DFO Scotia-Fundy Region 14th Regional Fish Health Workshop, November 1991.

Cornick, J.W. .1991. (Abstract). DFO programs aimed at preventing disease transfer through broodstock. Atlantic Salmon Federation, Workshop on Broodstock Development, St. Andrews, N.B., Feb. 27, 1991.

8. Review and Evaluation:

The Fish Health Unit continues to provide a first-class diagnostic program, and a service to clients that has become the ne plus ultra, in Atlantic Canada. The transfer of duties from outgoing to incoming laboratory supervisor was accomplished without loss of efficiency or accuracy.

The value of the program is reflected by the offer from Sea Farm Canada, to fund a contractor to work under FHU direction on certain Sea Farm requests, with surplus time available for routine work. Without this financial and human input, and labour provided by students and trainees, the core program could not be completed, nor could some of the work be done due to lack of critical mass in the laboratory. The program is thus under-funded and understaffed. Its success is due largely to the dedication, skill and loyalty of the staff.

FRESHWATER AND ANADROMOUS DIVISION

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous Project No.: 300

Section: Administration

Project Title: Division Administration

Project Leader: Ritter, J.

Other Researchers:

Work Activity: W.A.1.1.1

Key Words: research direction, Division administration

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1. Project Description:

This program manages the overall scientific and administrative operation of the Division by providing: (a) professional level advice and direction to Section needs; (b) administrative support to all staff; and (c) executive level contact with clients, the general public, and other government divisions and branches (federal, provincial, international).

2. Long-Term Objectives:

The continuing objective of this project is to direct the activities of the FW&A Division to effectively meet the requirements of the Division's mandate.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Ensure that the Division's mandate and the requests from the Science Directorate in FY 1991/92 are carried out and met in the most effective manner. (Ritter)

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous

Project No.: 301

Section: Stock Assessment and Enhancement

Project Title: Salmon Assessment Research

Project Leader: Marshall, T.

Other Researchers: Amiro, P.; Cutting, R.; Jessop, B.; O'Neil, S.; Ritter, J.

Work Activity: W.A.1.1.1.1

Key Words: salmon; assessments; assessment research

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1. Project Description:

Enumeration and monitoring of adult and juvenile stocks and Atlantic salmon harvest, preparation of required stock assessment documents, research into methodologies for improvement and expansion of salmon stock assessments, and provision of regional input to Canadian input on international matters involving Atlantic salmon.

2. Long-Term Objectives:

The Departmental legislated mandate includes the responsibility for managing anadromous fish resources according to current, sound scientific information. The long-term objectives of the project are to develop required data bases, conduct pertinent studies and analyses, and prepare biological advice and recommendations on a timely basis for internal and external clients having interests in the valuable Atlantic salmon resources.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Prepare required assessments of Atlantic salmon stocks to define stock status, such as Saint John, St. Croix, LaHave, Stewiacke, Liscomb, St. Mary's, Grand and Middle and inner Fundy rivers and, where possible, forecast future returns. (Marshall, Amiro, Cutting, Jessop)

Stock assessment for the upper Saint John River was vetted at ACFF Subcommittee, CAFSAC, and will be upgraded to Research Document. Also vetted were conservation levels and preliminary estimates of future surpluses for the Grand, Baddeck, Middle, North (Victoria Co), St. Mary's, Liscomb, East and West rivers Sheet Harbour, Musquodoboit, Gold, LaHave, Medway, Mersey, Tusket, Shubenacadie, Stewiacke, Big Salmon and Nashwaak rivers. Background material to the above advice contributed to an assessment of regional stock status by Salmon Fishing Area (below). Retirement and non-replacement of the last two technicians involved with conductance of field surveys and ageing of salmon (over 65 years combined experience) on the Saint John River reduced available effort for all assessment activities.

2. Prepare timely biological advice and recommendations for internal and external clients and service, particularly the biological information needs of, the Zone Management Advisory Committees. Involve external clients where feasible and desirable in the collection of biological data. (Marshall, Amiro, Cutting, O'Neil, Jessop, Ritter)

Prepared stock status report (item 3.1 above) of all SFA's of the region for vetting at CAFSAC and upgraded same to Research Document. Participated in and provided regional CAFSAC and other advice to five zone management committees, area managers and Canada-U.S. boundary water committees and interest groups (St. Croix, the Aroostook and Saint John above Grand Falls), based on counts of salmon by divers, electrofishing of juveniles and adults, counts, age and origin of salmon at fishways and estimates of sport catch. Provided numerous in-season forecasts of end-of-season projected counts at Mactaquac, and advised managers during various salmon allocation negotiations for native food fisheries. Advised and cooperated with numerous sport fishing associations, Indian Bands, corporations/commissions in the execution of various assessment-related projects, e.g., external clients i) operated adult counting facilities in fishways at Beechwood on the main Saint John River, Milltown, Woodland and Grand Falls on the St. Croix River and at the Moncton-Riverview causeway on the Petitcodiac River; ii) were directed in the conducting of biological surveys on the Sackville, Shubenacadie, Big Salmon and St. Mary's (see 3.11) rivers and Eskasoni Brook and creel surveys on the Kennebecasis and main Saint John rivers and iii) assisted in the salmon tracking study (see 3.9). Reduced technical assistance reduced effective deployment of resources.

3. Develop and/or improve pre- and in-season forecast models. (Marshall, Amiro, Cutting)

Investigated the utility of two- and three-variable non-parametric and parametric models to forecast respective 1SW and MSW salmon returns destined for Mactaquac, Saint John River (see 7.iii); and utilized both models for 1992 pre-season forecasts of returns to the Saint John River. Utilized an 18 year data base of cumulative weekly counts and mean monthly river discharges to provide managers with in-season advice (late July through August) on season-end count projections at Mactaquac.

4. Develop models of recreational catch that would enable use of catch as an indicator of stock strength. (O'Neil, Cutting, Jessop, Ritter).

Initiated exploratory analysis but had inadequate resources to provide meaningful output.

5. Participate in initiatives to examine distant interception of Scotia-Fundy Region stocks; formulate and test hypotheses and propose data collections (e.g., indices of change in marine environment, marine growth, sex ratio of smolts) to explain MSW changes in mainland stocks. (Marshall, Ritter, Cutting)

Investigated the error rate in the external sexing of wild and hatchery summer-run grilse to Mactaquac. This should contribute to the reevaluation of sex data submitted to the recently developed MSW predictor model which implicated mean length, mean smolt age and sex ratios of 1SW fish in the subsequent return of MSW salmon. Mean length was the only significant (<0.05) variable and supported the hypothesis that marine conditions which contribute to exceptional growth result in more 1SW and fewer MSW returns. The hypothesis would infer, however, that crossover from potential maturation after two winters at sea to maturation after one winter at sea should result in a significant increase in the proportion of females among 1SW returns. Captured and micro-tagged 1,200 wild smolts (4,000 in 1990) in the Beechwood forebays for the study of survival and distant exploitation of wild (as opposed to hatchery) salmon. None of the 1990 tags from Beechwood were returned from commercial sampling programs in distant waters or were among CWTs extracted from 1SW fish at Mactaquac in 1991.

6. Publish the model for determining salmon production capacity of rivers through use of information derived from remote sensing, and complete, if possible, survey information data base for N.B. rivers. Conduct study on parr density and age-at-smoltification, as resources permit. (Amiro)

Submission of the model for publication was preempted by involvement in the ESSA project (see 3.7) and preparation and presentation of a paper dealing with accuracy and precision of juvenile Atlantic salmon population estimates (see 4.2). Technical assistance was inadequate to complete the remote-sensed data base for New Brunswick rivers. Counts of smolts and estimation of their age on Little River (Stewiacke) will be used to complement ongoing studies of density-dependent growth of parr and subsequent age-at-smoltification.

7. Participate in the modelling exercise to assess the effects of acid rain on the production of N.S. salmon stocks. (See Acid Rain Research project for details). (Amiro, Cutting, Marshall)

Contributed a significant data base and analyses on biological parameters to the contract with ESSA (Environmental and Social Systems Analysts Ltd.) to model the effects of acidification on Atlantic salmon. Attempted to enumerate smolt output and measure juvenile densities from the acid-impacted LaHave River for model verification.

8. Set-up image processing system for analyzing scale patterns. (O'Neil, Amiro)

System in place; technical assistance inadequate to initiate projects.

9. Plan, coordinate and conduct the continuing cooperative sonic tagging project for studying adult Atlantic salmon movements and behaviour on the Saint John River. (Marshall)

Multi-sponsored project (item 6i; responsibilities largely carried out by DFO and NB Power) successfully concluded its second and final field season. Data from 1990 and 1991 have been tabulated and verified; exploratory analyses of the 1990 data were provided in a draft preliminary report and a poster on equipment and methodologies was presented at a conference in Aberdeen (see 4.1). Analysis and write-up of the two year study require person resources beyond those committed by DFO or co-sponsors. Observations and preliminary results from ultrasonic tagged fish at and in the vicinity of Beechwood were adequate to convince NB Power to initiate, in 1992, the first phase ($200'K) of a DFO plan to upgrade fish passage at Beechwood Dam.

10. Plan and implement, pending availability of funds, investigations to determine the cause(s) for recruitment failure common to inner Bay of Fundy stocks in four of the past five years. (Amiro)

Held vaccinated and unvaccinated groups of hatchery smolts from the Stewiacke, Moser and Big Salmon river smolts in salt water in a laboratory to ascertain their vulnerability to Vibrio - a bacteria ubiquitous to the Bay of Fundy - Scotia Shelf and hypothesized as a possible factor impacting survival of inner Fundy salmon stocks. Released tagged vaccinated and unvaccinated smolts to the Big Salmon, Petitcodiac, and Stewiacke rivers; provided background material on the possible 'problems' in inner-Fundy to a Steering Committee comprised of private, DFO science and management personnel for the development of broad-ranging investigative strategies.

11. Direct biological investigations carried out under the pilot 'river-specific management' project for the St. Mary's River. (Jessop, Cutting)

Developed, in participation with the St. Mary's River Working Group, a field project for 1991 and coordinated its implementation by H. Kerr, the project biologist hired by the St. Mary's River Association. Less was achieved than was planned for the juvenile electrofishing and angler survey project segments because of the adverse water levels at critical times. A summary of project activities is being prepared by H. Kerr.

12. Develop and prepare required regional input for special CAFSAC investigations, for Canada's input to ICES and for Canada's input to NASCO. (Marshall, Ritter)

As the regional delegates to the ICES Study Group on North American Salmon Fisheries and Working Group on North Atlantic Salmon, described events of the 1991 fisheries in Scotia-Fundy Region and Canada; assisted the Canadian delegation in the development of run reconstruction models of Canadian stocks for input to a North Atlantic (global) model; assisted in the evaluation of the effects of the 1991 quotas in the commercial salmon fishery of Newfoundland and Labrador and provided a Canadian compilation of microtag, finclip and external tag releases. Reviewed U.S. models of Canadian

interception of U.S. stocks, Greenland interception of Canadian stocks and new approaches to assessing interception in distant waters and advised CAFSAC and ICES as appropriate. Lack of any technical assistance reduced overall input.

13. Provide consultation and direction on the choice and use of salmon stocks and on the distribution programs for adult and all stages of juvenile salmon. (Marshall, Amiro, Cutting, Jessop)

Provided advice and directions to the fish culture program involving collection of some 23 salmon broodstocks (personnel and equipment directly involved in some 12 collections), redeployment of 12,000 Saint John adult salmon, and distribution of over two million juvenile salmon, some of which originated in private hatcheries. Released 53,000 micro-tagged hatchery smolts at seven locations in the upper Saint John in the third and last year of a study to assess variable survival and potential for development of areas from which downstream migrants would have to pass through/over hydroelectric facilities.

14. Continue preparation of individual river management plans, to the extent time permits. (Marshall, Cutting, Amiro, Jessop, Ritter)

Provided input to the St. Mary's River Steering Committee and redeveloped with public interest groups, U.S. agencies, provincial government representatives and within DFO, an interim strategy for conservation, enhancement (inc. numbers of adults to be trucked from Mactaquac to the Aroostook and above Grand Falls) for the Saint John River salmon resource above Mactaquac Dam. Advised on closure of inner Fundy rivers to recreational fishing until spawning escapement levels in the Big Salmon River meet conservation requirements.

4. Additional Accomplishments:

1. Marshall promoted the participation of technician J. Cameron (on loan to salmon tracking project) in the 4th European International Conference on Wildlife Telemetry in Aberdeen, Scotland, and assisted in his preparation of a poster "Application of acoustic underwater telemetry to a large high flow river system". He advised the A/DG, and Fredericton area MP, Bud Bird, on the in-season status of Saint John River stocks and assisted in their responses to anglers at a "fed bashing" organized and staged by the NB Salmon Council in the Renous, N.B., arena.

2. Amiro presented a paper entitled "Accuracy and precision of juvenile Atlantic salmon population estimates derived from electrofishing densities using design, model and non-parametric statistical techniques" at the International Symposium on the Production of Juvenile Atlantic Salmon in Natural Waters. He also prepared an article entitled "Inner Bay of Fundy Atlantic salmon stocks - a troubled resource?" for the winter Newsletter of the Nova Scotia Salmon Association. He is the Chairman of the Local Arrangements Committee for the 1994 annual meeting of the American Fisheries Society in Halifax.

3. Cutting supervised the section's presentation before an internal assessment technique review committee comprised of scientists from CAFSAC, Pacific, Capitol and Scotia-Fundy regions of DFO.

4. Ritter prepared and presented a paper on the "Management of the Atlantic Salmon Resource of Saint John River, New Brunswick" at a symposium of the American Fisheries Society in Rhode Island. He is the Science representative on the Canada-U.S. Steering Committee for the development and management of the fish resources of the St. Croix River.

5. Goals/Expected Outputs for 1992:

1. Prepare required assessments of Atlantic salmon stocks to define stock status, such as Saint John, St. Croix, LaHave, Stewiacke, Liscomb, St. Mary's, Grand, Middle and inner Fundy rivers and, where possible, forecast future returns. (Marshall, Amiro, Cutting, Jessop)

2. Prepare timely biological advice and recommendations for internal and external clients and service, particularly, the biological information needs of the Zone Management Advisory Committees. Involve external clients where feasible and desirable in the collection of biological data. (Marshall, Amiro, Cutting, Jessop, O'Neil, Ritter)

3. Continue the investigation of pre- and in-season forecast models, as resources permit. (Marshall, Harvie, Amiro, Ritter)

4. Investigate stock-recruit relationships on acid-impacted rivers (LaHave, Liscomb) and non-acid-impacted rivers (Saint John and Big Salmon) to ascertain optimal spawning requirements. (Marshall, Amiro, Cutting)

5. Investigate models that would enable use of recreational catch as an indicator of stock strength. (O'Neil, Jessop, Amiro, Ritter, Marshall)

6. Participate, as resources permit, in initiatives to examine distant interception of Scotia-Fundy Region stocks; formulate and test hypotheses and propose data collections (e.g., indices of change in marine environment, marine growth, sex ratio of smolts) to explain MSW changes in mainland stocks. (Marshall, Ritter, Cutting)

7. Publish the model for determining salmon production capacity of rivers through use of information derived from remote sensing, and complete, if possible, survey information data base for New Brunswick rivers. Investigate and advise on utility of ESSA model to assess current and potential capacity of the regions rivers to produce salmon. Conduct study on parr density and age-at-smoltification, as resources permit. (Amiro)

8. Participate in the modelling exercise to assess the effects of acid rain on the production of N.S. salmon stocks. (See Acid Rain Research project for details). (Amiro, Cutting)

9. Initiate, as resources permit, projects utilizing the image processing system for analyzing scale patterns. (Amiro)

10. Draft final report, as resources permit, of the two year cooperative sonic-tagging project for studying adult Atlantic salmon movements and behaviour on the Saint John River. (Marshall)

11. Implement investigations, as resources permit, to determine the cause(s) for recruitment failure common to inner Bay of Fundy stocks in recent years. (Amiro)

12. Direct biological investigations carried out under the pilot "river-specific management" project for the St. Mary's River. (Jessop, Cutting)

13. Develop and prepare required regional input for special CAFSAC investigations, for Canada's input to ICES, and for Canada's input to NASCO. (Marshall, Ritter)

14. Provide consultation and direction on the choice and use of salmon stocks and on the distribution programs for adult and all stages of juvenile salmon. (Marshall, Amiro, Cutting, Jessop, O'Neil)

15. Continue preparation of individual river management plans, to the extent time permits. (Marshall, Cutting, Amiro, Jessop, Ritter)

6. Background:

Highlights:

First outputs from the ESSA modelling exercise promise to show potential of rivers to produce Atlantic salmon under various stages of acidification; continued cooperative spirit exhibited by the numerous non-DFO factions involved in the Saint John River salmon tracking study; a favourable review of Atlantic salmon assessment programs within the division; culmination of a concerted division effort in the provision of advice through CAFSAC on conservation levels, and preliminary estimates of surplus salmon for nearly 20 rivers for which little or no advice had been previously provided.

Selected Involvements:

i. Collaborative Research -

With project biologist hired by the St. Mary's River Salmon Association for the investigation of river-specific management; Nova Scotia DOF in the collection of landlocked salmon for broodstock; NB Power, and to a lesser extent NBDNRE, Water Surveys Canada, Atlantic Salmon Federation, NB Salmon Council, Tobique Indian Band, Fraser's Inc., Town of Hartland, Fredericton and Central branches of the Saint John River Salmon Assoc., Tobique Salmon Protective Assoc., Atlantic Salmon for Northern Maine and Northwest Salmon Association on the Saint John River salmon tracking study; Shubenacadie Indian Band to assess salmon escapement to the Shubenacadie and Stewiacke rivers and a volunteer seeking fisheries work experience in the summary and analyses of data from varied projects.

ii. University Liaison -

iii. Communications -

Press and radio coverage of various aspects of salmon returns and spawning requirements, usually initiated by a media sensitive to the possibility of over-fishing by Native food fisheries.

iv. Contracts Administered -

St. Croix International Waterway Commission to monitor fish traps on the St. Croix River.

v. Other -

Collaborated with Kennebecasis River Salmon Association in their conducting of a creel survey; East Richmond Wildlife Assoc. and the Cobequid Salmon Assoc. for assistance on the Grand and Little (Stewiacke) rivers, respectively.

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Amiro, P.G., R.E. Cutting, B.M. Jessop, T.L. Marshall, and S.F. O'Neil. 1991. Status of Atlantic salmon stocks of Scotia-Fundy Region, 1990. CAFSAC Res. Doc. 91/5, 24 p.

Harvie, C.J., and P.G. Amiro. 1991. Forecasts of MSW salmon returns to the Saint John River using non-parametric and parametric models. CAFSAC Res. Doc. 91/22, 19 p.

Marshall, T.L. 1991. Assessment of Atlantic salmon of the upper Saint John River, N.B., 1990. CAFSAC Res. Doc. 91/56, 19 + v p.

iv. Popular and Miscellaneous -

8. Review and Evaluation:

This project was subjected to Peer Review in May. The Review Team gave the project and staff members a very favourable rating. The goals established for 1991, although overly ambitious, were either met or good progress was made. Similarly the goals for 1992 are overly ambitious considering the limited person-year and fiscal resources, and in view that client demands have greatly escalated. Internal clients are seeking more frequent and better advice. As well, the demands on staff members to become involved and often to direct/oversee project activities undertaken by Native bands and angling associations continue to increase. Increased resourcing of this project will be required in 1992 to satisfy client demands and make good progress on the established goals.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous Project No.: 302

Section: Stock Assessment and Enhancement

Project Title: Non-Salmonid Assessment Research

Project Leader: Jessop, B.

Other Researchers: Cutting, R.; Ritter, J.

Work Activity: W.A.1.1.1.1

Key Words: gaspereau; shad; alewife; striped bass; eels; diadromous fish; assessments; assessment research

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1. Project Description:

Enumeration and assessment of adult and juvenile stocks and harvests of non-salmonid diadromous species, especially the alewife and blueback herring (gaspereau); preparation of stock assessment documents and advice to managers, and research into improved methodology and expansion of assessments of anadromous (other than salmonids) and catadromous stocks.

2. Long-Term Objectives:

The responsibility for managing anadromous and catadromous fish resources according to current, sound scientific information lies in the Departmental legislated mandate. The long-term objectives of the project are to develop the data base, conduct pertinent analyses, and prepare biological advice on a timely basis for internal and external clients with interests in those diadromous species other than salmonids.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Continue the enumeration and assessment of the return of alewife and blueback herring to the Mactaquac Dam, Saint John River and to the Milltown Dam, St. Croix River. Achieve designated spawning escapements and supervise the commercial fisheries. Prepare draft manuscripts on the relation between spawning stock size and juvenile abundance index in the Mactaquac Dam headpond, Saint John River, and on the fecundity of alewife and blueback herring from several Maritime rivers. The output will be the escapement and fishery, and progress in manuscript publication and preparation. (Jessop)

All goals in connection with the enumeration, assessment, and control of the spawning escapement of gaspereau (alewife and blueback herring) returning to the Mactaquac Dam, Saint John River were achieved. FHMB managers were advised on the preparation of a three-year management plan for target spawning escapements at the Mactaquac Dam. The draft manuscript on the fecundity of alewives and blueback herring from several Maritime rivers is undergoing internal review and will soon be submitted for journal consideration. Work on the manuscript on the relation between spawning stock size and the juvenile abundance in the Mactaquac Dam headpond will resume when the preceding manuscript has been submitted.

2. Continue the assessment of the downstream movement of juvenile alewife and blueback herring from the Mactaquac Dam headpond. The output will be information relevant to understanding the life history of juvenile Alosa and the interpretation of the juvenile abundance index. (Jessop)

Information on the run timing and biological characteristics of juvenile gaspereau migrating downstream from the Mactaquac Dam headpond was collected between mid-July and late November by means of a net mounted on a stationary barge. The data will be integrated with existing data on juvenile life history.

3. Continue assessment of the run timing of American eel elvers to the East River, Sheet Harbour, and collection of biological data on the run. After the third year of data collection, a report will be prepared. (Jessop)

A third and final year of data was collected on the run timing, abundance, and biological characteristics of the elvers returning to the East River, Sheet Harbour. Report preparation will begin as soon as feasible.

4. Continue the American eel age verification study by assessing the survival of transplanted elvers and collecting samples for ageing. The output will be development of a time series of samples of American eels of known age. (Jessop)

A reduction in project budget and in the availability of helicopter time resulted in cancellation of the plan to electrofish the lakes previously stocked with elvers. A further effort to obtain eel growth data will be made in 1992 if helicopter time can be obtained.

5. Complete preparation of a draft report on fecundity of alewife and blueback herring in several Maritime rivers. The output will be a publication. (Jessop)

A draft report on fecundity of alewives and blueback herring in several Maritime rivers has been completed and is in internal review prior to revisions and submission to a journal.

6. Complete preparation of a draft report on the seasonal marine distribution of alewife and blueback herring in Scotia-Fundy Region. The output will be a publication. (Jessop)

The manuscript on seasonal marine distribution of alewife and blueback herring in Scotia-Fundy Region has been accepted by a journal, pending final revisions.

7. Provide biological and technical advice to fishery managers on gaspereau, American shad, striped bass, American eel, shortnose sturgeon, and other non-salmonid diadromous fish resources. The output will be timely, sound, scientific information based on the data current at the time of response. (Jessop, Cutting, Ritter)

An increasing number of requests for biological and technical advice on the non-salmonid diadromous species were effectively handled for internal and public sector clients. Advised FHMB managers on preparation of a regional striped bass management plan. Leader participated in advisory committees as required.

4. Additional Accomplishments:

1. Collected additional catch and biological data on gaspereau by-catch in marine fish survey cruises for examination of feeding activity of gaspereau. A data base was assembled on survey cruise by-catch of American shad.

2. Initiated a survey of the commercial catch composition of American eels in two locations of the lower Saint John River at the request of the Eel Fishery Advisory Committee. Developed a cooperative project with a UNB professor to permit a summer COSEP student to use a part of the collected data for an undergraduate honors thesis. Data entry to computer has largely been completed except for age data which remains to be obtained from otolith analysis.

3. Reanalyzed the data from a survey of the gaspereau runs to five rivers in Nova Scotia and wrote a report that is now in the final stages of editorial approval for the Manuscript Report series.

5. Goals/Expected Outputs for 1992:

1. Continue the enumeration and assessment of the return of alewife and blueback herring to the Mactaquac Dam, Saint John River and to the Milltown Dam, St. Croix River. Achieve designated spawning escapements and supervise the commercial fisheries. (Jessop)

2. Complete data analysis and summarize results of the assessment of downstream movement of juvenile alewife and blueback herring from the Mactaquac Dam headpond. (Jessop)

3. Complete data analysis and begin preparation of a report on the run timing and biological characteristics of American eel elvers to the East River, Sheet Harbour. (Jessop)

4. Complete analysis of stomach contents of gaspereau collected in marine fish surveys, analyze data, and draft report. (Jessop)

5. Begin ageing of American eel otoliths collected in the survey of the commercial fishery in the lower Saint John River. This task may be of extended duration because of its time-consuming nature and the possible higher priority of other tasks. (Jessop)

6. Resources permitting, continue the American eel age verification study by collecting otoliths from samples of transplanted, known-age eels for age analysis. (Jessop)

7. Complete a report and submit for journal consideration a paper on the relation between spawning stock size and the juvenile abundance index of alewives and blueback herring returning to the Mactaquac Dam headpond. (Jessop)

8. Provide biological and technical advice to fishery managers on gaspereau, American shad, striped bass, American eel, shortnose sturgeon, and other non-salmonid diadromous fish resources. The output will be timely, sound, scientific information based on the data current at the time of response. (Jessop, Cutting, Ritter)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

Leader is a core member of the Statistics, Sampling and Survey Subcommittee (CAFSAC).

ii. University Liaison -

Leader is supporting COSEP student research in cooperation with student's university professor.

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Jessop, B.M. 1991. The history of the striped bass fishery in the Bay of Fundy. In R. Peterson (ed.) Proceedings of the Striped Bass Workshop, St. Andrews, N.B., September 10, 1990. Can. Tech. Rep. Fish. Aquat. Sci. No. 1832.

Jessop, B.M., and W.E. Anderson. 1991. List history data on the alewife and blueback herring, Mactaquac Dam, 1982-1988. Can. Data Rep. Fish. Aquat. Sci. No. 829, 42 p.

iv. Popular and Miscellaneous -

8. Review and Evaluation:

This project continues to be very productive both in producing new science and in providing biological advice for the management of the non-salmonid diadromous fish resources of the Scotia-Fundy Region. The demands for advice to manage species other than alewife and blueback herring will continue to increase in 1992 as will the requirements to expand biological investigations to encompass more stocks and species. Most prominent on the list of new species requiring greater attention is the striped bass for which Gulf and Scotia-Fundy regions are in the process of establishing a new management regime.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous Project No.: 303

Section: Stock Assessment and Enhancement

Project Title: Salmon Enhancement Research (Enhancement Biology)

Project Leader: Cutting, R.

Other Researchers: Amiro, P.; Farmer, G.; Jansen, H.; Jessop, B.; Marshall, L.; O'Neil, S.; Ritter, J.

Work Activity: W.A.1.1.2.4

Key Words: salmon enhancement; hatcheries

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1. Project Description:

The project involves the identification, planning, implementation, and assessment of Atlantic salmon enhancement projects. Expertise in biology, engineering, and fish culture are coordinated to increase salmonid production for the commercial, recreational and Native food fisheries. Major activities are: identification of suitable projects, development of enhancement techniques, integration of engineering services and fish culture production output with project needs, monitoring of stocks under development, and provision of senior biological advice to planning and implementation of salmon enhancement programs.

2. Long-Term Objectives:

Increase Atlantic salmon production by using enhancement technology in conjunction with other resource management and habitat protection efforts. The enhanced production can be used to: expand the recreational fishery, increase commercial landings, and satisfy authorized food fishery requirements of Native communities.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Continue to operate the LaHave and Liscomb River Atlantic salmon enhancement projects, especially for their assessment data bases. (Jessop, Cutting)

Enumerations and field activities were undertaken on the LaHave and Liscomb rivers to continue project evaluations. Fishway counts and biological parameters were inserted into the on-going time series data bases. This information base was used (Project 301) in developing regional status reports and stock assessments which appear in CAFSAC documentation. Equipment was assembled for smolt enumeration on the upper LaHave River but efforts to capture smolts failed because of exceptionally high water.

2. Implement the activities associated with the plan to rehabilitate the Petitcodiac River salmon stock. (Amiro)

Tentative plans for evaluating the salmon smolt migration pattern in the Moncton causeway area were obviated by the opening of the causeway gates during the smolt period. Spawner returns were so low that the planned collection of broodstock by electrofishing was deemed a fruitless exercise, though a few fish were captured in the fishway trap. Small numbers of surplus parr stock at the Salmon Research Centre were released into the drainage.

3. Undertake and collaborate on the collection of the salmon broodstock for the fish culture program. (Amiro, Farmer, Cutting)

Salmon broodstocks were collected at enumeration facilities at East River (Sheet Harbour), LaHave, Liscomb, Medway, Petitcodiac, Saint John, and Tusket rivers, and by seining or electrofishing on the Annapolis, Gold, Grand, Hammond, Kennebecasis, Musquodoboit, Nashwaak, North, River Philip, Salmon (Mira), Salmon (Digby), St. Mary's, and Stewiacke rivers in joint operations with staff of the Fish Culture Section. Operation of the Petitcodiac River enumeration facility was carried out by a volunteer from the N.B. Wildlife Federation.

4. Coordinate the biological, engineering and private sector inputs to the Atlantic salmon development project for the Saint John River above Grand Falls. (Ritter, Marshall)

Coordination was carried out externally through a few meetings and many phone consultations with external clients. Though neither internal nor external funding for facilities construction, were available, engineering planning was developed and carried as far as permitted by present information. Collaborated with the private sector and U.S. officials in the allocation and transfer of eggs, juveniles, and adult salmon above Grand Falls and to the Aroostook tributary; trucked 367,000 fall fingerlings and 140 adults above Grand Falls and 100 adults above Tinker Dam on the Aroostook River.

5. Direct the development of the Atlantic salmon and gaspereau resources of the St. Croix River, N.B., and coordinate activities with U.S.A. officials. (Marshall, Jessop, Ritter)

Participated in the St. Croix River Steering Committee meetings to achieve coordination with U.S.A. officials. Operation of enumeration facilities was conducted by contract to the St. Croix International Waterways Commission by joint funding by DFO and Georgia-Pacific Corp., a Maine industry. Contributed to development of a three-year management plan for the gaspereau commercial fishery at the Milltown Dam, implemented in 1991. Coordinated collection of fishway counts and biological data on the gaspereau run done under contract by the St. Croix International Waterway Commission. Reviewed the engineering proposals for improvements to upstream and downstream fish passage at three main stem dams. The withdrawal of active involvement of the Maine Atlantic Sea-Run Salmon Commission in activities provides an opportunity for DFO to review current successes and to evaluate future direction of the salmon development program for the St. Croix.

6. Prepare a comprehensive salmon development proposal for the Sackville River. (O'Neil)

Contributed in a major way toward an inter-departmental (DFO-Environment) report on the salmon enhancement potential of the Sackville River, for publication in the new fiscal year.

Coordinated extensive habitat-related and fish stocking activities on the Sackville River (by working closely with a volunteer organization) as part of a long range restoration program.

4. Additional Accomplishments:

1. Several recreational organizations in both N.B. and N.S. assisted with distribution and stocking of hatchery-reared salmon fry and parr.

2. Collaborated with FHMB and N.S. Power Corporation, using CEF consultant, toward developing a fisheries development plan for the lower Mersey River. (Ritter, Cutting)

3. On behalf of Science Branch, played a key planning and coordination role in the design and rationalization of the recreational fisheries initiative as affecting regional fish resources. (Ritter)

5. Goals/Expected Outputs for 1992:

1. Continue to operate the LaHave and Liscomb rivers Atlantic salmon enhancement projects, especially to continue their valuable assessment data bases and, in the case of Morgan Falls, to monitor fish movements in the face of an imminent hydropower development. (Jessop, Cutting)

2. Undertake and collaborate on the collection of the salmon broodstock for the fish culture program. (Amiro, Farmer, Cutting)

3. Coordinate the biological, engineering, and private sector inputs to the Atlantic salmon development project for the upper Saint John River, i.e., the Aroostook River and the main river above Grand Falls. (Ritter, Marshall)

4. Direct the development of the Atlantic salmon and gaspereau resources of the St. Croix River, N.B., and coordinate activities with U.S.A. officials. (Marshall, Jessop, Ritter)

5. Coordinate the salmon development for the Sackville River, N.S., and carry out related field activities. (O'Neil)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

Information from projects is routinely used for stock assessments, for evaluating fish culture practices, and for apprising external clients interested in current project development. Communications related to the upper Saint John River salmon development involved briefing documents, exchanges with State of Maine officials, upper basin meetings, planning documentation, and seedstock reallocations.

iv. Contracts Administered -

v. Other -

Participated in the Annapolis Valley Rivers Committee interested in redeveloping fisheries resources for the people of the valley. (Cutting)

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Semple, J. Richard. 1991. Atlantic salmon habitat survey:enhancement opportunities and problems in the Dunbar Stream, Nashwaak River, New Brunswick. Can. MS. Rep. Fish. Aquat. Sci. 2076, 35 p.

iv. Popular and Miscellaneous -

8. Review and Evaluation:

This project provides a focus and direction for many of the Division's activities. It also contributes information that is used in stock assessments and to evaluate hatchery performance. Fiscal and person-power limitations restrict expansion of enhancement initiatives for which demands from recreational and Native fishermen continue to increase. Public interest in becoming involved in enhancement is also increasing, but no new A-base resources are available to cope with this growing demand. Although existing staff are stretched to the limit in the Division's attempts to respond to and work with the numerous public interest groups, this situation will worsen if major new funds are made available for the Recreational Fisheries Initiatives Programs under consideration for N.S. and N.B.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous

Project No.: 304

Section: Engineering Services

Project Title: Enhancement and Fish Passage Engineering

Project Leader: Jansen, H.

Other Researchers: Conrad, V.

Work Activity: W.A.1.1.2.4

Key Words: fish passage; mitigation; salmon enhancement; fishways

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1. Project Description:

Provides engineering technology required to operate and maintain existing Department-owned enhancement facilities ($3M replacement value). Involves planning, design, and construction of new enhancement projects consisting of habitat restoration or improvement, and fish passage facilities. Provides engineering services to the Fisheries and Habitat Management Branch.

2. Long-Term Objectives:

Maintain, restore and expand freshwater and anadromous fish production for the commercial, recreational and Indian food fisheries by the use of enhancement technology in conjunction with other resource management and habitat protection efforts.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

(Note that projects with * require funding over and above Division A-base.)

1. Complete the engineering aspects of planning future year projects as follows: (a) detailed design and contract documents for the proposed fishway for Grand Falls, St. John River; (b) functional design of improvements for Beechwood hydroelectric station fish passage facilities; (c) site survey of Gorden Falls, Pollet River, N.B.; (d) design of a downstream fishway for the Marshall Falls, NSPC storage dam; (e) continue with St. Mary's River flow control study; (f) preliminary investigation of downstream fish passage facilities at Tobique Hydroelectric Station. (Conrad, Jansen)

(a) Functional designs for a fishway and a trapping and trucking alternative were completed. Proposals for a geological-engineering study were received, however, funds were not available to proceed. (b) Completed. (c) Postponed to next season (staff not available when flows were low). (d) Completed. (e) Continuing. (f) Initiated; further work required next year.

2. Follow-up investigations of previously completed projects as follows: (a) Tobique Narrows fishway; (b) entrance problems at White Rock fishway; (c) fish passage problems at St. George, N.B. (Conrad, Jansen)

(a) Biological monitoring continuing. (b) Improvements by NSPC requested. (c) Implemented successfully by J.D. Irving.

3. Project administration and/or site supervision of construction projects as follows: (a) fishway assessment facilities and roadway improvements at Grand River, N.S.; *(b) fish trapping facilities at St. George fishway; *(c) Phase I of Grand Falls, St. John River, fishway construction; (d) fishway improvements at East River, Sheet Harbour, N.S.; (e) modification to Morrison Brook, N.S. culvert. (Conrad)

(a) No funds. (b) Construction drawings completed. (c) No funds. (d) No funds. (e) Fabrication completed; install next season.

4. Update the fishway inventory. (Conrad)

Completed and circulated to C&P field personnel for input on inspections. There are now 255 fishway installations including 39 culverts with special features for fish passage.

5. Provide engineering services to Fisheries and Habitat Management Branch consisting of the development of acceptable fish passage designs and negotiations with proponents of water-use projects to meet the requirements of Section 20 of the Fisheries Act. Also included are negotiations with owners of existing fish passage facilities for improvements. (Conrad, Jansen)

A. Functional designs of fishery protective measures were completed for the following water development projects: (a) A water supply dam for a gravel washing operation on Parks Brook, N.B. (b) A hatchery water supply dam on Cripps Stream, N.B. (c) Baffled highway culverts on Baker

Brook, N.B. (d) Small hydro development at Morgan Falls, N.S. (e) Small hydro development at West River, Sheet Harbour. (f) Hydro redevelopment at St. George, N.B. (g) Water level control dams at two sites on the Shubie Canal.

B. Ministerial approval of final construction drawings were given for fish passage facilities proposed at: Chamcook Lake by ASF, at Grafton Lake by Parks Canada, and for downstream facilities and improved upstream attraction at Woodland and Grand Falls (St. Croix River) by Georgia Pacific.

C. Improvements to existing facilities implemented at the following locations: in Nova Scotia - Truman Pond (new baffles); Sydney River (new baffles and concrete repairs); Sherbrooke Lake (downstream facilities); Chaswood Meadows (baffle repairs); Rhodenizer Lake (fishway modifications); Shorts Beach (new chutes added); Harmony Mills (pipeline extension and baffle improvements); Greenwood Lake, Indian Brook (screens and weir added). In New Brunswick - Beechwood collection gallery (minor improvements); Hillsboro Marsh (baffles adjusted); Peters Brook (rock excavation).

6. Applied research on engineering aspects of habitat improvements and restoration techniques in cooperation with the Stock Assessment and Enhancement Section, the Area Managers, Fishery Officers, and the Habitat Management Branch; (a) feasibility study of installing fish passage on the North Magaguadavic River at the Woolen Mill dams; (b) fish passage and flow requirements on the lower Nictaux River, N.S.; (c) fish passage at the dam on Paper Mill Lake, N.S.; (d) fish passage at Parrsboro River causeway; (e) fish passage improvements in tidal area of Salmon River, Digby Co., N.S.; (f) additional items requiring priority action will be identified during the year. (Conrad, Jansen)

(a) Carried forward to next year. (b) Flow data collected and working with NSPC for flow release options. (c) Preliminary feasibility study shows marginal benefits. (d) Design completed and owner requested to construct. (e) Completed. (f) Fishway for Mill Creek project. (g) Feasibility study and cost estimates for fishways at a waterfall and several dams on the Meteghan River. (h) Rerouting of fish on the Gaspereau and Black rivers with the turbines down. (i) Fishway for existing Arnold Lake Dam. (j) Fishway for existing East Loon Lake Dam.

4. Additional Accomplishments:

1. Design of commercial alewife harvesting equipment for Milltown N.B. fishway.

2. Investigation and report on salmon injuries observed at Mactaquac fish collection facility.

3. River survey at Gaspereau River dipping stand for court evidence.

4. A draft report Evaluation of the Water Storage Potential of Lakes on the St. Mary's River Drainage Basin and the Effect of Controlled Release on Flow Parameters During Low Summer Flow was completed.

5. Participated in an international workshop in St. John's, Newfoundland on fishery protective methods at hydroelectric projects.

6. Information exchange with visitors: Prof. Tuan from Taiwan and Stephen Gephard from Connecticut.

7. Provided advice on fish passage or handling facilities for projects in Quebec; Newfoundland; Lawrence; New Hampshire; North Esk River, Scotland.

8. Topographic survey of tidal area of Jordan River and design of proposed salmon angling pool(s).

9. Unpublished briefing document Hydrology and River Hydraulics Sackville River, N.S.

5. Goals/Expected Outputs for 1992:

(Note that projects with * require funding over and above Division A-base).

1. Complete the engineering aspects of planning future year projects as follows: *(a) Geological-engineering investigation of the Grand Falls fishway route for rock stabilization and complete functional design and costing of the fishway and trapping-trucking alternatives. (b) Site survey of Gorden Falls, Pollet River, N.B. (c) Continue with St. Mary's River flow control study. (d) Additional attraction water and fishway entrance improvements at Tobique fishway. (e) Preliminary investigation of downstream fish passage facilities for Tobique Hydroelectric Station. (f) Investigate fish passage efficiency of alewives at Tusket (3 sites), White Rock and Milltown. (g) Functional design of replacement fishway at NSPC Tusket Diversion Dam.

2. Design, project administration and/or site supervision of construction projects as follows: *(a) Phase I of Grand Falls, St. John River, fishway construction. (b) Morrison Brook, N.S. culvert modifications. (c) Install two weirs in channel downstream of fishway at Ruth Falls. (d) Minor improvements to Sackville River fishway. (e) Elver trapping at Mactaquac. (f) Smolt trapping facilities LaHave River. (f) Solve problem at highway culvert at Lochaber Lake.

3. Update the fishway inventory.

4. Provide engineering services to Fisheries and Habitat Management Branch consisting of the development of acceptable fish passage designs and negotiations with proponents of water-use projects to meet the requirements of Section 20, 21, 22 and 30 of the Fisheries Act. Also included are negotiations with owners of existing fish passage facilities for improvements. (Conrad, Jansen)

5. Applied research on engineering aspects of habitat improvements and restoration techniques in cooperation with the Stock Assessment and Enhancement Section, the Area Managers, Fishery Officers, and the Habitat Management Branch: (a) fish passage at Woolen Mill dams on the North Magaguadavic River, N.B. (b) Typical dam-fishway layouts. (c) Preliminary fish screening

tests. (d) Additional items will develop during the year. (Conrad, Jansen)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Most of the scheduled activities were completed, and the few that were not completed were deferred for good reasons. Major improvements or developments in fish passage are dependent on outside sources of funding, which in general have not been declared this far in advance of the actual activity.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous Project No.: 305

Section: Engineering Services Section

Project Title: Fish Culture Engineering

Project Leader: Jansen, H.

Other Researchers: Hubley, P.

Work Activity: W.A.1.1.2.4

Key Words: hatcheries; salmon enhancement; aquaculture

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1. Project Description:

Provides engineering technology required to operate and maintain existing hatcheries ($20M replacement). Plans, designs and constructs new hatchery facilities or modifies, improves, and expands existing facilities where technically feasible. Provides technical feasibility reviews of private and other government hatchery proposals and ad hoc advisory services to aquaculture operations.

2. Long-Term Objectives:

Expand Atlantic salmon production from the Region's fish culture facilities for the commercial, recreational and Indian food fisheries.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

(Note that projects with * require funding over and above Division A-base.)

1. Complete the engineering aspects of planning for future year projects as follows: *(a) Mactaquac FCS - investigate problem of low yield from well #5. (b) Mactaquac FCS - complete material lists and cost estimates for additional phases of modification of rearing ponds, and design of permanent repairs to ponds and flumes in spawning building. (c) Cobequid FCS - carry out additional design work for new supply & drainage pipes, improvements to dam and new or renovated hatchery buildings. (d) Coldbrook FCS - investigate feasibility of deepening existing circular ponds by extending/raising walls. (e) Mactaquac FCS - investigate the feasibility and practicality of sterilizing the hatchery water supply. (Hubley, Jansen)

(a) Unfunded; deferred to next year. (b) Completed. (c) Partially completed; to be continued next year. (d) Completed. (e) A low capital cost iodine treatment proposal appears to have potential.

2. Update the long-term minor maintenance plan and complete work on several items from the plan as funds permit. (Hubley)

(a) At the Mactaquac Accelerated Rearing Facility installed 60 additional trusses to reinforce two of the greenhouses. (b) Installed new furnaces at Mactaquac, Cobequid and Coldbrook. (c) At Cobequid FCS installed a fully operational washroom and sewage disposal field to replace a chemical toilet; labour supplied with a Corrections Canada-CEIC job training project. (d) Several minor projects completed at all of the hatcheries.

3. Continue with the planning of a preventative maintenance program for mechanical equipment. (Hubley, Jansen)

No time was available due to the many construction projects.

4. Proceed with project administration and/or site supervision for several construction projects as follows: *(a) Saint John FCS - construction and/or installation of 8 - deep 25' swede ponds or 10 - deep 25' circular ponds and associated piping and site work. *(b) Mactaquac FCS - construction/modification of 11 additional deep 36' swede ponds and associated piping and work to overhead doors. (c) Mactaquac FCS - completion of visitors facilities, e.g. additional landscaping, pavement marking, fabrication and installation of displays, construction of handrails and seats or rest areas, miscellaneous painting, installation of site furnishings and changing colour of FRP brailles in dump and holding ponds at sorting building to improve visibility of fish. *(d) Mactaquac FCS - installation of predator netting. *(e) Mactaquac FCS - painting of metal roofs and structural steel supports of pond buildings. *(f) Cobequid FCS - construct concrete dividers in another row of earth ponds. *(g) Cobequid FCS - Modify 6 - 25' Ø circular ponds by raising their walls, repairs to their floors and associated work to supply and drain piping. *(h) Yarmouth FCS - repair dam as required by the Town of Yarmouth, carry out other work to close out the hatchery. *(i) Carry out phase II of a four-year program to replace fuel storage tanks at the hatcheries to ensure compliance with the National Environmental Code

of Practice for Underground Storage Tank Systems Containing Petroleum Products 1989. (Hubley, Jansen)

(a) Completed 8 - 25' x 4' deep swede ponds and partially completed additional 8 ponds with labour provided by a CEIC job creation project sponsored by the Kennebecasis Salmon Association. (b) Completed with labour provided by a CEIC job creation project sponsored by the N.B. Wildlife Federation. (c) Completed with a Grand Opening on June 25. (d) No funding available, however, design was completed. (e) Completed pressure washing and primer coat of paint on roof with no painting of structural steel. (f) With labour supplied by a combined Corrections Canada CEIC job training project sponsored by the Cumberland Rivers Association, completed reconstruction of concrete dividers in two rows of earth ponds rather than the one row scheduled. (g) Funds not available/deferred to next year. (h) On hold due to uncertainty of closure. (i) Funds not available.

*5. Complete additional health and safety improvements at the fish culture stations as funds permit, with special emphasis on upgrading electrical systems. (Hubley)

At Saint John FCS, with Capital Assets funding, completed most of the refurbishing of the electrical system for the entire site. Also included was a second exit from the main hatchery attic, replacement of the flammable wall materials and windows in the office area. A fire rated furnace room was constructed by the CEIC job creation crew.

4. Additional Accomplishments:

1. At Mactaquac FCS reattached 31,622 ft² of metal roofing which was loose because the screws were pulling out of the rotten wood (also replaced and rebolted) on the steel purlins with four summer students.

2. At Mactaquac FCS a facility to sort undesirable fish species from those to be trucked to upriver areas.

3. A feasibility study and cost estimates of several potential systems for microstraining Cyclops scutifer, the first intermediate host of the gull worm parasite, from the Yarmouth FCS water supply.

5. Goals/Expected Outputs for 1992:

(Note that projects with * require funding over and above Division A-base).

1. Complete the engineering aspects of planning for future year projects as follows: *(a) Mactaquac FCS - investigate problem of low yield from well #5. (b) Continue with design of refurbished fish rearing facilities for Cobequid FCS. (c) Mersey FCS - construction drawings and cost estimates for installation of a central pH adjustment facility and a 32" main pipeline.

2. Update the long-term minor maintenance plan and complete work on several items from the plan as funds permit.

3. Continue with the planning of a preventative maintenance program for mechanical equipment.

4. Proceed with project administration and/or site supervision for several construction projects as follows: *(a) Saint John FCS - complete the 8 - deep 25' swede ponds which were partially completed last year. *(b) Mactaquac FCS - painting of roof and structural steel. *(c) Mactaquac FCS - construction/modification of nine deep 36' swede ponds and associated piping and work to overhead doors. *(d) Cobequid FCS - modify 5 - 25' Ø circular ponds by constructing new deep walls and a new drainage and water supply lines. *(e) Yarmouth FCS - depending on the decision to close or open, proceed with the modification required. *(f) Mersey FCS - construct flood protection dyke and bury 12" Ø pipeline under the spillway channel. *(g) Saint John FCS - construction/modification of eight deep 25' swede ponds and associated piping. *(h) Mactaquac FCS - modify fish sorting facility for removing undesirable species.

5. Complete additional health and safety improvements as funds permit. The major item is the replacement of fuel storage tanks at several hatcheries to comply with the National Environmental Code of Practice for Underground Storage Tank Systems Containing Petroleum Products 1989.

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Members of the Engineering Services Section have been very proficient at maximizing the expenditure power of the limited resources available for maintenance and upgrading of the Division's fish culture facilities which have a replacement value of more than $20 million. They have once again been very resourceful in acquiring funds and labour from outside the Region's A-base, e.g., Capital Assets, CEIC Section 25, Correction Services Canada. As a result of their activities, all facilities are operational and major upgrading of the Division's fish culture facilities is proceeding in phases. Unfortunately, current budgetary restraints and cutbacks are making it increasingly difficult to continue with the upgrading of facilities using non-A-base funds. An increase in A-base funds is required (as seed money to attract and effectively utilize CEIC and other B-base funds) to continue the upgrading of the Division's hatchery facilities at the current rate.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous Project No.: 306

Section: Stock Assessment and Enhancement

Project Title: Finfish and Invertebrate Introductions and Transfers

Project Leader: Cutting, R.

Other Researchers: Ritter, J.

Work Activity: W.A.1.1.1.1

Key Words: introductions; transfers

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1. Project Description:

Provides focus for review and coordination of Regional matters pertaining to the introductions and transfers of finfish and invertebrates and for coordination of the Division's involvement in assessing the impact of aquaculture on wild salmonid populations.

2. Long-Term Objectives:

Coordinate Divisional and Regional (as required) assessments of introductions and transfers of marine organisms.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Provide Regional and Canadian representation for required inputs to Regional, national, ICES, and NASCO groups regarding introductions and transfers of marine organisms, especially salmonids. (Cutting)

Solicited federal and provincial inputs and assembled the Canadian national report for the ICES Working Group on Introductions and Transfers of Organisms annual meeting. Provided Canadian editorial input to Canadian sections of the ICES Cooperative Research Report on Introductions and Transfers scheduled for publication in 1992. As chairperson of the Regional Non-Indigenous Species Introductions Committee, coordinated and expedited the preparation of advice, recommendations, or written permissions for proposals for the movement of aquatic organisms with possible impact on native populations. Those fish movements addressed species as varied as Arctic charr, Atlantic salmon, American eel, striped bass, bay scallop, brook trout, giant scallop, Icelandic scallop, horseshoe crab, and prawns (sand shrimp, white shrimp, and tiger shrimp). Maintained the U.S.A.-Canada combined inventory of salmonid introductions and transfers in eastern North America for the Scientific Working Group on Introductions and Transfers of Salmonids, a bilateral unit of the North American Commission of NASCO.

2. Promote and coordinate studies to identify and evaluate the impacts of the N.B. salmon aquaculture industry on local wild salmon stocks. (Ritter, Cutting)

Collaborated with the Atlantic Salmon Federation in the development of a proposal for studying the possible impacts of aquaculture on N.B. wild salmon populations. Assisted a visiting Irish scientist with the collection of salmon tissue materials for study of this issue. Collected and reviewed current publications on this subject, principally by ICES and NASCO.

4. Additional Accomplishments:

Participated in the development of a national registry for aquaculture stocks. (Ritter)

5. Goals/Expected Outputs for 1992:

1. Provide Regional and Canadian representation for required inputs to Regional, national, ICES, and NASCO groups regarding introductions and transfers of marine organisms, especially salmonids. (Cutting).

2. Promote and coordinate studies to identify and evaluate the impacts of the salmon aquaculture industry on local wild salmon stocks. (Cutting, Ritter)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Outputs are the documents required by Regional administration or clients, draft correspondence or advice needed by senior levels in DFO, and input to ICES and NASCO requirements on introductions and transfers.

iv. Popular and Miscellaneous -

8. Review and Evaluation:

All the goals of this project were met in 1991. Limited AFAP funding is being made available to the Atlantic Salmon Federation to initiate in 1992 a collaborate project with DFO to investigate the impacts of N.B. aquaculture escapees on the nearby Magaguadavic wild salmon population. The Division will work with the Federation to guide the project and to oversee a part of the field activities.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous Project No.: 308

Section: Fish Culture

Project Title: Hatchery Operations and Production

Project Leader: Farmer, G.

Other Researchers: Aitken, D.; Austin, W.; Goff, T.; McAskill, J.; Penney, G.; Young, E.; Dunfield, R.

Work Activity: W.A.1.1.2.4

Key Words: aquaculture; Atlantic salmon enhancement; hatcheries

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1. Project Description:

Juvenile anadromous Atlantic salmon produced at six hatcheries and landlocked salmon at one hatchery are distributed to public waters for enhancement purposes. Atlantic salmon smolts and parr are sold as seedstock to the aquaculture industries in N.S. and N.B. and are available for private, university and government research. Trapping and trucking operations for gaspereau and adult salmon are carried out on the Saint John River, N.B. Technical advice on salmonid culture methods and facilities are provided routinely to private aquaculturists.

2. Long-Term Objectives:

Support public fisheries and the stocks upon which they depend. Encourage and support the development of salmonid aquaculture industries in N.S. and N.B.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Meet all hatchery production targets as outlined by salmon enhancement biologists. (Farmer)

Twenty-two discrete stocks of anadromous Atlantic salmon were reared at Scotia-Fundy hatcheries for stock enhancement purposes. The 105,000 salmon fry, 775,000 parr and 755,000 smolts distributed in 32 rivers during 1991 satisfied production targets.

2. Support the salmon aquaculture industries in N.B. and N.S. through the provision of technical advice and stock for broodstock development. (Farmer, Goff, Aitken, McAskill)

Thirty thousand Saint John River 1+ smolts were produced at the Saint John Hatchery for the New Brunswick Salmon Growers broodstock development program which is being conducted as part of the Salmon Genetics Research Program. Twenty-two thousand LaHave, River Philip and Saint John 1+ smolts produced at the Mersey Hatchery were supplied to three sea cage operators in Nova Scotia during 1991 as part of an industry broodstock development program. The performance of the smolts supplied to the Nova Scotia industry during 1990 was assessed and the results reported to industry members. Fifty thousand Saint John 1+ smolts produced at the Mactaquac Hatchery were supplied to a number of sea cage operators in New Brunswick to help alleviate a shortage of private-sector smolts. Fifteen thousand 1+ Saint John smolts produced at the Saint John Hatchery were provided to the Salmon Demonstration and Development Farm operated by the New Brunswick Salmon Growers Association for research purposes.

3. Improve smolt quality as measured by a quality index. (Farmer)

Sixty-five percent of the 1+ smolts and 85% of the 2+ smolts produced at Scotia-Fundy hatcheries were observed to be of good quality. Research has shown that the necessary improvement in smolt quality will require the replacement and/or modification of outmoded rearing ponds at the Mactaquac, Saint John and Cobequid hatcheries. Considerable improvements to the ponds at these locations were carried out during 1991.

4. Carry out trapping and trucking operations for adult salmon and gaspereau returning to the Mactaquac hydro dam on the Saint John River. (McAskill)

A total of 11,801 adult Atlantic salmon were captured at the Mactaquac Dam on the Saint John River and then transported to the Mactaquac Hatchery for sorting and the collection of biological information. Approximately 400 adult salmon were retained for broodstock purposes and the remainder transported to release sites located above the Mactaquac Dam to satisfy the recreational fisheries and spawning escapements. Adult salmon were released in the main Saint John River at Woodstock and above Grand Falls and in the Tobique and Aroostook tributaries. Two hundred and seventeen tonnes of gaspereau were collected at the Mactaquac Dam for the commercial harvest and 896,000 gaspereau transported to the Mactaquac headpond to satisfy the required spawning escapement.

5. Continue to work toward increasing public awareness of ongoing programs of DFO and the fishery resources of the Scotia-Fundy Region. (Ritter, Farmer)

The Mactaquac Visitor Facility was officially opened during June. Guided tours of the hatchery are provided to the public and feature the viewing of juvenile and adult Atlantic salmon as well as other species of freshwater and anadromous fishes. Displays and written material are available to explain Atlantic salmon biology, salmon enhancement and management programs and fish culture techniques.

Several recreational fisheries organizations participated in the incubation of salmon eggs and/or the distribution of fry or hatchery parr within the rivers they have specific interest in (e.g., Gold, Musquodoboit, East Sheet Harbour rivers, N.S.; Upper Saint John, Salmon, Tobique, Meduxnekeag, Kennebecasis rivers, N.B.).

6. Close operations at the Yarmouth Hatchery and dispose of the facility through CADC. (Ritter, Farmer, Young)

Salmon rearing operations at the Yarmouth Hatchery were terminated with the April distribution of salmon smolts. One staff member has retired and the other is on assignment with the Fisheries and Habitat Management Branch. DFO staff have met with recreational fisheries organizations located in Shelburne, Yarmouth and Digby counties, N.S., to develop a salmon enhancement plan for southwestern N.S. The report which has been developed contains details of the salmon enhancement plan and compares the costs of providing the required hatchery parr and smolts from the Yarmouth Hatchery or alternately from the Mersey Hatchery located in Queens Co., N.S. It is expected that a decision on the future of the Yarmouth Hatchery will be made early in 1992.

4. Additional Accomplishments:

Supplied Atlantic salmon eggs to: (a) Ontario Ministry of Natural Resources for their Lake Ontario restoration program; (b) Aqua Health Ltd., P.E.I., for the development of vaccines; (c) SALEN, the public group which leases the Florenceville Hatchery, for their upper Saint John River enhancement program; (d) three recreational fishing groups to conduct egg incubation studies on the Saint John River, N.B. and (e) numerous government and university scientists for their research.

5. Goals/Expected Outputs for 1992:

1. Meet production targets for juvenile hatchery salmon specified by salmon enhancement biologists. (Farmer)
2. Support the salmon aquaculture industries in N.B. and N.S. by providing technical advice and stocks for broodstock development. (Farmer, Goff, Aitken)
3. Modify hatchery facilities to improve smolt quality as measured by an index. (Farmer, Jansen, Hubley)
4. Carry out trapping and trucking operations for adult salmon and gaspereau returning to the Mactaquac hydro dam on the Saint John River. (McAskill)
5. Increase public awareness of ongoing DFO programs and the fishery resources of the Scotia-Fundy Region. (Farmer)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

All program goals were met or exceeded. Hatchery operations are efficient but risk is high because of ageing equipment and facilities and limited backup. The quality of the hatchery produced smolts is improving with the upgrading of hatchery facilities which is being accomplished largely with non-A-base funds. Expansion of hatchery facilities and programs will be necessary in the near future if the demands for hatchery stocks to support Native fisheries are to be met. The high level of performance from this project depicts the dedication of staff members. Because many staff members are approaching retirement, plans must be made and action taken to recruit capable and highly qualified new fish culturists to the project beginning in 1992.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous Project No.: 309

Section: Fish Culture

Project Title: Fish Culture Research

Project Leader: Farmer, G.

Other Researchers: McAskill, J.; Aitken, D.; Goff, T.; Austin, W.; Penney, G.; Young, E.

Work Activity: W.A.1.1.2.4

Key Words: aquaculture; Atlantic salmon enhancement; hatcheries

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1. Project Description:

Devise salmon broodstock, rearing, distribution, marking, evaluation and research programs and coordinate these programs with hatchery staff, stock assessment and enhancement biologists, engineers and fish health and nutrition biologists. Feedback from these programs is used to improve rearing methods, facilities, smolt quality and survival. Private aquaculture proposals are assessed for federal/provincial funding agencies. Chair salmon seedstock committees in Nova Scotia and New Brunswick involved in the coordination of seedstock supply to private-sector hatcheries and marine cage sites and in the implementation and assessment of salmon broodstock development programs. Chair scientific advisory committee to the Salmon Genetics Research Program.

2. Long-Term Objectives:

Provide and coordinate biological input to the Division's hatchery programs to ensure their effectiveness and continued improvement. Liaise with provincial fisheries officials and the aquaculture industries in Nova Scotia and New Brunswick in the areas of salmon seedstock supply, broodstock development and the assessment of private aquaculture proposals. Chair scientific advisory committee to the Salmon Genetics Research Program.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Coordinate and provide biological input to the Region's fish culture program. Improvement in the quality of both 1+ and 2+ smolts is possible and of high priority. (Farmer)

Rearing, broodstock, nutrition, fish health, marking and research programs were devised in conjunction with hatchery managers, Branch biologists, engineers and scientists and then implemented. Sixty-five percent of the 1+ smolts and 85% of the 2+ smolts produced at Scotia-Fundy hatcheries were observed to be of good quality. Research has shown that the necessary improvement in smolt quality will require the replacement and/or modification of outmoded rearing ponds at the Mactaquac, Saint John and Cobequid hatcheries. Considerable improvements to the ponds at these locations were carried out during 1991. Most of the concrete raceways at the Saint John Hatchery were removed and replaced with eight, deep, 7.6 m Swedish-type ponds. Walls of 11 - 11 m Swedish-type ponds at the Mactaquac Hatchery were extended so that water depth in the ponds could be increased to 1 m. Modifications to the earthen ponds at Cobequid Hatchery were completed. Ponds at that location were deepened, reshaped and the deteriorating control structures replaced.

2. Work with the salmon aquaculture industries in N.S. and N.B. to develop and assess their broodstock programs. (Farmer, Aitken, Goff)

Thirty thousand Saint John River 1+ smolts were produced at the Saint John Hatchery for the New Brunswick Salmon Growers broodstock development program which is being conducted as part of the Salmon Genetics Research Program. Twenty-two thousand LaHave, River Philip and Saint John 1+ smolts produced at the Mersey Hatchery were supplied to three sea cage operators in Nova Scotia during 1991 as part of an industry broodstock development program. The performance of the smolts supplied to the Nova Scotia industry during 1990 was assessed and the results reported to industry members.

3. Chair the N.B. and N.S. Salmon Seedstock Committees. (Farmer)

Meetings were held and contacts made with industry members in N.S. and N.B. to discuss salmon seedstock supply. Present DFO involvement is primarily to provide seedstock for broodstock development purposes. Smolt supply in the Scotia-Fundy Region from private hatcheries ranges from 3.5-4 million annually and the sea cage industry has generally been self-sufficient in terms of smolt supply. However, an oversupply of smolts in Nova Scotia during 1991 caused hardship for some private hatchery operators who were unable to market their product. In New Brunswick, the destruction of 300,000 smolts at a private hatchery last spring because of disease concerns caused some smolt shortages. DFO was required to supply 50,000 smolts from the Mactaquac Hatchery to help alleviate the shortage. Some recent developments may influence the future supply of private-sector smolts in N.S. and N.B. Revision of the federal Fish Health Protection Regulations may allow the movement of private-sector smolts from N.S. to N.B. and alleviate oversupply problems in N.S. Approximately 200,000 smolts being reared in Maine presently satisfy the Fish Health Protection Regulations for

marketing in N.B. However, smolt demand in N.B. may increase with the end of the provincial moratorium which restricted increases in the number of sea cage sites.

4. Continue as a member of the N.B. Salmon Development Working Group. Identify hatchery proposals submitted for ERDA and/or ACOA funding, which have potential for success. (Farmer)

Participated as a member of the N.B. Salmon Development Working Group formed to evaluate private hatchery proposals submitted for ERDA and/or ACOA funding. Only three proposals for construction of hatcheries in N.B. were submitted for review during 1991. However, nine proposals originating in Nova Scotia and seeking funding (ACOA, ISTC, AFAP, N.S. Research Foundation Corporation) for the development of sea cage sites were reviewed.

5. Report on completed biological investigations. (a) Improvements in salmon egg quality attributable to changes in holding practices. (b) The influence of parentage and smolt size at release on age at maturity of adult Atlantic salmon. (c) Survey of east Shelburne County rivers in preparation for smolt release and liming experiments. (d) Sex ratios of hatchery-reared salmon smolts. (e) Effects of stream liming on invertebrate diversity and abundance. (f) Gull worm incidence among juvenile Atlantic salmon. (Farmer)

Report (c) is nearing completion and another manuscript 'Some factors which influence the survival of hatchery Atlantic salmon smolts (Salmo salar) utilized for enhancement purposes' was presented as part of the Colloque Sur L'Ensemencement, March 1-3, 1991, Quebec City and is in press.

6. Chair the Scientific Advisory Committee of the Salmon Genetics Research Program. (Farmer)

The Scientific Advisory Committee (SAC) met October 16 and 17, 1991, with Salmon Genetics Research Program (SGRP) staff to review ongoing programs. A report of the review prepared by the SAC provides an assessment of ongoing SGRP programs and makes recommendations for future research initiatives. The SAC chairman will meet with SGRP staff early in 1992 to discuss recommendations outlined in the review.

7. Reconstruct salmon rearing ponds at the Saint John, Mactaquac and Cobequid hatcheries. (Engineering Services and Fish Culture sections)

Pond reconstruction and modifications at the three hatcheries completed as outlined in 3(1) will result in a significant improvement in smolt quality. An electrical upgrade of the Saint John Hatchery is also nearing completion.

4. Additional Accomplishments:

The Mactaquac Visitor Facility was officially opened during June. Guided tours of the hatchery are provided to the public and feature the viewing of juvenile and adult Atlantic salmon as well as other species of freshwater and anadromous fishes. Displays and written material are available to explain Atlantic salmon biology, salmon enhancement and management programs and fish culture techniques. (Engineering Services and Fish Culture sections)

5. Goals/Expected Outputs for 1992:

1. Coordinate and provide biological input to the Region's fish culture program. Improvement in the quality of both 1+ and 2+ smolts is possible and of high priority. (Farmer)

2. Work with the salmon aquaculture industry in N.S. to develop and assess their broodstock program. (Farmer)

3. Chair the N.B. and N.S. Salmon Seedstock Committees. (Farmer)

4. Identify aquaculture proposals submitted to federal agencies for funding which have potential for success. (Farmer)

5. Report on completed biological investigations. (a) Improvements in salmon egg quality attributable to changes in holding practices. (b) The influence of parentage and smolt size at release on age at maturity of adult Atlantic salmon. (c) Survey of east Shelburne County rivers in preparation for smolt release and liming experiments. (d) Sex ratios of hatchery-reared salmon smolts. (e) Effects of stream liming on invertebrate diversity and abundance. (f) Gull worm incidence among juvenile Atlantic salmon. (g) Magnitude of cormorant predation on salmon smolts. (Farmer)

6. Chair the Scientific Advisory Committee of the Salmon Genetics Research Program. (Farmer)

7. Modify existing 11 m Swedish-type rearing ponds at the Mactaquac Hatchery and construct an additional 8 - 7.6 m Swedish-type ponds at the Saint John Hatchery (Engineering Services and Fish Culture sections).

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

With P.J. Austin - Smith, Nova Scotia Department of Lands and Forests, on the predation of double-crested cormorants, Phalacrocorax auritus on hatchery and wild Atlantic salmon smolts in Nova Scotia rivers.

ii. University Liaison -

R. Doyle and C. Herbinger (Gene Probe Laboratory, Dalhousie University) are involved in the joint DFO - N.S. aquaculture industry salmon broodstock development program and will advise the industry on broodstock selection practices.

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Farmer, G.J. 1991. Programs of the region's fish culture stations, p. 48-51. In T.E. Smith (ed.) Science Review 1988 and 89. Scotia-Fundy Region, Department of Fisheries and Oceans, Box 1006, Dartmouth, N.S. B2Y 4A2.

MacPhail, D.K. 1991. Ages of the salmon broodstock collected in the Scotia-Fundy Region during 1990. Internal Document 91-01, 57 p.

McLean, E.J. 1991. Quality evaluation of hatchery-reared 1+ Atlantic salmon smolts. Internal Document 91-04, 124 p.

McLean, E.J. 1991. Quality evaluation of hatchery-reared 2+ Atlantic salmon smolts. Internal Document 91-05, 51 p.

iv. Popular and Miscellaneous -

8. Review and Evaluation:

This project provides the biological support and feedback for improving the efficiency of hatchery operations and the effectiveness of hatchery projects. It also coordinates the inputs from other sections and divisions of DFO, other government agencies and the public to the Division's fish culture program. In recent years the effort directed towards the conduct of biological investigations has decreased because of loss of the project leader and responsibility for program direction falling on the Section Head, who is burdened with an exceptionally heavy administrative workload. Effort in 1991 deteriorated further with the retirements in the Section of a senior biological technician and the Supervisor of Hatchery Operations and Production. With these retirements biological output decreased and the administrative workload of the Section Head increased. Because the biological investigations carried out under this project are of the utmost importance to continuing to improve the success of the Division's hatchery program, consideration must be given to reinstatement of the science component of this project. The science output and corresponding improvements in hatchery performance will continue to be modest unless more resources are assigned to address key biological questions.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous Project No.: 310

Section: Stock Assessment and Enhancement

Project Title: Anadromous Species Statistical Consulting and Data Collection and Analysis

Project Leader: O'Neil, S.

Other Researchers: Cutting, R.; Marshall, L.; Harvie, C.; Jessop, B.; Newbould, K.

Work Activity: W.A.1.1.1.1

Key Words: data processing; salmon; assessments; biostatistics

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1. Project Description:

Provision of timely and accurate catch/effort statistics (both commercial and sport) for diadromous fish species to scientific staff, fishery managers, provincial resource agencies, and the public. Responsibility for the collection of diadromous statistics was delegated to the Freshwater and Anadromous Division, and procedures for salmon are coordinated with some provincial resource agencies. Preliminary analyses are carried out on data, and the systems developed are verified for accuracy and timeliness. The Tag Clearing House is administered by this project, supplying biologists and scientists with a computerized system for entry and retrieval of release and recapture data on wild and hatchery stocks of Atlantic salmon. Biostatistical consulting services are also provided under this project.

2. Long-Term Objectives:

(i) To provide catch/effort statistics for the diadromous fish species in the Region as required by DFO. (ii) To maintain an information retrieval system for Division tagging and tag recapture data. (iii) To provide editing services to the Division; and (iv) To provide biostatistical consulting services to Division members.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Ensure that catch and effort data for anadromous sport and commercial fisheries are provided in a timely and accurate fashion for stock assessment purposes, for planning and assessment of enhancement projects, and for habitat management. (O'Neil, Harvie)

Data on various species were collected, analyzed and summarized for distribution to assessment staff and other resource agencies as required. (i.e., CAFSAC, Research Branch, Ottawa, Regional FHM Branch, NASCO, ICES, Nova Scotia Department of Natural Resources).

2. Maintain Tag Clearing House for: (a) Regional salmon tagging programs; and (b) Canadian salmon tagging programs. (Newbould, O'Neil)

Maintained and summarized as required by clients.

3. Provide editorial services to Division staff. (Newbould)

Five manuscripts were edited and sent out for publication.

4. Continue to provide base statistics for users by conducting the following priority projects: (a) 1989 and 1990 sportcatches to be published for wider distribution; (b) creel surveys to be designed as required and data analyzed as priorities and schedules permit; (c) improved documentation of existing recreational data base; (d) publication of a report on proposed New Brunswick salmon fishery data collection methods. (O'Neil, Cutting, Marshall)

(a) Data distributed; manuscripts are in preparation. (b) Creel surveys were designed for the Kennebecasis and Saint John rivers. The resulting data were analyzed and the results were relayed to the relevant biologist-in-charge. (c) Documentation of the existing recreational data base has been improved but is not completed. (d) Draft report has been prepared. Additions to the results and discussion are necessary prior to circulation for review.

5. Develop a creel survey design for the St. Mary's River 1991 fishery. (O'Neil, Jessop)

This goal was anticipated but early indications of a need for this were apparently incorrect. No formal request for a creel survey for the Saint Mary's River was made.

4. Additional Accomplishments:

Staffed CS position with C. Harvie, who has a strong mathematics background. Provided biostatistical advice and consulting to division staff for almost the entire reporting period.

Made progress on a report to document historical salmon angling seasons, catch, effort and discharge.

5. Goals/Expected Outputs for 1992:

1. Ensure that catch and effort data for anadromous sport and commercial fisheries are provided in a timely and accurate fashion for stock assessment purposes, for planning and assessment of enhancement projects, and for habitat management. (O'Neil, Harvie)

2. Maintain Tag Clearing House for: (a) Regional salmon tagging programs; and (b) Canadian salmon tagging programs. (Newbould, O'Neil)

3. Provide editorial services to Division staff. (Newbould)

4. Design creel surveys and analyze the resulting data, as required. (O'Neil)

5. Prepare documentation of catch/effort system. (O'Neil)

6. Provide required biostatistical consulting. (Harvie)

7. Complete publication of 1989 and 1990 angling statistics in Data Report Series and work towards finalizing seasons/discharge report. (O'Neil)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

O'Neil, S.F. and D.A.B. Swetnam. 1991. Collation of Atlantic salmon sport catch statistics, Maritime Provinces, 1951-59. Can. Data Rep. Fish. Aquat. Sci. No. 860.

O'Neil, S.F., D.A. Stewart, K. Newbould and R. Pickard. 1991. 1988 Atlantic salmon sport catch statistics, Maritime Provinces. Can. Data Rep. Fish. Aquat. Sci. No. 852.

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Good progress was made on all goals with the exception of goal 5 which was not required. The Division's capabilities in biostatistics were greatly enhanced with the staffing of the Unit's CS position with C. Harvie.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous Project No.: 311

Section: Stock Assessment and Enhancement

Project Title: Divisional Informatics

Project Leader: O'Neil, S.

Other Researchers: Amiro, P.; Cutting, R.; Harvie, C.; Marshall, L.; Boudreau, P.R.

Work Activity: W.A.1.1.1.1

Key Words: administration; data processing; informatics

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1. Project Description:

Directs Freshwater and Anadromous Divisional informatics programs including planning and review, the development of software, software evaluation, hardware acquisition and maintenance, staff training or coordination of EDP related training and data base management system development. Provides advice to Division staff on software, hardware and program-related EDP requirements.

2. Long-Term Objectives:

Continue to provide software development and maintenance service, and system management expertise. Upgrade the level of competence of Division staff on in-house micro-computer and mainframe systems (software and hardware). Ensure that Division EDP requirements are addressed and provided, wherever possible, and work towards having Division staff make more effective use of the data on hand and to prepare for efficient use of any new data being collected.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Fill vacant computer services coordinator position. (O'Neil, Cutting)

CS position filled on acting basis, January 21, 1991; filled permanently in early May 1991.

2. Orient and train new CS in existing programs and objectives, particularly the ORACLE data base systems. (O'Neil)

The CS was familiarized with ongoing programs and initiatives. The practical aspects of ORACLE data base development was delegated to a term CS. The staff CS was trained for one week in ORACLE.

3. Finalize conversion of all HP1000-based software and IMAGE/QUERY data bases to micro-computer systems. (CS)

All IMAGE/QUERY dbase has been transferred to IBM-PC based systems. The distribution data base has been completed (in ORACLE), the Tag Clearing House data base is 65 percent complete and the trap data base will be completed in 1992.

4. Establish image processing station for use in discriminant function analyses and related applications. Become familiar with the BIOSCAN-OPTIMUS software and provide consulting support on same. (Amiro, O'Neil, CS)

An image processing station was set up and Windows 3.0 and BIOSCAN-OPTIMUS software installed and tested. Consulting support on the system was provided as required.

5. Initiate adult salmon trap data base development with plans to complete same in 1992. (CS, Marshall, Cutting)

The trap data base (see 3 above) was initiated and will be completed in 1992. The trap data base may become incorporated into a larger scale data base system development plan.

6. Participate in GIS acquisition and installation/development. (CS)

A GIS (SPANS) was acquired by the Habitat Research Section. The system was not installed during 1991. Use of a GIS has been confined to Habitat Research Section during this reporting period.

7. Provide long-range EDP planning support by keeping abreast of changes in technology. (O'Neil)

A long range EDP plan was prepared to cover the years 1991-95. The plan has served the Division well in that a diversified group of IBM-PC's have met our computing needs during the past two years.

8. Collaborate in developing solutions in enhancement or assessment related problems by applying EDP science and technology. (CS)

Quattro-pro was selected as an optimal tool for preliminary analysis and graphical display of trap

data. A Saint John River salmon returns model was tested in SYSTAT re: non-parametric and parametric models. Prepared a network proposal to facilitate analysis of the angling data set.

9. Provide consultative computing support and training to division staff, as required. (CS)

Consultative support was provided as required. A course in MS-DOS was prepared and taught to 16 staff. A course in LOTUS-1-2-3 was taught to six staff members.

4. Additional Accomplishments:

Worked with Frank Curry, Informatics and Systems Services Division, to coordinate installation of BANYAN VINES network to FWA, including wiring, installation of ethernet cards, a controller and server access for peripherals.

5. Goals/Expected Outputs for 1992:

1. Conduct comprehensive review of data base management requirements for the Division, evaluate options and recommend course of action. A tentative plan to prepare a large scale DBMS with links to statistical and graphical software will be carefully considered during the review because of the significant costs involved. (O'Neil, Harvie, Marshall, Cutting)

2. Complete (pending the outcome of 1) development of the trap data base system. (O'Neil, Harvie, Marshall)

3. Provide informatics consulting support, including software development and training to Division staff. (Harvie, O'Neil)

4. Prepare a long range informatics plan which reflects anticipated informatics need and the changes in technology. (O'Neil, Harvie)

5. Complete evaluation of a network proposal for in-house (LAN) and, if approved, install, test and support. (Harvie)

6. Evaluate feasibility of use of GIS for graphical display of geobased data or modelling. (Harvie, Boudreau, O'Neil)

6. Background:

Highlights:

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Memoranda to division management providing advice and options.

Bullerwell, A., E.J. MacLean, D. Wallace and C. Harvie. 1991. Documentation of the hatchery fish distribution ORACLE data base. In-house report.

8. Review and Evaluation:

With the filling of the Division's lone CS position this project is once again on track. The major challenges for 1992 are to decide upon the most appropriate DBMS and to establish the blueprint for its application throughout the Division.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous

Project No.: 315

Section: Freshwater Habitat Research

Project Title: Acid Rain Research

Project Leader: Watt, W.

Other Researchers: White, W.; Watson, N.; Ritter, J.

Work Activity: W.A.1.1.3.2

Key Words: acid rain; Atlantic salmon; computer model; mitigation; liming; biomonitoring

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1. Project Description:

Chemical and biological monitoring of river and lake acidification and its impact on Atlantic salmon and other freshwater species. Investigation of possible mitigation techniques, pilot studies, and demonstration projects (liming). Model development to assess the impact of acid deposition on salmon production.

2. Long-Term Objectives:

Long-term objectives are to: (1) provide information to aid policy development under international air quality agreements, and under NASCO and ICES; (2) design and test mitigation procedures and apply them to preserve (for a future restocking effort) nuclei of Atlantic salmon stocks presently threatened with extinction; (3) maintain a long-term biomonitoring program to detect biological changes attributable to increases or decreases in acid deposition, and to determine the impact of acidification/deacidification on selected freshwater communities.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Continue long-term biomonitoring protocols for limno, littoral and river benthos, lake and river fish, and acid river bioassays with caged juvenile Atlantic salmon. (Watson, White, Barbour, Watt)

All biomonitoring protocols were completed in 1991, the fourth year of the biomonitoring program. Macrobenthos samples were collected three times (spring, summer and fall) at five river sites and twice (spring and fall) at three lake sites (Watson). Counting and identification of the 1990 samples is proceeding (contract) and will be completed before the end of the year. Fish samples were collected from three lakes (White). Fish bioassay cages were deployed at four river sites in 1991. (White, Barbour, Watt)

2. Continue monthly water sampling and annual electrofishing in eight acidified Nova Scotian rivers to monitor the fate of remnant Atlantic salmon populations. Prepare a report on results from the first ten years. (White, Watt)

Monthly water sampling and chemical analyses were carried out on all biomonitoring rivers (Watt). Annual electrofishing was carried out on eight of Nova Scoria's acidified rivers to assess the present status of acid-impacted remnant salmon stocks and other fish species in these rivers (White). This was the eleventh year of the N.S. salmon river biomonitoring project. An interim report on the design and the preliminary results is in preparation, but because of changes in national priorities the report has been postponed to allow for a proposed downsizing and reorganization of this long-term project.

3. Continue liming and biological/chemical monitoring of the demonstration deacidified refuge in the East Branch of East River, N.S. (White, Watt)

In Jan-Feb of 1991, 400 tonnes of powdered limestone were spread over the ice of four headwater lakes of the East Branch of East River, Nova Scotia. This was the sixth consecutive year of liming. The deacidified refuge and its controls are biologically and chemically monitored. Refuge pH's remained stable at near neutrality (Watt). Salmon parr and fry numbers increased further at all stations within the limed portion of the river, indicating colonization of empty deacidified habitat by the enhanced numbers of returning spawners (White). Main river sites (below the confluence with the limed tributary) have also been successfully colonized (White), and water chemistry shows significant down-river improvement (Watt). This implies a substantial export of acid neutralizing capacity from the refuge, indicating that the system is now near saturation. The extent of annual liming can now be reduced, since the original concept was that only a small refuge would be required to maintain the genetic continuity of the stock (Watt). A report is in preparation (Watt).

4. Test the preliminary freshwater and marine life stage modules of the acid river Atlantic salmon model, correct shortcomings and prepare final versions. Program and commence testing the preliminary hydrochemical module. (All Habitat Research staff plus other Sections and Divisions of Biological Sciences Branch)

Marine and freshwater modules were programmed and tested, and a number of shortcomings were noted. A contract has been let (with Environmental and Social Systems Analyst Ltd. of Vancouver) to prepare revised versions, and to prepare a hydrological and geochemical module to complete the model (Watt, and staff from other Sections and Divisions of Biological Sciences Branch, and from Environment Canada).

5. Assess the results of the 1990/91 study. Do a mobility (microscopy) and/or viability (fluorescent) study of cryopreserved sperm (precocious parr) from Atlantic coast stocks, to test for compatibility with cryopreservation methodology. (Watt)

Aquaculture funds were not available, so the planned joint project could not proceed. The available funding (AFAP) was used to support one student's research for one year. Sperm was collected from 230 precocious salmon parr, and cryogenically preserved. Thawed sperm was tested for motility and damage (fluorometry). These results will be compared with results from fertility tests conducted this fall with thawed sperm and fresh eggs. A thesis is expected (Guelph) in 1993 (Watt).

4. Additional Accomplishments:

Analysis has been completed on a study examining twenty years of presence/absence data on N.S. lake fish species, and the relation between disappearance of species and levels of acidity. A report is in preparation. (White)

A national benthic invertebrate species list was developed for the biomonitoring data base, and the list has been computerized. (Watson)

5. Goals/Expected Outputs for 1992:

1. Continue long-term biomonitoring protocols for lake benthos and fish, scaling down the benthos portion to one sample per year. (Watson, White)

2. Reorganize the acid river biomonitoring program (chemistry, invertebrates and fish), reducing the scale and the number of rivers, and mothballing the caged fish bioassay program. (White, Watt)

3. Commence computerization and transmission of the biomonitoring data to the national data base. (White, Watson, Watt)

4. Maintain the limed refuge on East River, N.S. as a study area to measure the juvenile salmon production levels that can be achieved by deacidifying an Atlantic Upland stream. This information is required for development of the computer simulation model of salmon in acid rivers, see #5 below. (White, Watt and staff of Stock Assessment Section)

5. Test the preliminary hydrochemistry module of the Atlantic Salmon Regional Acidification Model, identify shortcomings and prepare a revised version. Test the revised versions of the freshwater and marine life stage modules and design studies to collect some of the data required to fill the information gaps made apparent by the modelling exercise. Program and commence testing the preliminary hydrochemical module. (All Habitat Research staff plus staff from other Sections and Divisions of Biological Sciences Branch and Environment Canada)

6. Complete data analysis and publish:

   (i) Creation of a limed refuge for genetic preservation of an Atlantic salmon stock threatened by acidification, East River, N.S. (Watt)

   (ii) Evidence for lethal and sub-lethal effects of acidification, and their mitigation, in semi-natural caged fish bioassays using juvenile Atlantic salmon. (Watt)

   (iii) Model of Atlantic salmon production in relation to stream pH. (Ritter, Regional DFO staff and ESSA)

6. Background:

Highlights:

A regional tax ($20,000) on our LRTAP funding means that processing of 1991 benthic samples will be delayed, and regional biomonitoring data from previous years cannot be computerized and transmitted to the new national data base ($10,000 was given to us for regional data base development this year).

Selected Involvements:

i. Collaborative Research -

Dr. R. K. Misra (Physical and Chemical Sciences Branch) is developing specialized statistical procedures and computer programs for trend-through-time analysis of the biomonitoring data.

The Environment Canada Water Quality Laboratory in Moncton, N.B. performs major ion and metal analyses on stored water samples from the biomonitoring program.

ii. University Liaison -

Dr. David Cone, St. Mary's University, Halifax, N.S. is collaborating on a study of eel parasites as indicators of acidification in N.S. rivers. A manuscript is in preparation.

iii. Communications -

iv. Contracts Administered -

Mr. Paul Mandell, Halifax, N.S. - same day analyses for water chemistry parameters that do not permit storage ($20K).

Environmental and Social Systems Analysts Ltd, Vancouver, B.C. - Development of models to assess the impacts of acid deposition on Atlantic salmon production in Nova Scotia ($76K).

Ms. Lynn Barrington, Halifax, N.S. - Caged fish bioassays in acid rivers ($12K).

Dr. K.A. Neil, Acadia University, N.S. - Identification and enumeration of benthic invertebrates ($10K).

v. Other -

The biomonitoring program requires considerable person-power, supplied this year by five students.

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

This project will undergo major changes in 1992. Both the lake and stream biomonitoring activities are being streamlined to match the lower level of funding anticipated in the future. Similarly, the caged fish bioassays will be discontinued. The lake liming activity will move into a new phase with achievement of the initial objectives, and the modelling exercise will be greatly reduced with completion this year of the second of the two major phases of this activity. 1992 should see the emergence of a streamlined project and increased effort on preparation and analyses of data and publication.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Freshwater and Anadromous Project No.: 316

Section: Freshwater Habitat Research

Project Title: Freshwater Fish Habitat Assessment and Related Research

Project Leader: Watt, W.

Other Researchers: White, W.; Boudreau, P.R.

Work Activity: W.A.1.1.3.1

Key Words: alewife; Atlantic salmon; habitat research; mitigation; gaspereau; salmon enhancement

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1. Project Description:

Conduct biological investigations as required to protect freshwater fisheries habitat by: (a) reviewing all major development proposals and doing field assessments to determine the potential for impact on freshwater and anadromous fisheries; (b) conducting post-construction assessments of mitigation effectiveness and developing improved mitigation techniques; and (c) investigating habitat problems relating to fish passage, habitat alterations, water diversions, and screening of intakes.

2. Long-Term Objectives:

Provide DFO's freshwater research and assessment requirements arising from the fish passage and habitat protection sections of the Fisheries Act, and the Federal Environmental Assessment and Review Policy (EARP).

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Respond to any freshwater fish habitat related EARP and RSCC environmental impact assessment referrals, and prepare Initial Environmental Assessments and (where necessary) Initial Environmental Evaluations for new projects in the Freshwater and Anadromous Division. (White)

Environmental assessment activity: An Environmental Impact Assessment Report was prepared for a DFO project to provide fish passage on the upper Saint John River at Grand Falls N.B. An Environmental Impact Assessment was reviewed for a hydroelectric project at Morgan Falls N.S. on the LaHave River. Initial Environmental Assessments were prepared for enhancement and fish passage engineering at Grand River, N.S.; St. George, N.B.; Sheet Harbour, N.S.; and Morrison Brook, N.S.; replacement of underground fuel storage tanks at all hatchery sites; outdoor pond construction and modification at Saint John, Mactaquac and Cobequid, and dam repairs at Yarmouth; lake liming and road repairs at East River, N.S.

2. Design, and if flow conditions permit, carry out an assessment of the effectiveness of the downstream bypass at Milltown, St. Croix River, New Brunswick/Maine. The study will use radio tagged Atlantic salmon smolts. (White, Watt)

The experimental design is complete and all necessary equipment is ready, however, flow conditions were not suitable in 1991. Spillage of excess water over the dam took place during most of this year's smolt migration. The effectiveness of the bypass cannot be tested when excessive amounts of water are being spilled.

3. Provide scientific advice to the Fisheries and Habitat Management Branch and senior DFO management with regard to non-guidelined and complex fish habitat alteration proposals, and other technical problems affecting the administration of the fish passage and fish habitat protection sections of the Fisheries Act. (White, Barbour, Watt)

A field reconnaissance was conducted on the Madawaska River (N.B.), and local user groups were consulted. Consultant proposals were reviewed and advice was provided for letting a contract to conduct a survey of the fishery enhancement potential of the river.

Advice was provided on the resource requirements for liming proposals on the Barrington River (Shelburne Co.), Meteghan River (Yarmouth Co.), Salmon and Bear rivers (Digby Co.), Little Salmon River (Halifax Co.), the 101 Highway at Little Springfield Lake (Halifax Co.), a liming and flow diversion proposal for Jordan Lake (Shelburne/Queens Co.), and a proposed stream liming program on Cape Breton Island.

Advise was provided re effects of water quality on salmon and trout populations in MacKintosh Run (Halifax Co.), on the regulation of water levels in the St. Croix River to protect anadromous fish habitat, on the suitability of urban lakes for trout stocking and/or natural populations, and fishery resources in the vicinity of all existing military bases in Scotia Fundy.

Fish kills were investigated on Nine Mile River at Enfield (July 11) and Fall River (July 22).

4. Monitor for possible reappearance of the Coho salmon incursion on the Cornwallis River, as per ICES recommendation. (Barbour)

Not done. All discretionary summer field programs were cancelled due to lack of funds.

5. Carry out a statistical analysis of the data on microhabitat availability (IFIM), egg deposition and electrofishing densities of juvenile salmon in the Tobique River system, N.B., and prepare a report. (Boudreau)

The analysis has been completed and a draft manuscript prepared.

6. If GIS resources are available, investigate the practicality of integrating the LaHave River salmon management model with a GIS. (Watt, Boudreau)

Programs were written to convert NTX format to ESL format, and digital base maps for the entire LaHave drainage have been converted for use with INFOCUS/QUIKMAP and SPANS. An attempt to install an old version of SPANS was only partially successful, however, several model conversion problems have been resolved. Based on this experience a new version of SPANS was acquired, for running in OS-2 instead of MS-DOS.

7. If resources are available, commence data assessment and computerization for the detection of impacts of long-term climate changes on freshwater habitat in Scotia-Fundy. (Watt, Boudreau)

No resources were available to do this work.

8. If equipment and resources are available, install and do preliminary tests on an acoustic array system for the automated counting of migrating salmon (adult and juvenile). Progress in habitat research is presently handicapped by lack of an accurate (and non-person-power intensive) method to measure habitat productivity. An automated method for smolt (and adult) counting that could be installed on virtually any river would be invaluable. (Boudreau)

No resources were available to do this work.

4. Additional Accomplishments:

Our new biologist (Boudreau) successfully completed a course in limnology at Dalhousie University, to broaden his knowledge of freshwater systems.

5. Goals/Expected Outputs for 1992:

1. Respond to any freshwater fish habitat related EARP and RSCC environmental impact assessment referrals, and prepare Initial Environmental Assessments and (where necessary) Initial Environmental Evaluations for new projects in the Freshwater and Anadromous Division. (White)

2. Design, and if flow conditions permit, carry out an assessment of the effectiveness of the downstream bypass at Milltown, St. Croix River, New Brunswick/Maine. The study will use radio tagged Atlantic salmon smolts. (White)

3. Provide scientific advice to the Fisheries and Habitat Management Branch and senior DFO management with regard to non-guidelined and complex fish habitat alteration proposals, and other technical problems affecting the administration of the fish passage and fish habitat protection sections of the Fisheries Act. (White, Watt)

4. Set up a SPANS GIS model of juvenile salmon production in the portion of LaHave river above Morgan Falls. (Boudreau)

5. Publish a Technical Report on relative roles of egg deposition and habitat availability in juvenile salmon densities in Gulquac River, Saint John System, N.B. (Watt).

6. Publish a Technical Report on relation between alewife run density and efficiency in use of a fish ladder on the St. Croix River, N.B. (Watt)

6. Background:

Highlights:

Finally getting the 1983 data set on Gulquac analyzed. This was made possible by assignment of an additional biologist to the Habitat Research Section.

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

iv. Contracts Administered -

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

Barbour, S.E. Atlantic salmon habitat evaluation in the context of the Department of Fisheries and Oceans (DFO) policy for the management of fish habitat. p. 9-12, in "Collected papers on fish habitat with emphasis on salmonids", CAFSAC Research Document 90/77 (423 p.).

Barbour, S.E. Microhabitat selection by juvenile Atlantic salmon in a small, unstable stream; p. 295-306, in "Collected papers on fish habitat with emphasis on salmonids", CAFSAC Research Document 90/77 (423 p.).

White, W.J. Limitations of Habitat Evaluation Procedure (H.E.P.) models for fish habitat management; p. 237-254, in "Collected papers on fish habitat with emphasis on salmonids", CAFSAC Research Document 90/77 (423 p.).

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Scarcity of resources (O&M and technical support) prevent the undertaking of new field research initiatives. Hence, 1992/93 will be largely confined to service (rather than research) and the publication of past research results.

AQUACULTURE AND INVERTEBRATE FISHERIES DIVISION

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Aquaculture and Invertebrate Fisheries Project No.: 400

Section:

Project Title: Coordination, Aquaculture and Invertebrate Fisheries Program

Project Leader: Cook, R.

Other Researchers: Chang, B.; Fawkes, G.

Work Activity: W.A.1.1.1.3; W.A.1.1.2.2; W.A.1.1.3.2

Key Words: aquaculture; invertebrate fisheries; habitat ecology

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1. Project Description:

The Aquaculture and Invertebrate Fisheries Division has lead responsibility for finfish culture in the marine environment, experimental marine fish larval work, and the culture of invertebrates applicable to the Bay of Fundy area. Specific responsibilities include the management of research programs on physiology of salmonid growth and reproduction, invertebrate biology and aquaculture, marine finfish aquaculture, aquaculture ecology research, marine phytotoxins, groundfish ecophysiology, salmon ecology and acid rain. The Division also has the lead responsibility for invertebrate fisheries assessments and biological research in the Bay of Fundy area. Other specific responsibilities within the Biological Sciences Branch include: focus for Aquaculture Research and Development in Southwestern New Brunswick; administration of St. Andrews Biological Station as a Regional Science Institute.

2. Long-Term Objectives:

Plan, direct and coordinate research programs in fields of aquaculture research and development relevant to the responsibilities of the Biological Station for aquaculture and invertebrate fisheries research; facilitate technology transfer related to aquaculture development, particularly marine finfish culture in the Region; manage a federal scientific institution and provide facilities and services necessary to support fisheries research relevant to the overall mandate of the Biological Station; serve as Senior Branch Advisor on aquaculture activities within the Scotia-Fundy Region; assess the invertebrate fisheries resources of the Bay of Fundy area, carry out related research and provide biological advice to fisheries managers.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Direct the scientific research programs on finfish aquaculture, aquaculture ecology and marine toxins, acid rain ecology, and invertebrate aquaculture and fisheries in the Bay of Fundy area. (Cook)

Developed research projects on aquaculture in conjunction with HMSC, ASF (SGRP), the NBSGA, and private sector. Participated in Federal-New Brunswick Environmental Committee for Aquaculture in the Bay of Fundy. Participated in planning of marine toxin research studies and regional LRTAP research through Branch coordinative committees.

2. Promote technology transfer in the field of mariculture and provide a focus for aquaculture development and respond to requests for advice on aquaculture. (Cook, Chang)

Delivered presentations to a broad spectrum of audiences on aquaculture, including industry and scientific associations. Served on Atlantic Aquaculture Fair Executive Committee. Provided advice to Area Manager (SWNB) and to the province on aquaculture and related technology, and to industry representatives and growers. Development of ASDDF project proposals and funding alternatives. Served on Management Committee of ASDDF. Convened technology transfer sessions on aquaculture. Served on Steering Committee on Disease Prevention in N.B. Farmed Salmon Industry (UNB coordinated program).

3. Serve as Senior Branch Advisor on aquaculture. (Cook)

Provided overview on aquaculture programs within Region to senior managers, provided commentary, and represented Region at meetings on aquaculture development. Served on the Coordinating Committee of the Canada-New Brunswick MOU on Aquaculture and related subcommittees. Coordinated responses on behalf of BSB on finfish aquaculture. Served on APICS Aquaculture Committee. Provided advice to ACOA, Fisheries Development Branch, and Canada-New Brunswick Cooperation Agreement on aquaculture development. Participated in working group with Area Manager (SWNB) to coordinate DFO aquaculture activities in Scotia-Fundy section of New Brunswick. Prepared Canadian administrative report to ICES Mariculture Committee and served as rapporteur to Mariculture Committee at the Statutory Meeting.

4. Provide support to the Division's computing needs, including programming and equipment trouble-shooting. (Fawkes)

Support for Division programming and equipment trouble-shooting was provided including: plotting of

scallop and lobster tag recovery data, plotting of scallop surveys, continued development of aquaculture data base. Participated in the Biological Station Computer Advisory Committee. Maintained an inventory of Division computer hardware and software.

5. Serve as Station Director to coordinate provision of scientific support services to all programs and to encourage inter-divisional and Branch research activities carried out at St. Andrews. (Cook)

Provided general direction to Coordinator, Station Support Services on the facilities, vessels and other scientific support services at St. Andrews for all scientific research programs. Served as Scientific Authority for Atlantic Reference Centre and as a voting member of the Huntsman Marine Science Centre. Chaired Station Management Committee and represented Station on Regional Science 'Tuesday Club'. Responded to broad spectrum of general inquiries to St. Andrews Station on fisheries sciences and aquaculture. Provided guidance to Station Communications initiatives. Encouraged inter-Branch/Division participation in work plan development, seminar presentations, and provided guidance to completion of Station Conference Centre and made arrangements for official opening.

6. Coordinate scientific evaluation of aquaculture site applications and develop a geographic data base system for aquaculture developments in the Bay of Fundy area. (Chang)

Coordinated DFO Science input into aquaculture site referral system. Participated as member of Canada-New Brunswick Aquaculture Advisory Committee, Aquaculture Environmental Coordinating Committee, and the DFO Southwestern N.B. Aquaculture Working Group. Development of a geographic data base system proceeded slowly, due to shortage of funds and unavailability of digitized maps for the southwestern N.B. area.

4. Additional Accomplishments:

1. Provided advice and reports to the IJC St. Croix Pollution Advisory Board as a Canadian member in support of the restoration of anadromous fisheries to the St. Croix River.

2. Initiated a number of local facility improvements including the new building for the Atlantic Reference Centre, the Station Conference Centre and Histology Laboratory.

3. Served as Editorial Board of the journal Fisheries Research.

4. Development of plans for Regional Aquaculture Coordination Office.

5. Goals/Expected Outputs for 1992:

1. Manage the scientific research programs carried out at the St. Andrews Biological Station on aquaculture, marine fish and invertebrate fisheries, habitat ecology and marine chemistry in the Bay of Fundy/Gulf of Maine area.

2. Serve as Station Director and coordinate, by means of a Station Management Committee, the provision of scientific and administrative support services to all programs at the St. Andrews Biological Station.

3. Coordinate the evaluation of aquaculture site applications in SWNB and provide a scientific focus for aquaculture development and activities arising from the St. Andrews research programs. (Chang)

4. Provide support to the computing needs of the aquaculture, invertebrate fisheries and habitat ecology research projects at the Biological Station. (Fawkes)

6. Background:

Highlights:

The project is to provide scientific leadership to the aquaculture, marine fish, invertebrate fisheries and habitat ecology research programs carried out at the St. Andrews Biological Station, Scotia-Fundy Region.

Selected Involvements:

i. Collaborative Research -

Collaborative research activities are very broad and will be documented within the individual project reports submitted by scientific staff operating out of the Biological Station.

ii. University Liaison -

Act as supervisor for Science Subvention projects undertaken by university researchers. Served on regional fisheries and aquaculture committees. Served as a voting member of the Huntsman Marine Science Centre which includes the participation of twelve universities. Encourage staff participation as adjunct professors and supervise postgraduate students.

iii. Communications -

Provide numerous interviews and presentations to aquaculturists, fishermen, associations, universities and the press. Wrote several articles for Atlantic Fish Farmer and other regional papers. Served as member of the Atlantic Aquaculture Fair Executive Committee. Ongoing collaboration with communications officer at St. Andrews. Development of display depicting the scientific institutions of St. Andrews.

iv. Contracts Administered -

Salmon Genetics Research Program, Atlantic Salmon Federation, $220K (1990-91). (DFO share, see project 401 for details).

Atlantic Reference Centre, Huntsman Marine Science Centre, $85K (1990-91) (Core funding base; see Project 540 for details).

v. Other -

7. Publications:

i. Primary -

ii. Interpretive Scientific -

iii. Scientific and Technical -

Cook, R.H. (ed.). 1991. Canada, 4-19. In H. Ackfors (ed.). Activity report 1990/91 Mariculture Committee. ICES C.M. 1991/F:1.

Cook, R.H. and R.E. Lavoie. 1991. Science and aquaculture: a matter of demand and supply, p. 40-44. In Science Review of the Bedford Institute of Oceanography, the Halifax Fisheries Research Laboratory, and the St. Andrews Biological Station 1988 and '89. DFO Scotia-Fundy Region.

Cook, R.H. and W. Pennell (Editors). 1991. Proceedings of the special session on salmonid aquaculture, World Aquaculture Society, February 16, 1989, Los Angeles, U.S.A. Can. Tech. Rep. Fish. Aquat. Sci. 1831: p. 167.

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Substantial progress has been achieved in the scientific programs of the Division during the review period. Good progress was achieved with New Brunswick officials and the SWNB Area Manager in aquaculture development and in related communications with the general public. More effective working relationships among the various scientific programs at St. Andrews have been achieved and a number of significant improvements to Station facilities during the review period have been implemented.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Aquaculture and Invertebrate Fisheries Project No.: 401

Section:

Project Title: Salmon Genetics Research Program

Project Leader: Cook, R.

Other Researchers: Saunders, R.; Ritter, J.; Farmer, G.; Peterson, R.; Olivier, G.; Claytor, R.

Work Activity: W.A.1.1.2.2

Key Words: salmon; aquaculture; salmonid culture; genetics

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1. Project Description:

This is a cooperative project of the Department of Fisheries and Oceans and the Atlantic Salmon Federation. It is carried out at the Atlantic Salmon Research Centre near St. Andrews. Initiated in 1973, the research program is designed to advance technology in salmon genetics and demonstrate the benefits of selection which will contribute to the economic value of Atlantic salmon. Research involves the estimation of genetic parameters that will enhance the efficient development of strains of salmon suitable for both the strategies of salmon enhancement and sea-cage culture.

2. Long-Term Objectives:

Design, develop and test models, protocols and procedures for breeding which have practical application both in the management of Atlantic salmon stocks and in aquaculture; chair the Salmon Genetics Research Program Steering Committee to coordinate the development of improved strains of Atlantic salmon so that the strategies of salmon enhancement and cage rearing can be realized; implement the four line selection matrix producing smolt, individually identified as to pedigree, for sea ranching and sea-cage culture; encourage collaborative research at the Salmon Research Centre's facilities to complement the breeding program.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Evaluate freshwater growth and smoltification in control and select lines of the Biotechnology strain.

Two percent increase in smoltification of select vs control line.

2. Spawn control and select lines of Strain 87JC at ASDDF.

Control and select lines spawned in November, 1991.

3. Monitor performance of Strain 84JC with multiplier growers.

Advantages in selects over commercials is apparent in growth corrected for smolt size.

4. Establish families at the freshwater stage in Strain 90JC.

Families are being reared for presumptive smoltification evaluation in early 1992.

5. Evaluate the return rates of control and vaccinated (vibrio and furunculosis) groups of released smolts.

Vaccination was detrimental to return rate.

6. Establish cooperative research projects in sperm cryogenics, disease resistance and evaluation of the behavior of cage escapees, where funds can be obtained.

Progress with University of Guelph on sperm cryogenics with UNB-lead disease prevention project on bacterial kidney disease. Allozyme research on cage-cultured strains by visiting scientist, Dr. T. Cross, Dublin, Ireland, forms a baseline for cage-escapee work.

4. Additional Accomplishments:

1. Monitoring of the performance of SGRP stock multiplier growers.

2. Input to Northeast Division of the Society of Fisheries meetings.

3. Input to the 4th International Symposium of Genetics in Aquaculture, Wuhan, China.

4. Publication of primary, scientific, technical and popular press releases of information.

5. Discussions with individuals and presentations to groups concerned with the genetics of both wild and aquaculture stocks.

5. Goals/Expected Outputs for 1992:

1. Evaluate seawater performance in control and select lines of the Biotechnology strain.
2. Evaluate freshwater performance of control and select lines of the 87JC strain.
3. Integrate disease resistance into the selection index to be used in the 84JC strain.
4. Evaluate smoltification in strain 90JC.
5. Evaluate the return rates of control and vaccinated (vibrio and furunculosis) groups of released smolts.
6. Establish cooperative research projects in sperm cryogenics, disease resistance, allozyme and DNA markers, sea lice resistance and evaluation of the behavior of cage escapees, where funds can be obtained.

6. Background:

Highlights:

The SGRP continued to conduct research and development in the genetics of strains involved in release-return, as well as cage-cultured stocks. The procurement of gametes from the Saint John River for the 89JC and 90JC stocks has involved close cooperation between the ASF and the Freshwater and Anadromous Division (BSB).

Selected Involvements:

i. Collaborative Research -

Assessment of ovarian development in grilse, salmon and grilse x salmon crosses in collaboration with R.R. Claytor, DFO, Moncton.

G. Oliver will be summarizing results on resistance of families to challenges with furunculosis in line with data layout formats recently discussed.

ii. University Liaison -

G.W. Friars is an Honorary Research Associate of the University of New Brunswick, where he acts as co-supervisor of a Ph.D. student, Alex Hanke.

G.W. Friars has been appointed to the supervisory committee of Adam Harrington, a graduate student at the University of Guelph, doing cooperative research with the SGRP on sperm cryogenics.

Preliminary work on the role of methyl testosterone on the reconditioning of kelts has been commenced with L.W. Crim of Memorial University. Further studies will be developed in connection with successes encountered in 1991.

Pedigreed families have been reared for DNA fingerprinting research in conjunction with C.M. Herbinger and R.W. Doyle, of Dalhousie University. Additionally, blood samples have been procured to evaluate DNA heterozygosity in released smolts contrasted to returning adults.

Modelling of parr length distribution is being conducted in conjunction with I. McMillan and M. Quinton, of the University of Guelph.

Collaborative work on milt cryogenics is being planned with R. Moccia, of the University of Guelph and M.A. McNiven, of the Atlantic Veterinary College. A graduate student at Guelph, Adam Harrington, is doing research on SGRP strain 85XC.

Collaborative work on disease, with M. Burt, W. Lynch and T.J. Benfey, of the University of New Brunswick, G.B. Bacon, of the Research and Productivity Council, and the N.B. Salmon Growers' Association, is being planned. This work has been extended to examine family variation in resistance to sea lice in cooperation with Dr. B. MacKinnon, of the University of New Brunswick.

Collaborative work with J.A. Ritter, DFO, and R.W. Doyle, Dalhousie University, is being planned in connection with cage escapees.

Preliminary development of a technical bulletin on Sea Ranching will be supplemented by input from G. Farmer, DFO.

Cooperative work with C. Exley, University of Stirling, Scotland, is being conducted on aluminum and silicon content of water from concrete and fibreglass tanks.

iii. Communications -

Meetings with growers and enhancement managers.
Involvement in trade shows.
Publications described below.
Presentations to visiting groups.
Popular press.
Participation in scientific meetings:

Bailey, J.K. and G.W. Friars. 1991. Are feral Atlantic salmon likely to have a quantitative

genetic impact on wild populations? DFO Conference in Nanaimo, B.C., June 3-8 (poster).

Bailey, J.K., F.M. O'Flynn and G.W. Friars. 1991. Genetic and phenotypic correlations among freshwater growth traits in Atlantic salmon. Aquacult. '91, St. Andrews, N.B.

Benfey, T.J. and G.W. Friars. 1991. The production of all-female triploid Atlantic salmon. Abstracts from a presentation to the Atlantic Universities Aquaculture Conference, March 8-9, 1991. St. Mary's University, Halifax, N.S., M.J. Dadswell, Chairman.

Friars, G.W. 1991. Breeding Atlantic salmon for performance in sea cages. 47th Ann. N.E. Fish and Wildlife Conf.

Friars, G.W. 1991. Selection for resistance to disease in a breeding program for Atlantic salmon. DFO Fundy Region 14th Fish Health Workshop, p. 7.

Friars, G.W. and J.K. Bailey. 1991. Time trends in returns from sea coupled with genetic equilibrium in Atlantic salmon (Salmo salar). DFO Conference in Nanaimo, B.C., June 3-8 (poster).

Friars, G.W., J.K. Bailey and F.M. O'Flynn. 1991. Application of selection indexes in Atlantic salmon (Salmo salar). 4th Int. Sym. on Gen. in Aquacult., Wuhan, China, April 28-May 3.

Hanke, A.R., G.W. Friars, J.M. Terhune. 1991. The effect of competition of the ranks of Atlantic salmon families with different hatching times in a grilse and a two-sea-winter stock. Aquacult. '91, St. Andrews, N.B.

O'Flynn, F.M., G.W. Friars, J.K. Bailey and J.M. Terhune. 1991. The development of a linear selection index in Atlantic salmon. Aquacult. '91, St. Andrews, N.B.

iv. Contracts Administered -

v. Other -

Primary breeder for the N.B. Salmon Growers' Association.

7. Publications:

i. Primary -

Friars, G.W. 1991. Some tests and applications of quantitative genetics theory in trifolium poultry and fish. Informacion Technica Economica Agraria, Vol. 87A. Nos. 2-3, p. 103-107.

Hanke, A.R., S. Backman, D.J. Speare and G.W. Friars. 1991. An uncommon presentation of fungal infection in Atlantic salmon fry. J. Aquat. Anim. Health 3: 192-197.

ii. Interpretive Scientific -

iii. Scientific and Technical -

Anonymous. 1991. SGRP Annual Report 1990/91.

Anonymous. 1991. Atlantic Salmon Workshop. Proceedings from a workshop held on October 17, 1989, St. Andrews, N.B., SGRP Report Series 131.

Friars, G.W. and T.J. Benfey. 1991. Triploidy and sex reversal in relation to selection in the Salmon Genetics Research Program. Can. Tech. Rep. Fish. Aquat. Sci. No. 1789, p. 81-83.

Friars, G.W., J.K. Bailey and K.A. Coombs. 1991. Some aspects of selection in aquaculture, p. 85-92. In R.H. Cook and W. Pennell (eds.) Proceedings of the special session on salmonid aquaculture, World Aquaculture Society, February 16, 1989, Los Angeles, USA. Can. Tech. Rep. Fish. Aquat. Sci. 1831.

Soto, C.G., 1991. Fertilization and mortality rate of Atlantic salmon (Salmo salar) eggs during incubation. SGRP Rep. Ser. No. 134.

iv. Popular and Miscellaneous -

Anonymous. 1991. Newsletter on Salmon Genetics Research Program, April 1991.

Scott, S.A. 1991. Genetics plays key role in 1990 returns to the SGRP. Atlantic Salmon Journal, 40 (1), p. 14.

Scott, S.A. 1991. Workshop on broodstock development. Salar, May, 1991.

8. Review and Evaluation:

The SGRP has been undergoing significant change in the last few years with the increasing focus on the development and selection of strains for salmon aquaculture. The direct participation of the NBSGA and the New Brunswick Department of Fisheries and Aquaculture, have strengthened the program. The re-orientation of strain improvement to meet aquaculture production objectives has received

strong industry support. The program is well managed by the Atlantic Salmon Federation and collaborative research with DFO scientists and the universities is very productive. The involvement of the SGRP in research to assess the problem of aquaculture salmon escapees on wildstock is relevant and timely. This program is continuing to develop and is a long-standing example of DFO private sector science collaboration.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Aquaculture and Invertebrate Fisheries Project No.: 402

Section: Aquaculture

Project Title: Salmonid Growth, Smolting and Reproduction

Project Leader: Saunders, R.

Other Researchers: Harmon, P.; Knox, J.D.; Duston, J. and Hovey, A. (IRAP-R project with Connors Bros.)

Work Activity: W.A.1.1.2.2

Key Words: salmon; aquaculture; salmonid culture; physiology

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1. Project Description:

Conduct physiological research on salmonid growth and smolting to elucidate effects of environmental manipulation on metabolism, growth and behaviour; evaluate smolting on the basis of endocrinological, metabolic and osmoregulatory activity; investigate environmental and genetic bases for age-at-maturity of Atlantic salmon; conduct field tests on sea farms to scale-up promising lab results; transfer salmonid culture technology to private sector through contact with commercial marine and freshwater salmon producers.

2. Long-Term Objectives:

Provide solutions to biological problems encountered or anticipated in salmonid aquaculture; improve the quality and cost-effectiveness of producing salmon smolts for aquaculture and enhancement of wild populations; improve the productivity and cost-effectiveness of salmonid aquaculture through a better understanding of the environmental and genetic control of age-at-maturity; develop and perfect methods of controlling maturity; participate in an effective extension service for the salmonid aquaculture industry by cooperative research and technology transfer with salmonid aquaculture companies and by receiving feedback from new R&D initiatives.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Continue study of underyearling smolt production in Atlantic salmon with emphasis on early production. (Saunders, Duston)

Success appears to depend on fish reaching smolt size before experiencing winter photoperiod. A high percentage of the population is showing smolt-like salinity tolerance in October-November.

2. Investigate natural occurrence, genetic basis and possible use as a genetic marker of spotted fins in Atlantic salmon. (Saunders)

We did not undertake this work because of inadequate lab space and funds.

3. Report findings of attempts to acclimate parr to seawater in autumn. (Duston)

Paper in press in Aquaculture.

4. Report findings from experiment on effects of different levels of dietary omega-3 fatty acids in salmon. (Ackman, Saunders)

Paper on levels of omega-3 fatty acids and their stability published in J. Food Process. Preserv.

5. Investigate alternate tissues for enzyme for bioassay of fish growth. (Benfey, Saunders)

Muscle, but not liver, appears to be a good tissue for assay of enzyme closely associated with growth.

6. Initiate cooperative experiment with Connors Bros. on reduction of maturation as grilse in Atlantic salmon deprived of food during various periods in winter-spring if AFAP funding approved. (Saunders, Frantsi)

The sea cage component of the study is underway. AFAP funding has been provided in December 1991 for the remainder of the fiscal year. A lab component is being done using my operating budget.

4. Additional Accomplishments:

1. Participating in study of transgenic salmon with added growth hormone as part of an NSERC strategic grant project with scientists from University of Toronto, Queen's University and Memorial University of Newfoundland.

2. Conducted experiment in cooperation with SGRP to evaluate smolt status of salmon reared in

concrete vs fibreglass rearing tanks.

5. Goals/Expected Outputs for 1992:

1. Hatch and rear transgenic (growth hormone) salmon and evaluate effects of extra copies of GH on growth and smolting. (Saunders, Fletcher)

2. Continue study of underyearling smolt production with follow-up evaluation of long-term survival and growth in seawater. (Saunders, Duston)

3. Evaluate smolt production from previously mature male parr. (Saunders)

4. Conduct study in cooperation with Connors Bros., re effectiveness of food deprivation in winter-spring on grilse maturation. (Saunders, Frantsi)

5. Report findings of cooperative study with SGRP, re smolt production in concrete vs fibreglass rearing tanks. (Saunders, Friars)

6. Evaluate influence of photoperiod and temperature on development of bimodality in length frequency as an indication of incipient smolt status. (Saunders, Duston)

6. Background:

Highlights:

Participated in Helsinki meetings of ICES Genetics and Introduction and Transfers Committees.

Selected Involvements:

i. Collaborative Research -

With James Duston, of Connors Bros., on autumn transfer to seawater and smolt development of juvenile salmon under terms of IRAP-R contract; with personnel of SGRP, re evaluation of smolt status of salmon grown in concrete and fibreglass rearing tanks.

ii. University Liaison -

Completed studies of omega-3 fatty acids in salmon with Dr. R. Ackman, of Technical University of N.S.; with Dr. Tillmann Benfey, of University of New Brunswick, re enzyme bioassay of salmon growth; completed study of coronary arteriosclerosis in salmon with Dr. A.P. Farrell, Simon Fraser University; served as opponent for Ph.D. thesis examination at University of Umeå, Sweden; began NSERC-sponsored study of growth hormone transgenic salmon with staff from University of Toronto, Queen's and Memorial Universities.

iii. Communications -

Presented lecture to students in Aquaculture Technician Training Program, N.B. Community College; DFO press release, re environmental manipulation of juvenile salmon growth.

iv. Contracts Administered -

v. Other -

Serving as Scientific Advisor, re IRAP-R contract with Connors Bros., Aquaculture Division.

Liaison Officer for two DFO Science Subvention projects.

7. Publications:

i. Primary -

Duston, J., R.L. Saunders and D.E. Knox. 1991. Effects of increases in freshwater temperature on loss of smolt characteristics in Atlantic salmon (Salmo salar). Can. J. Fish. Aquat. Sci. 48: 164-169.

Rourke, A.W., R.L. Saunders and P.R. Harmon. 1991. Changes in plasma protein patterns in smolting Atlantic salmon, Salmo salar L., are not dependent on changed growth rates. J. Fish. Biol. 39: 35-43.

Lubin, R.T., A.W. Rourke and R.L. Saunders. 1991. Influence of photoperiod on the number and ultrastructure of gill chloride cells of the Atlantic salmon (Salmo salar) before and during smoltification. Can. J. Fish. Aquat. Sci. 48: 1302-1307.

Polvi, S.M., R.G. Ackman, S.P. Lall and R.L. Saunders. 1991. Stability of lipids and omega-3 fatty acids during frozen storage of Atlantic salmon. J. Food Process. Preserv. 15: 167-181.

McCormick, S.D., W.W. Dickhoff, J. Duston, R.S. Nishioka and H.A. Bern. 1991. Developmental differences in the responsiveness of gill Na^+, K^+ - ATPase to cortisol in salmonids. Gen. Comp. Endocrinol. 84: 308-317.

Stefansson, S.O., B. Th. Björnsson, T. Hansen, C. Haux, G.L. Taranger and R. L. Saunders. 1991. Growth, parr-smolt transformation, and changes in growth hormone of Atlantic salmon (Salmo salar) reared under different photoperiods. Can. J. Fish. Aquat. Sci. 48: 2100-2108.

ii. Interpretive Scientific -

Saunders, R.L. 1991. Potential interaction between cultured and wild Atlantic salmon. Aquaculture 98: 51-60.

iii. Scientific and Technical -

Duston, J., D.E. Knox and T., Maynard. 1991. On producing 1.5+ year-old Atlantic salmon smolts by photoperiod manipulation. Bull. Aquacult. Assoc. Can. 91-3: 41-43.

Saunders, R.L. 1991. Le concept de souche dans la gestion et la restauration des populations de saumon Atlantique. In Nicole Samson et Jean-Pierre le Bel (Eds.) Compte Rendu de L'atelier sur le nombre de reproducteurs requis dan les rivières à saumon. Ile aux Coudres. Février 1988. Minist. du Loisir, de la Chasse et de la Pêche, 65-80.

Saunders, R.L. 1991. Salmonid mariculture in Atlantic Canada and Maine, U.S.A., P. 21-36. In R.H. Cook and W. Pennell (Eds.) Proc. Special Session on Salmonid Aquaculture, World Aquac. Assoc. February 16, 1989. Can. Tech. Rept. Fish. Aquat. Sci. 1831.

Saunders, R.L. 1991. Canadian studies on gene technology, biochemical markers and means of reducing genetic interaction between cultured and wild salmon. 9 p. In Anon. 1991. Report of the Working Group on Genetics. ICES C.M.1991/F:45. Mariculture Committee.

iv. Popular and Miscellaneous -

8. Review and Evaluation:

Data from the studies of environmental manipulation of juvenile salmon in relation to growth, smolting and sexual maturation have been reported in the scientific and technical literature. These reports are increasingly quoted and the data are being used as guides by fish farmers to increase numbers and effectiveness in smolt production. The effectiveness of the project owes much to successful collaboration with other scientists nationally and internationally and through contact with salmon growers.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Aquaculture and Invertebrate Fisheries Project No.: 404

Section: Applied Ecology

Project Title: Phytotoxin Research

Project Leader: Wildish, D.

Other Researchers: Martin, J.L.; Wilson, A.

Work Activity: W.A.1.1.3.3

Key Words: aquaculture; phytotoxins; domoic acid; PSP

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1. Project Description:

The aim of the research undertaken is to document phytoplankton autecology of species of microalgae which are harmful to finfish or bivalve molluscs, particularly those of commercial value. Individual projects are selected based on their practical relevance in resolving problems primarily in mariculture in the Bay of Fundy, but also in more traditional fisheries.

2. Long-Term Objectives:

To understand phytoplankton autecology of species harmful (or potentially harmful) to commercially valuable bivalve molluscs or finfish. This will allow remedial or inspection measures to be considered in the mariculture or traditional fisheries industries.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Undertake a temporal cluster analysis to determine annual, recurrent patterns in phytoplankton species and their density.

Considerable effort was expended in changing the data base (species, density and environmental parameters X time) from a form suitable for technical report publishing to one suitable for temporal statistical analysis. This work is still not completed. Preliminary attempts were made to choose a computer compatible temporal analysis for use with this large data base, inclusive of environmental variables, but there is now no expert advice regarding statistics in St. Andrews. One possibility to maximize the scientific value of this large, five-year data base is to allow Ms. Martin to explore different temporal analytical techniques following further training in these methods (half credit course at U.N.B.).

2. Continue a phytoplankton bloom dynamics monitoring project at 4 stations sampled regularly as part of the Scotia-Fundy program.

Sampling was completed satisfactorily to date, although some sample analyses are back-logged due to lack of contracted help in the identification laboratory. A technical report is in preparation detailing the 1990-1991 results.

3. Initiate a new project to determine the factors controlling the production of domoic acid in Nitzschia pseudodelicatissima.

A new incubator was commissioned during the year which enabled more culture experiments to be run. various nutrient levels (N, PO_4, Si) were tested. Microscopic observations showed that bacteria were present in the cultures. Tests are underway to obtain axenic cultures so that nutrient effects are free of microbial mediation.

4. To develop and test an automated flume in which seston and flow can be controlled. The laser diode system required for controlling seston levels in the flume is expensive ($30K). Any further work on determining bivalve feeding rates when fed toxic microalgae is only possible if it is purchased (submitted to Scotia-Fundy Phytotoxin Advisory Committee).

The laser diode system was not purchased and a cheaper alternative, a flow-through Turner fluorometer, was tested, although this system has obvious limitations, e.g. can only be used where pure cultures of one species of microalgae are fed, it does appear possible to use it in these limited conditions as a seston controller. A new flume lab and new flume (the mini flow tank designed by M. Chin Yee) were installed in July. Experiments are currently underway to confirm that bivalve feeding can be monitored in the flow-through fluorometer.

5. Continue to determine the effects of toxic microalgae on the behaviour and physiology of finfish by conducting further screening bioassays involving open heart ECG's with 40-50 microalgae from the Bay of Fundy; conduct fish bioassays with implanted acoustic heart tags when challenged with 1 or 2 toxic microalgae.

Difficulty was found in obtaining repeatable control ECG's between different fish preparations.

Because of this difficulty, this bioassay has been abandoned - an unpublished report is being prepared on our results and experience.

The flume lab is currently (November) being prepared for these experiments (purchase of behavioral observation tank, purchasing and acclimating salmon smolts).

4. Additional Accomplishments:

1. Gave advice to the industry through personal contacts, DFA and DOE (N.B.), the N.B. Salmon Growers Association (Martin, Wildish), DFO Inspection, Halifax, DFO Communications Branch, Ottawa, and DFO, Moncton. (Martin)

2. Reviewed manuscripts and research proposals inclusive of DFO Science Subvention proposals. (Wildish, Martin)

3. Presented "Distribution and domoic acid content of Nitzschia pseudodelicatissima in the Bay of Fundy" at the 5th International Conference on Toxic Marine Phytoplankton, Newport, Rhode Island, 28 October - 1 November, 1991. (Martin)

5. Goals/Expected Outputs for 1992:

1. Determine the factors controlling the production of domoic acid in N. pseudodelicatissima.

2. Collaborate with K. Haya in a PSP study involving saxitoxin uptake and elimination in American lobsters.

3. Provide a reduced phytoplankton monitoring service to the salmonid aquaculture industry (four stations, surface water only, weekly from May - October), whilst at the same time maintaining a long time series analysis of phytoplankton of the SW mouth Bay of Fundy.

4. Complete development and testing of an automated flume, based on the Turner fluorometer as the seston controller. Undertake collaborative work with Dr. P. Lassus, IFREMER, Nantes, France, to determine the effect of locally important toxic microalgae on bivalve feeding rates.

5. Conduct fish bioassays with implanted heart tags to determine the effect of toxic microalgae on physiology and behaviour.

6. Background:

Highlights:

Building and equipping a custom-designed flow simulation lab, including successful calibration of a new flume capable of velocities up to 100 $cm.s^{-1}$.

Selected Involvements:

i. Collaborative Research -

Collaborative work with PCS group at St. Andrews continued to be mutually beneficial.

ii. University Liaison -

Significant liaison was maintained with the universities of Rhode Island, U.S.A., and Lund, Sweden.

iii. Communications -

Invited presentations were prepared for the Workshop on the Environmental Impacts of Mariculture organized by Canada/Norway: "Methods for determining benthic flora and fauna near mariculture sites" (D. Wildish) and "Determining the potential harm of phytoplankton blooms to cultured salmonids in seawater" (D. Wildish and J. Martin). The workshop to be held in Bergen, Norway was cancelled due to lack of travel funds by Canada.

iv. Contracts Administered -

One contract for phytoplankton identification. (J. Martin)

v. Other -

7. Publications:

i. Primary -

Haya, K., J.L. Martin, L.E. Burridge, B.A. Waiwood and D.J. Wildish. 1991. Domoic acid in shellfish and plankton from the Bay of Fundy, New Brunswick, Canada. J. Shell. Res. 10: 113-118.

ii. Interpretive Scientific -

iii. Scientific and Technical -

Wildish, D.J. 1991. The flow simulation laboratory at St. Andrews Biological Station. Can. M.S. Rep. Fish. Aquat. Sci.

iv. Popular and Miscellaneous -

Martin, J.L., K. Haya, L.E. Burridge and D.J. Wildish. 1991. Nitzschia pseudodelicatissima - a source of domoic acid in the Bay of Fundy, eastern Canada. In: D.C. Gordon (ed.) Proc. Second Canadian Workshop on Harmful Marine Algae. Can. Tech. Rep. Fish. Aquat. Sci. 1799: 14. (abstract)

Martin, J.L., D.J. Wildish and M.M. LeGresley. 1991. Phytoplankton monitoring in the Fundy Isles Region. In: D.C.Gordon (ed.) Proc. Second Canadian Workshop on Harmful Marine Algae. Can. Tech. Rep. Fish. Aquat. Sci. 1799: 14. (abstract)

Wildish, D.J., F. Bouvet, R.H. Peterson and J.L. Martin. 1991. The effect of marine, microalgal extracts on the salmon smolt electrocardiogram. In: D.C. Gordon (ed.) Proc. Second Canadian Workshop on Harmful Marine Algae. Can. Tech. Rep. Fish. Aquat. Sci. 1799: 28-29. (abstract)

8. Review and Evaluation:

This project continues to meet its long term objectives by being proactive in choosing individual research topics. In addition, solid progress has been made in:

- determining the source of production of domoic acid in the Bay of Fundy
- planning a temporal analysis of the Bay of Fundy phytoplankton data
- determining which phytoplankton species might be of potential harm to the salmonid mariculture and the commercial bivalve fishing industries.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Aquaculture and Invertebrate Fisheries Project No.: 405

Section: Aquaculture

Project Title: Marine Finfish Aquaculture

Project Leader: Waiwood, K.

Other Researchers: Howes, K.; Reid, J.

Work Activity: W.A.1.1.2.2

Key Words: halibut; cod; haddock; marine fish culture

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1. Project Description:

This project has focused on halibut (Hippoglossus hippoglossus) and consists of three research thrusts: broodstock development; juvenile production; and on-growing. Currently about 45 broodstock are held in a special facility and are producing over 20 liters of eggs per spawning season. On-growing studies have included the evaluation of modified herring weirs, salmon cages and specially-designed bottom cages. Egg and larval studies began in 1991.

2. Long-Term Objectives:

To develop technologies for the culture of marine finfish in support of the aquaculture industry in the Scotia-Fundy Region; to determine the feasibility of introducing new marine fish species and culture techniques for aquaculture purposes; to transfer technologies related to marine fish culture to industry, and to provide advice on physiological and behavioural problems related to the aquaculture of marine finfish in the Scotia-Fundy Region.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Submit for publication technical paper on Weir study.

The first draft of this paper has been prepared for submission as a technical report.

2. Continue research on collection of zooplankton (M.Sc. student project).

The first season of data collection was successfully completed. A time series of zooplankton collections was made. A poster paper entitled "A simple method for the mass collection of zooplankton for early feeding marine fish" was presented at the Larvi '91, Ghent, Belgium, August 27-30, 1991. An oral presentation was made at the Atlantic Aquaculture Fair (June).

3. Initiate study on haddock feeding (M.Sc. student project), if funded by NSERC.

This study was not funded by NSERC however, several collections were made in May/June, 1991 and over 80 haddock were eventually placed in tanks in St. Andrews. Subsequently, 20 haddock were transferred to a salmon cage on Campobello Island. After some initial mortality, survival and growth have been good. The remainder of the fish were kept in St. Andrews to be used for broodstock. This represents one of the few (if not the only) haddock broodstock in captivity.

4. Initiate study on combined effect of salinity and flow rate on egg mortality.

A study on the effect of low salinity on egg development was initiated. Data on fertilization and hatching success, mortality, and developmental abnormalities has been analyzed. Preliminary results indicate that halibut eggs can be incubated in low ambient salinities. However, the studies show some benefit in increasing salinity in order to reduce flow rates. This indicated that the method of controlling salinity had to be refined.

5. Fabricate and assemble yolk-sac larval rearing systems and, if possible, initiate survival studies.

Despite numerous delays, incubators were eventually delivered and set up for yolksac larvae. Unfortunately, after the initial attempt no more eggs were obtained from the broodstock. The limited operation did, however, indicate that the water supply system had to be modified for the next year. This has been done.

6. Complete annual broodstock report.

Delays in staffing a technician position and the resultant increase in work loads has delayed preparation of this report.

7. Continue study on halibut bottom cage in cooperation with Washington County Community College, Eastport, Maine.

This cage has been modified to incorporated safety features. Construction is now complete. Halibut will be placed in this cage in the spring of 1992.

8. Continue study on halibut on-growing in modified salmon cages in cooperation with Harbour DeLoutre Products Ltd.

This study was continued another year. The preliminary results are very encouraging with 100% survival and excellent growth rates. These results strongly suggest that halibut on-growing in the Bay of Fundy is economically feasible using modified salmon culture methods.

4. Additional Accomplishments:

1. Paper entitled "halibut (Hippoglossus hippoglossus) a potential aquaculture species for the Maritimes" was published in Aquanotes 16: 32-36.

2. A paper entitled "Low temperature feeding in cod (Gadus morhua) by Waiwood, K.G., S.J. Smith and R. Peterson was published (Can. J. Fish. Aquat. Sci. 48(5): 824-831).

5. Goals/Expected Outputs for 1992:

1. Continue on-growing studies on halibut and haddock with Harbour DeLoutre Products Ltd., Campobello.

2. Continue study on the on-growing of halibut in bottom cage with Maine Aquaculture Innovation Center (MAIC) and Marine Trade Center, Eastport.

3. Continue work on mass collection of zooplankton in conjunction with the MAIC and the University of Maine.

4. Complete experiments on effect of salinity on incubation of halibut eggs; analyze data.

5. Initiate studies on incubation methods for halibut yolk sac larvae including an evaluation of incubator type and effect of salinity on survival and development; analyze data.

6. Submit for publication Technical Report on halibut on-growing in weirs.

7. Present paper at 16th Annual Larval Fish Conference, Kingston, RI, June 17-19, 1991.

8. Present paper at conference on Broodstock Management and Egg and Larval, Quality, Stirling, Scotland June 23-27, 1991.

9. Conduct collaborative studies with Anders Mangor-Jensen (Austevoll, Norway) on water transport in fish eggs.

6. Background:

Highlights:

We are pleased with the progress made with our on-growing studies. The results indicate a four-year production cycle for halibut is feasible with a three-year cycle as a long-term goal. So far, there is every indication that the on-growing aspect of halibut culture is economically feasible. Due to the current level of A-base support, egg and larval studies have progressed more slowly. It should be noted, also, that we did not receive the second year of funding from AFAP as applied for. On the other hand, we are very encouraged by successes in Norway this year which indicate that commercial quantities of halibut fry can be produced using current technology.

Selected Involvements:

i. Collaborative Research -

- with the Maine Aquaculture Innovation Center, University of Maine and North Atlantic Aquaculture Inc., on a growout study using bottom cages and a Masters student project on the collection of wild zooplankton for feeding larval fish.

- with Harbour DeLoutre Products Ltd. on a halibut grow-out study using modified salmon cages (funded by Canada - New Brunswick Cooperative Agreement on Fisheries and Aquaculture Development).

- with John Allen at the Huntsman Marine Science Centre, St. Andrews, on projects related to cage rearing of halibut.

ii. University Liaison -

- with the University of Maine, Orono, Maine, co-supervisor of a M.Sc. student

- with University of New Brunswick, Honorary Research Associate

- with the N.B. Community College, supervision of a summer student and presentation of several lectures

iii. Communications -

Bulletins/Newspapers: Atlantic Fish Farming, June 20, 1991, "Halibut eggs do well" by Laura Haley; Sou'wester, February 28, 1991, "Canada looks at halibut aquaculture" by Thea Smith; Northern Aquaculture, "Halibut culture prospects encouraging" by Suzanne Taylor; Fish Farming International, July, 1991, "Canada program assists three research projects"; The Quoddy Tides, September 2, 1991 "Halibut raising could be wave of future" by E. French; Telegraph Journal, November 30, 1991, "Halibut may change direction of aquaculture", by D. Gowan; St. Croix Courier,

November 26, 1991, "Grower tries raising haddock" by T. Lockhart;

TV: ASN Interview and news feature on Alive at Five by Lavern Stewart, October 24, 1991.

Other: DFO Backgrounder, June 3, 1991. "Aquaculture research programs receive AFAP funding". Weekly Scientific Briefing, "On-growing studies with halibut continuing", by K.G. Waiwood.

iv. Contracts Administered -

1. Canada - N.B. Cooperative Agreement on Fisheries and Aquaculture Development ($38K) for halibut on-growing study in modified salmon cages.

2. Scientific authority on MAIC grant for the development of methods for the mass collection of zooplankton ($20K US).

v. Other -

7. Publications:

i. Primary -

Waiwood, K.G., S.J. Smith and M.R. Peterson. 1991. Feeding of Atlantic cod (Gadus morhua) at low temperature. Can. J. Fish. Aquat. Sci. 48(5): 824-831.

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

Waiwood, K.G. 1991. Halibut (Hippoglossus hippoglossus) a potential aquaculture species for the Maritimes. Aquanotes 16: 32-36.

8. Review and Evaluation:

Considerable progress has been made in this major study in spite of a serious shortage of technical assistance during critical seasons for spawning and hatching. The cooperation projects with a weir operator and a salmon sea-cage operator have provided useful information which should help to answer important questions about grow-out feasibility and biological aspects of growth and suitability of cage-enclosures. Meaningful progress with spawning, incubation and rearing to the grow-out stage will depend heavily on having adequate help. The broodstock development component of the project is making good progress. Much useful information should come from the DFO workshop being organized by Dr. Waiwood to consider marine fish culture from a national perspective.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Aquaculture and Invertebrate Fisheries Project No.: 406

Section: Applied Ecology

Project Title: Aquaculture Ecology Research

Project Leader: Wildish, D.

Other Researchers: Martin, J.L.; Wilson, A.

Work Activity: W.A.1.1.3.5

Key Words: aquaculture; habitat research; benthos

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1. Project Description:

The aim of this work is to determine the extent and biological implications of habitat changes caused by the intensive culture of finfish or bivalve molluscs, so that remedial measures to minimize self pollution can be taken. The research involves collaboration with chemical and physical oceanographers in PCSB. Another aim is to research environmental factors influencing bivalve mollusc carrying capacity, so that cultured bivalve production can be predicted and therefore optimally managed.

2. Long-Term Objectives:

Fully understand all of the environmental factors influencing the holding capacity of cultured marine fish and the production of cultured suspension-feeding marine bivalve molluscs.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

1. Continue a study of environmental factors influencing bivalve feeding rates. Will conduct experiments with bivalve molluscs to test the importance of gill bypass shunting as a mechanism for the observed decrease of filtration rate with increasing ambient flow. This work will be done in collaboration with Prof. D.D. Kristmanson, University of New Brunswick.

Two manuscripts have been accepted for publication in J. Exp. Mar. Biol. Ecol. on the interactive effect of velocity and seston concentration on bivalve feeding and the effect of flow on the growth of juvenile and adult giant scallops. A number of different techniques have been tried to assess the importance of gill bypass shunting during partial valve closures. These include pressure measurements at the exhalant and isokenetic sampling of exhalant flows. The former method has been discarded as impractical with the scallop exhalant and work with the latter continues but has yet to produce conclusive results.

2. The following benthic studies in relation to environmental effects of salmonid mariculture will be undertaken: completion of a seasonal study of sedimentary conditions near salmonid net pens, inclusive of data analysis and preparation of an MS; continue collaboration with PCS and HED in developing a holding capacity model for the L'Etang salmonid culture industry; continue collaboration with Dr. B.T. Hargrave, HED to determine realistic input parameters suitable for use in the holding capacity model. The focus of this work will be on microbial ecology and it will involve a PDF. The costs will be shared between AIFD and HED.

Seasonal benthic studies were completed as planned and two manuscripts are nearing completion on seasonal changes in benthic oxygen demand under a salmonid mariculture site (in collaboration with B. T. Hargrave) and on dissolved oxygen/nutrient conditions in the seawater above this site (in collaboration with P. Keizer). Collaboration with PCS and HED continued with a number of modelling workshops held during the year. A show and tell session with the salmon mariculture industry and its managers is planned for January, 1992, at which time progress to date on ecological modelling in the L'Etang to determine the holding capacity for salmonids will be presented. A collaborative project with B.T. Hargrave on the microbial ecology of salmonid net pen sites was cancelled because the PDF candidate selected, Dr. Karen Wiltshire, obtained a job elsewhere, and the funds to support it (from AFAP) did not materialize.

3. Develop a research proposal (and obtain funding for it) to determine "The effects of dissolved oxygen and temperature on salmon smolt growth." This information is needed by the aquaculture industry to show how environmental conditions can affect growth rates.

The project "The effects of dissolved oxygen and temperature on salmon smolt growth" was initiated in a small way with student help at the Huntsman Marine Science Centre. Funds are still being sought from NRC for this project through Dr. Brian Glebe, of HMSC. It is hoped to have the project underway by spring, 1992.

4. Additional Accomplishments:

1. Acted as co-chairman with Dr. Barry Jones (N.B. Department of Fisheries and Aquaculture) of the N.B. Aquaculture Environmental Coordinating Committee. Gave advice to the industry via the N.B. Salmon Growers Association. During the year, an environmental monitoring project designed by DJW became operational (Wildish and N.B. Department of Environment)

2. At the request of Habitat Management (A. Ducharme), undertook studies in Blacks Harbour to delimit the extent of pollution caused by a large fish processing facility. The work was done in collaboration with Dr. V. Zitko, PCS, and a report was prepared (see section 7 (iii)). (Wildish, Wilson)

3. Gave advice to environmental consultants regarding pulp mill pollution in L'Etang and acted as expert witness for the Crown in a court action in which the pulp mill was charged with exceeding the PME regulated levels of BOD and suspended solids. (Wildish).

4. Undertook training of Mr. Peter Fenety in environmental matters related to aquaculture. Mr. Fenety was on lateral transfer from DOT (Air Traffic Controller) and hoping to redeploy in the aquaculture industry. (Wildish, Wilson)

5. Reviewed manuscripts received from primary journals or from colleagues for pre-review. Also reviewed a few research proposals from the Natural Sciences and Engineering Research Council - two individual applications and one infrastructure grant. (Wildish)

5. Goals/Expected Outputs for 1992:

1. Continue a study of environmental factors influencing bivalve feeding rates. Emphasis will be on behavioural responses to velocity. Part of the work will involve a collaborative project on bivalve molluscs feeding on toxic microalgae with Dr. P. Lassus, IFREMER, Nantes (see project 404). Will organize a fifth benthic workshop to be held in the fall of 1992 at St. Andrews. (Wildish, Wilson)

2. Undertake a review of the literature regarding flow as an environmental factor affecting suspension feeding benthic animals. (Wildish)

3. Continue the study "The effects of dissolved oxygen and temperature on salmon smolt growth" with Dr. Brian Glebe, of Huntsman Marine Science Centre. The project is focused on determining potential effects of low dissolved oxygen on feeding and growth by salmon. (Wildish)

4. Organize a fifth benthic workshop at St. Andrews in collaboration with J. Grant and B.T. Hargrave on "Marine Benthos and Flow". (Wildish)

6. Background:

Highlights:

Use of a video camera to record changes in the scallop exhalant associated with velocity related changes suggests that valve closure is the mechanism of feeding inhibition. Also the commissioning of the new flow simulation lab occurred in July of 1991.

Selected Involvements:

i. Collaborative Research -

Continued collaboration with R. W. Trites (PCS) and B.T. Hargrave (HED) on developing input data for a salmonid holding capacity model. Initiated new collaborative projects with Dr. B. Glebe (HMSC) and Dr. P. Lassus (IFREMER, France).

ii. University Liaison -

Honorary Research Associate at UNB.

Co-supervision of Mr. Luc Roseberry at the Université du Québec à Rimouski.

iii. Communications -

Gave radio and TV interviews concerning the environmental effects of mariculture and L'Etang pulp mill pollution.

Wrote an article for Science Review 1990-91 on "Effect of flow on mollusc suspension feeding".

iv. Contracts Administered -

Two personal service contracts for laboratory assistants - $50K.

v. Other -

7. Publications:

i. Primary -

Wildish, D.J. and B. Frost. 1991. Volumetric growth in gammaridean Amphipoda. Hydrobiologia. 223: 171-176.

Wildish, D.J., A.J. Wilson and B. Frost. 1992. Benthic boundary layer macrofauna of Browns Bank, N.W. Atlantic as potential prey of juvenile benthic fish. Can. J. Fish. Aquat. Sci. 49: 153-160.

Chevrier, A., P. Brunnel and D.J. Wildish. 1991. Structure of a suprabenthic shelf sub-community of gammaridean amphipoda in the Bay of Fundy compared with similar sub-communities in the Gulf of St. Lawrence. Hydrobiologia. 223: 81-104.

ii. Interpretive Scientific -

iii. Scientific and Technical -

Wildish, D.J. and V. Zitko. 1991. Chemical oceanographic conditions in Black's Harbour, N.B. in 1989-1991. Can. MS. Rep. Fish. Aquat. Sci. 2132: 11 p.

iv. Popular and Miscellaneous -

8. Review and Evaluation:

With the cooperation of HED scientists from B.I.O., good progress has been achieved in producing a holding capacity model of the salmon mariculture industry at least within the L'Etang. A workshop designed to bring this knowledge to the industry and its managers is planned for early 1992. The building of the new flow simulation laboratory at St. Andrews should enable fundamental discoveries regarding bivalve mollusc feeding, growth and behavior to be made which will have practical importance in culture of these species. It is recommended that these opportunities are rigorously pursued over the next few years.

PROGRAM REVIEW, EVALUATION AND PLANNING 1991/92

Division: Aquaculture and Invertebrate Fisheries Project No.: 407

Section: Aquaculture

Project Title: Effects of Low pH on Salmonid Development

Project Leader: Peterson, R.

Other Researchers: Martin-Robichaud, D.; Lacroix, G.

Work Activity: W.A.1.1.3.2

Key Words: acid rain; salmon

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1. Project Description:

Investigate the influence of low pH on physiological processes, such as ion transport and behaviour of developing salmonid eggs and alevins. Carry out lake and stream surveys to determine the limits imposed by lake and stream pH distribution of fish and fish food organisms.

2. Long-Term Objectives:

Prediction of how low pH and other ionic concentrations interact to affect early fish development, and establishment of acceptable pH limits. Ability to predict how increased acidification will limit fish and fish food resources. Note that goals for 1988 in the 1988/89 PREP have changed.

3. Goals/Expected Outputs vs. Accomplishments in 1991:

Complete publication of experimental results.

4. Additional Accomplishments:

5. Goals/Expected Outputs for 1992:

1. I anticipate that sufficient material for one more publication, on adsorption of Al to the salmon chorion, is on file. This data will be written into a manuscript in 1992/93. I suggest this project be cancelled after 1992/93.

6. Background:

Highlights:

Factors related to stream size and alkalinity were most influential in determining fish and stream insect species associations in three catchments of N.B. and N.S. The lower limiting mid-summer pH levels for creek chub, salmon, brook trout and eel are 5.2, 5.0, 4.7 and < 4.5, respectively.

Selected Involvements:

i. Collaborative Research -

ii. University Liaison -

iii. Communications -

1. Peterson, R.H. and P. McCurdy. 1991. Fish distribution in three watersheds of N.B. and N.S., a poster presentation at the 'International Symposium on the production of juvenile Atlantic salmon in natural waters'; St. John's, Nfld., January 25-27.

2. Peterson, R.H., L. Van Eeckhaute and D. Gale. 1991. Distribution of fish, mayflies, caddisflies and stoneflies in three coastal watersheds of N.B. and N.S., Canada, an oral presentation at the American Fisheries Society annual meeting, San Antonio, Texas, September 8-12.

iv. Contracts Administered -

v. Other -

Donated voucher specimens from the insect surveys to the N.B. Museum, Atlantic Reference Centre, and Royal Ontario Museum; provided research specimens to S.K. Burian (South Connecticut State

University) and K.L. Schmude (University of Wisconsin).

7. Publications:

i. Primary -

Peterson, R.H. and D. Gale. 1991. Fish species associations in riffle habitat of streams of varying size and acidity in New Brunswick and Nova Scotia. J. Fish. Biol. 38: 859-871.

ii. Interpretive Scientific -

iii. Scientific and Technical -

iv. Popular and Miscellaneous -

8. Review and Evaluation:

This project continues to make major contributions to understanding of the influence of low pH on ion transport, and other physiology and behavior of developing salmonid embryos and alevins.