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Canadian Science Advisory Secretariat | **Secrétariat canadien de consultation scientifique**

Proceedings Series 2003/006 | **Série des compte rendus 2003/006**

Proceedings of a Workshop to Develop Guidelines for Support of Southern Upland NS and Eastern Cape Breton Island Atlantic Salmon

12-13 September 2001
Ramada Inn
Dartmouth, Nova Scotia

Compte rendu d'un atelier visant à élaborer des lignes directrices pour soutenir les populations de saumon atlantique du sud du bas-plateau de la Nouvelle-Écosse et de l'est de l'île du Cap-Breton

Les 12 et 13 septembre 2001
Ramada Inn
Dartmouth (Nouvelle-Écosse)

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February 2003 / Février 2003

FOREWORD

These Proceedings are a record of the discussions at a Workshop to develop Guidelines for Support of Southern Upland and Eastern Cape Breton Island Atlantic Salmon on Sept 12 -13, 2001. They were prepared by volunteer rapporteurs at the meeting. The purpose is to archive the activities and discussions of the meeting, including recommendations, uncertainties and to provide a place to formally archive official minority opinions on status reports. As such, interpretations and opinions presented in this report may be factually incorrect or misleading, but are included to record as faithfully as possible what transpired at the meeting. No statements are to be taken as reflecting the consensus of the meeting unless they are clearly identified as such. Moreover, additional information and further review may result in a change of decision where tentative agreement has been reached.

AVANT-PROPOS

Le présent document relate les discussions tenues à un atelier visant à élaborer des lignes directrices pour soutenir les populations de saumon atlantique du sud du bas-plateau de la Nouvelle-Écosse et de l'est de l'île du Cap-Breton, ayant eu lieu les 12 et 13 septembre 2001. Il a été établi par les rapporteurs bénévoles présents à la réunion, dans le but de rendre compte des activités et discussions de l'atelier, y compris des recommandations et des incertitudes, et il sert aussi à consigner en bonne et due forme les opinions minoritaires officielles au sujet des rapports d'état. Les interprétations et opinions qui y sont présentées peuvent être incorrectes sur le plan des faits ou trompeuses, mais elles sont intégrées au document pour que celui-ci reflète le plus fidèlement possible ce qui s'est dit à la réunion. Aucune déclaration ne doit être considérée comme une expression du consensus des participants, sauf s'il est clairement indiqué qu'elle l'est effectivement. En outre, des renseignements supplémentaires et un plus ample examen pourront avoir pour effet de modifier une décision qui avait fait l'objet d'un accord préliminaire.

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February 2003 / Février 2003

ISSN 1701-1280

Published and available free from:
Une publication gratuite de:

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Science Advisory Secretariat / Secrétariat canadien de consultation scientifique
200, rue Kent Street
Ottawa, Ontario
K1A 0E6

http://www.dfo-mpo.gc.ca/csas/

CSAS@DFO-MPO.GC.CA

Printed on recycled paper.
Imprimé sur papier recyclé.

Correct citation for this publication:
On doit citer cette publication comme suit:

Marshall, T.L., G. Stevens, and K. Rutherford. 2003. Proceedings of a workshop to develop guidelines for support of Southern Upland NS and Eastern Cape Breton Island Atlantic Salmon. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2003/006.

TABLE OF CONTENTS

ABSTRACT

Failure of the divestitures of mainland Nova Scotia hatcheries resulted in their return without funding to Department of Fisheries and Oceans (DFO) Maritimes Region Science. Science proposed retention of the Coldbrook and Mersey hatcheries as "biodiversity facilities" in support of "species-at-risk" (inner Bay of Fundy salmon, Atlantic whitefish and possibly Atlantic Coast [Southern Upland] Atlantic salmon) through live gene banking. Capacities for mitigation, integrated fisheries management plans, research and Aboriginal food fisheries were inferred to Fisheries Managers but undefined and unfunded. A workshop was convened on Sept 12-13, 2001, in which client groups were invited to share information background to Science funded initiatives/Fishery Management objectives and advise on possible allocation of biodiversity facility space surplus to science requirements. Workshop reports and recommendations by clients failed to yield allocation strategies for conservation/gene banking and IFMP/Aboriginal initiatives noting in general that the Department's operational policy framework for recreational fisheries promoted enhancement of fisheries resources with hatchery production and that the Region should seek appropriate funding to do so.

As a follow-up to the workshop, the Region drafted a Briefing Note intended for the Minister. A recommendation was for national funding of biodiversity facilities so as to eliminate the erosion of Science's regional research capacity and insure some production capacity for Fisheries Management initiatives. That Briefing Note was not advanced to the Minister, but, with Headquarters directives, was eventually revised for the background of the new Minister of Fisheries and Oceans, April 2002 (Appendix 6). That new document more simply related observations on the importance of the biodiversity facilities to preservation and recovery of threatened and endangered species, their operation within an east coast no-enhancement mandate and their limited funding.

RÉSUMÉ

Faute d'être parvenu à se dessaisir de ses écloseries dans la partie continentale de la Nouvelle-Écosse, le ministère des Pêches et des Océans (MPO) dans la Région des Maritimes en a gardé la responsabilité, mais sans financement. La Direction des sciences a proposé de conserver les écloseries de Coldbrook et de Mersey, pour en faire des « centres de biodiversité » servant à soutenir les « espèces en péril » (saumon atlantique de l'arrière-baie de Fundy, corégone atlantique et peut-être saumon atlantique de la côte atlantique [sud du bas-plateau de la Nouvelle-Écosse]) grâce au stockage de gènes. Par ailleurs, il est présumé que les gestionnaires disposent des capacités connexes aux mesures d'atténuation, de plans de gestion intégrée des pêches, de recherche et aux pêches de subsistance des autochtones, mais ces capacités ne sont ni définies, ni provisionnées. Lors d'un atelier tenu les 12 et 13 septembre 2001, on a invité des groupes de clients à échanger de l'information fondamentale sur les initiatives financées par les Sciences et les objectifs de la Gestion des pêches, et à donner leur avis sur l'utilisation possible de l'espace excédentaire aux besoins scientifiques dans les centres de biodiversité. Il ressort des rapports et recommandations de l'atelier que les clients ne sont pas parvenus à produire des stratégies de répartition entre, d'une part, la conservation et le stockage de gènes et, d'autre part, les initiatives connexes aux PGIP et aux pêches autochtones; on a noté en général que le cadre stratégique opérationnel du Ministère au sujet de la pêche récréative est favorable à la mise en valeur des stocks halieutiques à l'aide de la production des écloseries et que la Région devrait chercher à obtenir le financement qui lui est nécessaire à cette fin.

En guise de suivi à l'atelier, la Région a rédigé une ébauche de note de breffage à l'intention du Ministre. Elle y recommandait un financement national des centres de biodiversité afin d'éviter l'érosion des capacités de recherche régionales des Sciences et de garantir une certaine capacité de production pour les initiatives de la Gestion des pêches. Cette note de breffage ne s'est pas rendue jusqu'au Ministre, mais selon les directives de l'Administration centrale, elle a été ultérieurement révisée pour l'information du nouveau ministre des Pêches et des Océans, en avril 2002 (annexe 6). Ce nouveau document établissait plus simplement les liens entre, d'une part, les observations sur l'importance des centres de biodiversité et, d'autre part, la préservation et le rétablissement des espèces menacées et en danger de disparition, le fonctionnement de ces centres dans un contexte d'absence de mise en valeur des stocks sur la côte est, et leur financement.

INTRODUCTION

A Workshop to develop guidelines for support of southern Upland, Nova Scotia (NS) and eastern Cape Breton Island Atlantic salmon was held on September 12-13, at the Ramada Inn, Dartmouth. The Workshop consisted of: 1) presentations by DFO background to the evolving objectives and operation of the NS biodiversity facilities and 2) discussion groups comprised of invited representatives of most NS DFO client groups. Discussion groups were asked to provide their collective perspectives on the future use of the facilities and possible allocation of space surplus to Science requirements to meet Fishery management objectives.

The co-chairs welcomed participants (Appendix 1) noting that several of those who had been invited (Appendix 2; Letter of Invitation [venue had to be changed at the last minute]) had withdrawn because of uncertainties arising from the events of the previous day (Sept 11). The updated agenda (Appendix 4) and list of background presentations (Appendix 5) was reviewed followed by a brief discussion of the Chairs' expectations from the Discussion groups (two rather than three) in their consideration of stock assistance for all of Salmon Fishing Areas 19-21. The reports of the Discussion groups follow the background presentations; a follow-up summary for the Minister of Fisheries and Oceans of the background and status of the Region's biodiversity facilities, including the outcome of this workshop, appears in Appendix 6.

INTRODUCTORY REMARKS
Larry Marshall

Issue

Science Branch has limited capacity to conserve/mitigate increasing numbers of endangered salmon stocks and seeks client advice on appropriate deployment of NS biodiversity facilities for conservation, mitigation, integrated fisheries management plans, Aboriginal food fisheries and research needs.

Background

- Federal salmon hatcheries and their stock "enhancement"/supplementation capacities were divested as a result of the government's "Program Review" in 1995.

- Failure of the Cobequid, Coldbrook and Mersey divestitures resulted in their return to DFO Science in spring of 2000 for re-divestiture or disposal.

- Many stocks have collapsed or are "collapsing" (recruits not replacing spawners) and *DFO Science* has proposed retention of the Coldbrook and Mersey hatcheries as "biodiversity facilities" for live gene banking in support of "species-at-risk" (inner Bay of Fundy salmon, Atlantic whitefish and possibly Atlantic Coast [Southern Upland] Atlantic salmon) and mitigation of stocks heavily impacted by low marine survival and/or pH impacted habitat.

- Use of biodiversity facilities in the provision of Aboriginal food fisheries, integrated fisheries management plans (IFMPs), and research were inferred to Fisheries Managers but undefined.

The Challenge

Demands for conservation/preservation including live gene banking of unique endangered stocks, mitigation of collapsing stocks supporting of Aboriginal food fisheries, IFMPs and research needs easily exceed the capacities of the Mersey and Coldbrook Biodiversity Facilities.

Sobering thoughts

- Only about 31 of 65 Southern Upland rivers have more than remnant salmon populations, and without mitigation will be reduced to five or six.

- Acid rain recovery will not occur in SU rivers for perhaps 50 years.

- Wild Pacific and Atlantic salmon numbers are in a continuing long-term downward trajectory. Declines are most evident in the more human-impacted southern parts of their range. For example:
  - US Pacific Northwest (California, Oregon, Washington, and Idaho)
  - US Northeast and southern Canada (New York, Rhode Island, Connecticut, New Hampshire, Vermont, Maine, southern New Brunswick and now, all but Gulf Nova Scotia) and
  - Southwest Europe (Spain, Portugal, France, Germany, Denmark and England)

- The divestiture of East Coast hatcheries symbolized an end to “enhancement” activities and was, and remains consistent with a view that:

- Hatcheries failed/were failing to recognize limitations on, and ramifications of an attempt to control nature.

- “Recovery”/enhancement of stocks through the use of hatcheries addressed the symptoms rather than the causes of declines, (e.g., marine and freshwater habitat/ecosystem change).

Meffe(1992) suggested a number of reasons why the hatchery approach, on the US west coast, will ultimately fail:

I) History indicates that salmon continue to decline despite over a century of hatchery activity.

II) Hatcheries are costly to run and divert resources from efforts to address the cause of declines, e.g., local and ecosystem-level habitat restoration.

III) Hatcheries were a genetically unsound approach to management that could affect wild populations (there is a history of ignoring genetically effective population sizes and transfer of stocks among sub-basins and drainages thereby ignoring local adaptations and site fidelities.)

IV) Hatchery production leads to increased harvest of declining wild populations of salmon (harvest might also be equated to predation).

V) Hatcheries conceal from the public the truth of real salmon declines.

Wild Salmon Framework and Role of Biodiversity Facilities

On the West Coast of Canada, DFO is attempting to enunciate a "Wild Salmon Policy" that would be consistent with the UN's Convention on Biological Diversity, i.e., to ensure the long term viability of (salmon) populations in natural surroundings and the maintenance of fish habitat. Six principles have been identified for the conservation of wild salmon. The role of "hatcheries" is greatly diminished/redirected:

I. Wild salmon will be conserved by maintaining the greatest genetic diversity of local populations in the greatest numbers of habitats, and will be guided by the "Policy for the Management of Fish Habitat".

II. Wild salmon will be managed and conserved as aggregates of local populations (stock complexes) with priorities on maintaining genetic diversity within stock complexes rather than individual populations.

III. Minimum and target levels of abundance will be determined for each conservation unit (or stock). Operational targets and constraints are to be expressed in measurable terms, i.e., limit reference points (LRPs) and one or more target reference points (TRP). These points roughly define 3 abundances: "*abundant*", "*requires rebuilding*" and "*collapsing*", the latter being akin to the situation at hand where-in the long-term viability of the stock is at risk.

IV. Fisheries will be managed to conserve wild salmon and optimize sustainable benefits

V. Salmon cultivation techniques may be used in strategic short-term intervention to preserve populations at greatest risk of extirpation if the genetic changes that result from the intervention are less detrimental than the genetic changes that occur from continued low abundance. Technologies include fish culture, broodstock rearing and live gene banking.

VI. When genetic diversity and long-term viability may be affected, conservation of wild salmon populations will take precedence over other production objectives involving cultivated salmon

Consistent with the draft west coast policy is the current focus on live gene banking (outlines to follow) and freshwater broodstock production being explored by stakeholders at our Mactaquac Biodiversity Facility. At Mactaquac we are :

- Live gene banking the inner Bay of Fundy's Big Salmon River stock.
- Contemplating *freshwater* broodstock production in place of the previous major thrust - 325,000+ smolts.
- Allowing natural spawning of all wild returns.
- Permitting natural selection on all freshwater stages, smolts and adult survivors to produce the fittest fish for future building of the stocks once marine survival improves.
- Eliminating hatchery returns which in the case of the Saint John, home on the hatchery rather than on useful spawning areas and are frequently contested in issues of allocation.

The outcome of this intervention would be the rearing of a cross section of upper Saint John River parr/pre-smolts to mature adults in the biodiversity facility, releasing them just prior to spawning for mate selection and increasing the seeding of available habitat from 15-20%, to as much as 50-60% of conservation requirements.

The following presentations are designed to give you a concise appreciation of:

The status of Atlantic salmon in Atlantic NS,
The principles of live gene banking,
Constraints of Biodiversity Facilities,
Review of the past “hatchery” programs,
The current utility of liming to increase natural production and finally,
Possible program approaches for DFO.

Presentation 1. Opening Remarks
Greg Stevens

Slide 1

WORKSHOP

To Develop Guidelines For Hatchery Support of Atlantic Salmon

NS Southern Uplands and Eastern Cape Breton

Slide 2

Past Management Initiatives

- Commercial salmon fisheries in the Maritimes were closed in 1985.
- Retention of large salmon in the recreational fishery was prohibited in 1985.
- Aboriginal and recreational fisheries have been closed since 1990 in the inner Bay of Fundy rivers.
- More recently, salmon exploitation has been virtually eliminated in many NS salmon rivers.

Slide 3

Results

- We are not seeing the positive results expected from reduced exploitation.
- Salmon stocks remain below conservation levels in most NS rivers.
- There has been a virtual loss of access to the resource by Aboriginal people and recreational users.

Slide 4

Conclusions

- Exploitation by humans is not currently a significant contributing factor to low stock levels.
- Poor marine survival, of unknown causes, coupled with acidity in many Atlantic Coast of NS rivers are significant factors.

Slide 5

The Management Challenge

- Conservation implies more than just protection of fish. It implies protection for sustainable use.
- To meet the challenge, a management regime is required that:
  - responds to conservation issues;
  - adheres to the precautionary approach;
  - recognizes and addresses constitutional and treaty rights; and
  - fosters access for recreational use.

Slide 6

The Cost of Not Meeting the Challenge

- The cost of not meeting this challenge will be significant.
- Loss of access will mean loss of interest and commitment.
- It may result in increased levels of illegal introductions of non-indigenous species.
- Contributions to the salmon resource by Aboriginal people through:
  - guardian programs,
  - stock assessment, and
  - habitat improvement will be eroded.

Slide 7

The Cost of Not Meeting the Challenge (con't)

- Similarly, contributions by recreational users through
  - licence sales/direct financial donations,
  - equipment purchases,
  - countless volunteer hours dedicated to public education, habitat assessment/improvement,
  - river watch programs,
  - assisting with data collection, fish counting will dissipate.
- Millions of $$ in lost revenue.
- Less than 2% of the angling population in NS continues to fish salmon.

Slide 8

DFO's Role and Responsibilities

- In 2001 DFO published an Operational Policy Framework for Recreational Fisheries in Canada.
- This Operational Policy Framework has five guiding principles:

1. Recreational Fishing is a socially and economically valuable and legitimate use of fishery resources.

Slide 9

DFO's Role and Responsibilities (con't)

2. Fisheries and Oceans is responsible for providing sustainable recreational harvesting opportunities as part of integrated management plans consistent with its policies.

- This involves promoting a shared conservation ethic in conjunction with all stakeholders to provide for sustainable harvesting opportunities and where required, protect, restore and enhance fisheries resources and fish habitat.
- At the same time, the policy framework will be consistent with DFO's constitutional and fiduciary responsibilities to Aboriginal people and with treaty obligations.

Slide 10

DFO's Role and Responsibilities (con't)

3. Recreational harvesters have a responsibility for shared stewardship for resource conservation and enhancement.
4. Mechanisms for federal/provincial co-operation in areas of shared jurisdiction will be established and strengthened.
5. Fisheries and Oceans has a leadership role to coordinate policies/programs with the federal government which relate to recreational fishing.

Slide 11

Hatcheries as a Tool

- Hatcheries can be used as a tool to support access.
- First priority is live gene banking.
- Second priority is to protect what we have, particularly that which may be unique.
- Third priority is the enhancement for access provided that:
  - capacity exists or is acquired in excess of that required to meet the first two priorities;
  - there are no long-term negative stock implications.

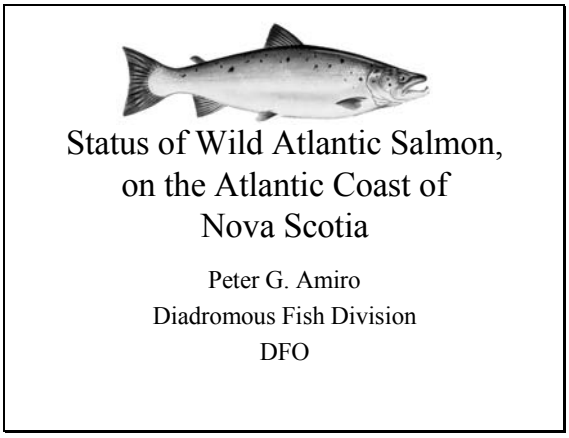
Slide 12

Expected Output

- Users' recommendations for hatcheries and hatchery products.
- Output of this workshop is key to further progress on a Multi-Year Salmon Management Plan (IFMP).
- Reminder to DFO of its commitments in the Operational Policy Framework.

Presentation 2. Status of salmon in Nova Scotia Southern Uplands and Cape Breton Peter Amiro

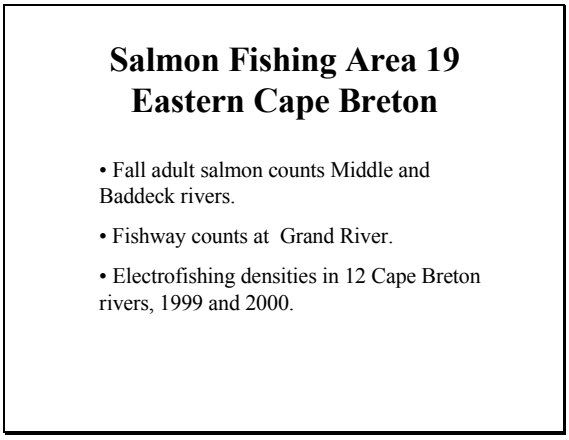
Slide 1



The status of wild Atlantic salmon on the Atlantic coast of Nova Scotia is assessed in three Salmon Fishing Areas (SFAs) :

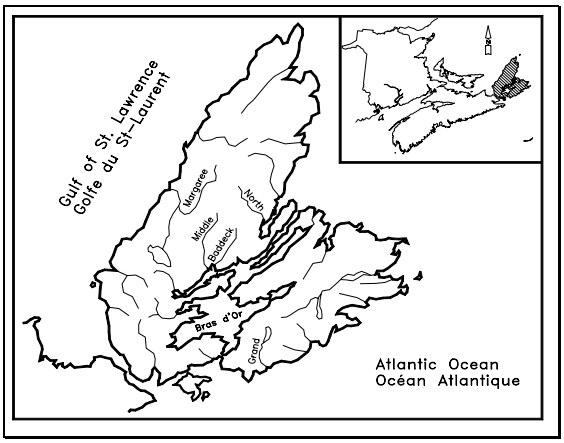
- SFA 19 Eastern Cape Breton
- SFA 20 Eastern Shore
- SFA 21 South Shore

Slide 2



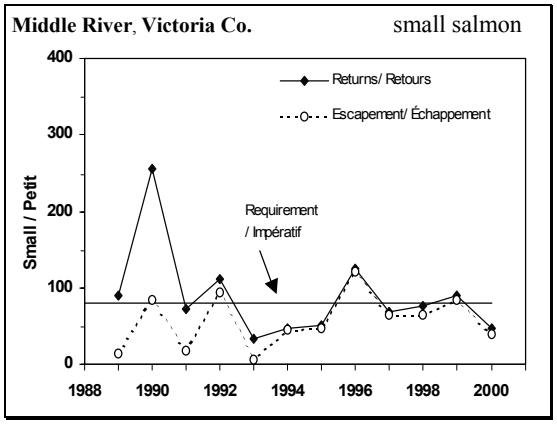
How stocks were assessed in SFA 19.

Slide 3



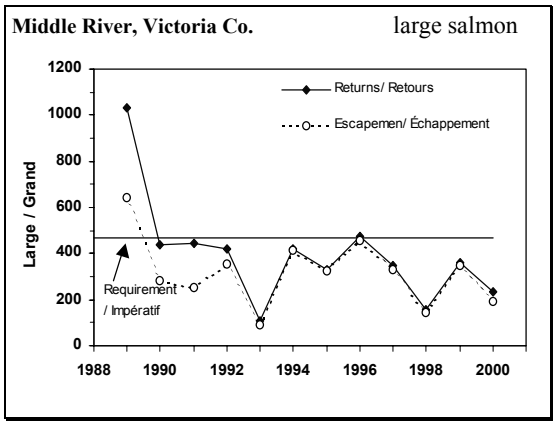
Where salmon were annually assessed in SFA 19.

Slide 4



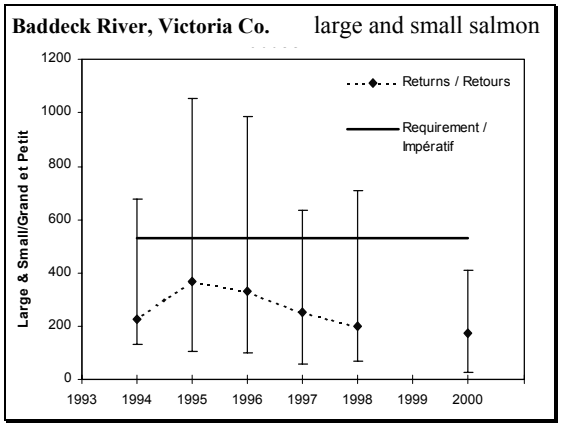
Record of returns and escapement after harvests of small (<63cm) Atlantic salmon relative to the conservation requirement in the Middle River, Victoria County, 1989 to 2000.

Slide 5



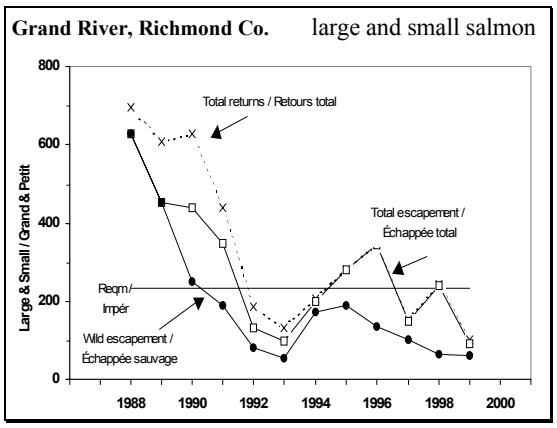
Record of returns and escapement after harvests of large (≥63cm) Atlantic salmon relative to the conservation requirement in the Middle River, Victoria County, 1989 to 2000.

Slide 6



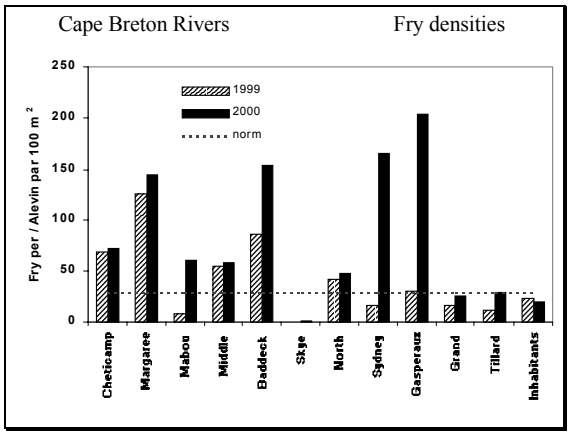
Estimated total numbers of Atlantic salmon returning to the Baddeck River, Victoria County relative to the conservation requirement, 1994 to 2000.

Slide 7



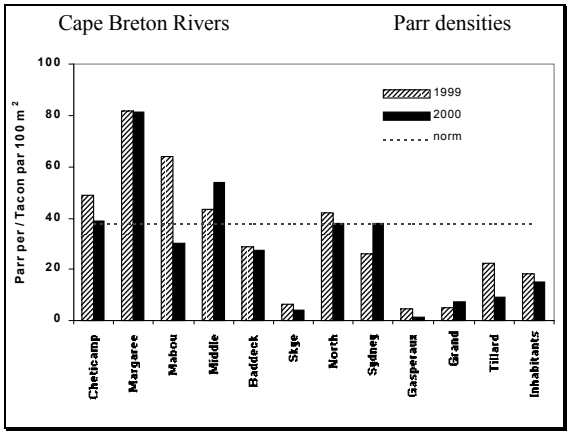
Estimated total numbers of Atlantic salmon returning to the Grand River, Richmond County, relative to the conservation requirement, 1988 to 1999.

Slide 8



Density per 100 m^2 of age 0^+ (fry) Atlantic salmon parr in twelve rivers of Cape Breton Island, 1999 and 2000 relative to "Elson's normal parr density of 29 fry per 100 m^2".

Slide 9



Density per 100 m^2 of age1^+ and older Atlantic salmon parr in twelve rivers of Cape Breton Island, 1999 and 2000 relative to "Elson's normal parr density of 38 parr per 100 m^2.

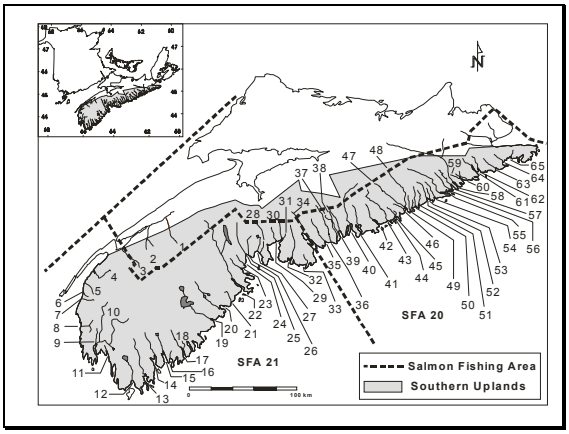
Slide 10

Salmon Fishing Areas 20 &21 Southern Upland

- Rivers with low pH.
- Counts at fishways and population estimates.
- Return rates of hatchery smolts.
- Some juvenile salmon densities.
- Prognosis based on acid rain and low marine survival.
- Results of electrofishing cruise 2000.

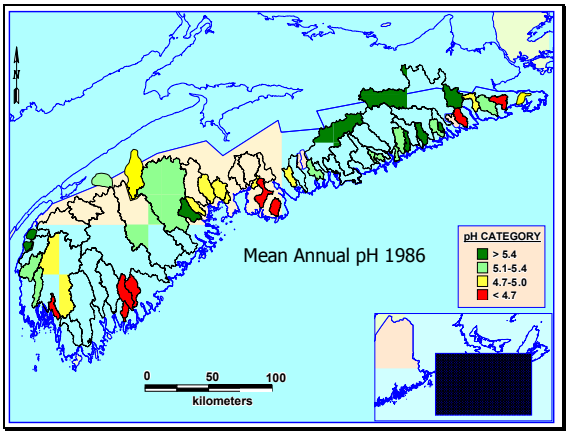
List of the constraints, monitoring methods and modeling used to assess the status and prognosis of rivers in SFAs 20 and 21, which occupy the geological area of Nova Scotia known as the Southern Upland.

Slide 11



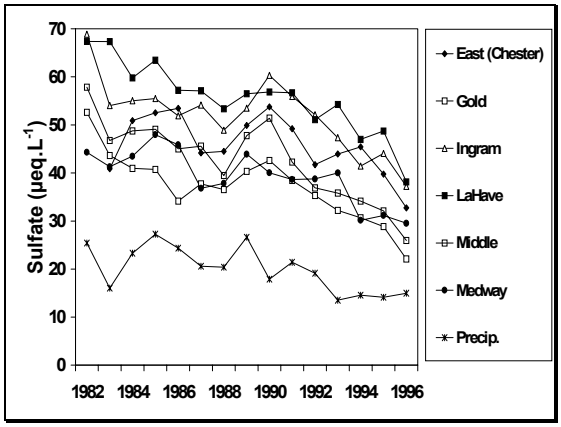
Location of the 65 rivers of the Southern Upland of Nova Scotia.

Slide 12



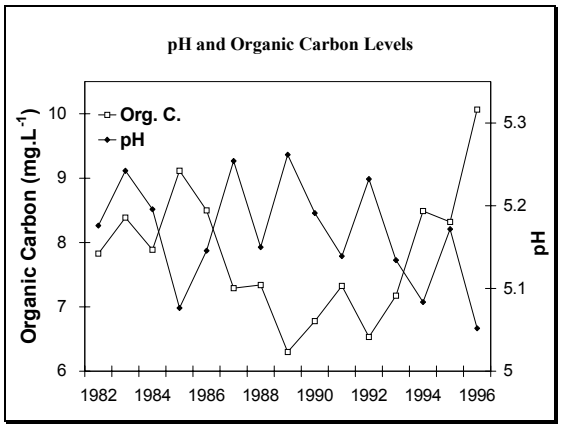
Graphic presentation of the drainage areas of rivers on the Southern Upland of Nova Scotia categorized by their mean annual pHs as determined in 1986.

Slide 13



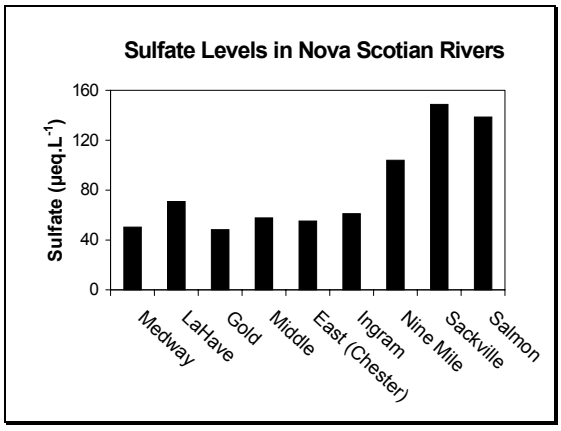
Trends in annual sulfate levels determined from water samples obtained from six rivers of the Southern Upland of Nova Scotia and from precipitation 1982 to 1996.

Slide 14



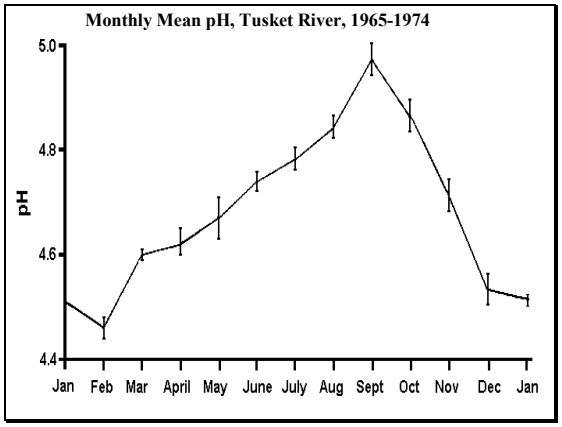
The inverse relationship between pH and organic carbon is indicative of a loss in the acid neutralizing capacity in soils of the Southern Upland. These soils have been stripped through acute acid precipitation. Cations, like calcium, that buffer acids and provide essential elements for salmon growth and survival, are no longer available in sufficient quantity. The recovery of these essential cations will be slow, perhaps in the order of 30 to 50 years.

Slide 15



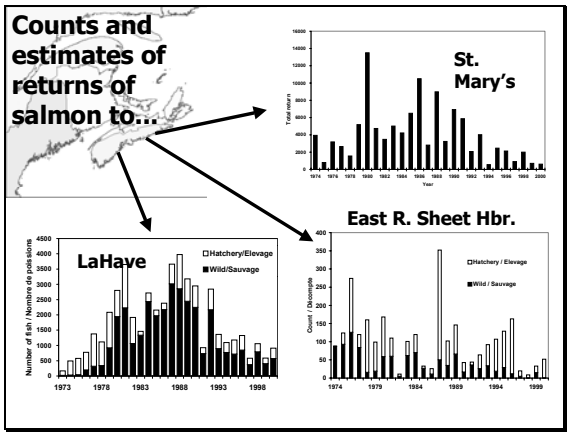
Sulfate levels in various rivers of the Southern Upland showing increased levels in rivers more proximate to local sources of sulfate.

Slide 16



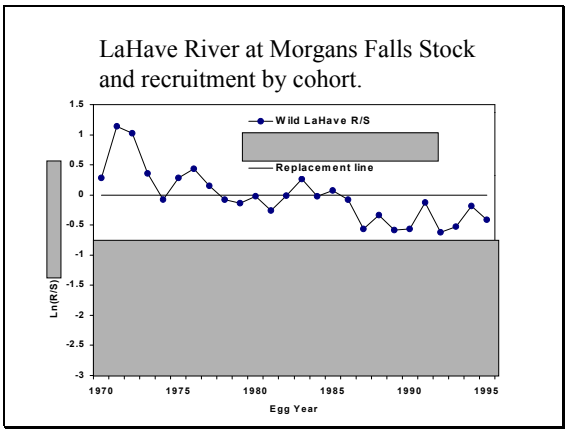
Typical annual pattern of pH as represented by Tusket River monthly mean pH, 1965 to 1974.

Slide 17



Records of annual counts of Atlantic salmon at three monitoring sites on the Southern Upland for the period 1973 to 2000.

Slide 18

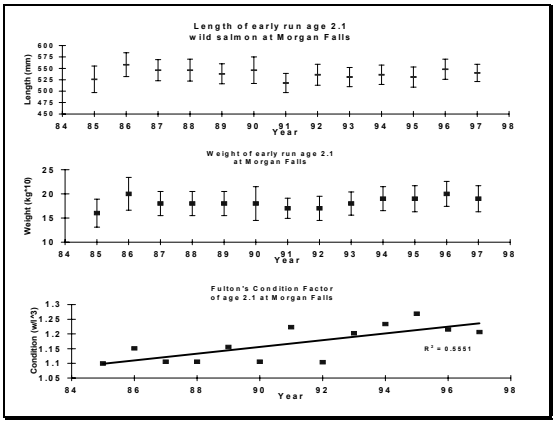


Trends in logarithm of recruits per spawning wild salmon (Ln R/S, referred to as a survival index) escaped above Morgans Falls, LaHave River, 1970 to 1995. Hatchery results are grayed out.

Slide 19

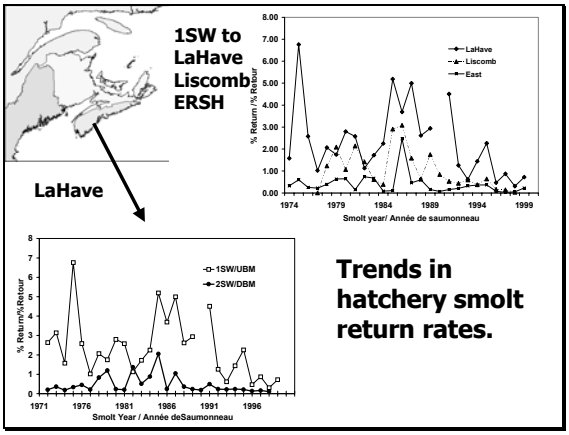
Has the condition of the fish changed?

Slide 20



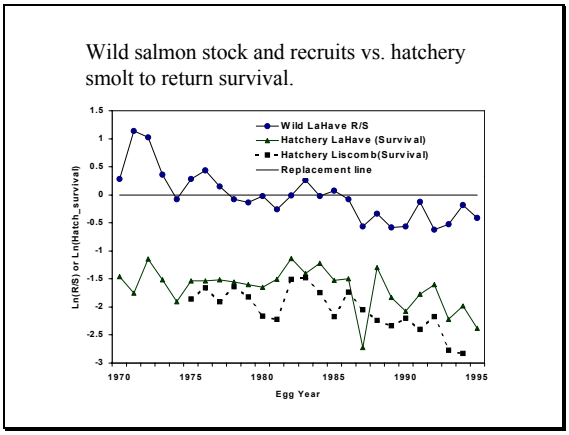
Trends and annual variation in length, weight and condition of wild aged, two-year freshwater smolts returned after one sea winter to Morgans Falls on the LaHave River before August.

Slide 21



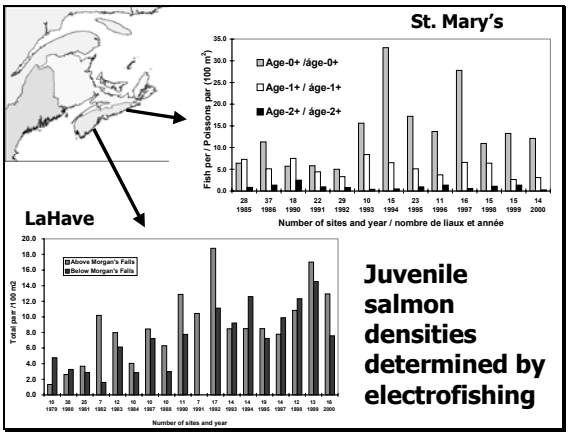
Trends in hatchery smolt return rates after one sea winter to the LaHave, Liscomb and East River Sheet Harbour and after one and two sea winters to Morgans Falls, LaHave River.

Slide 22



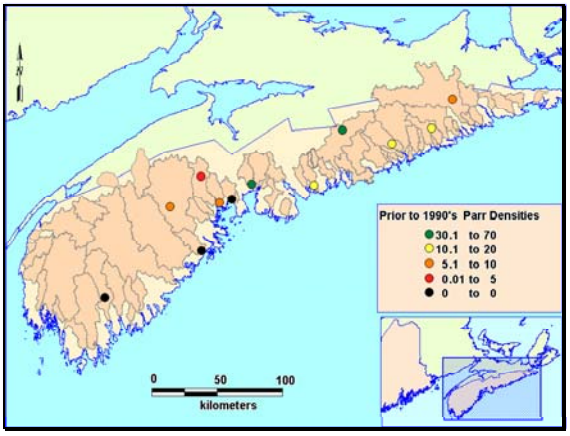
Comparison of LnR/S to the logarithm of survival of hatchery stocked smolts aligned by egg year for native origin hatchery smolts stocked, released, and returned to the LaHave and Liscomb rivers.

Slide 23



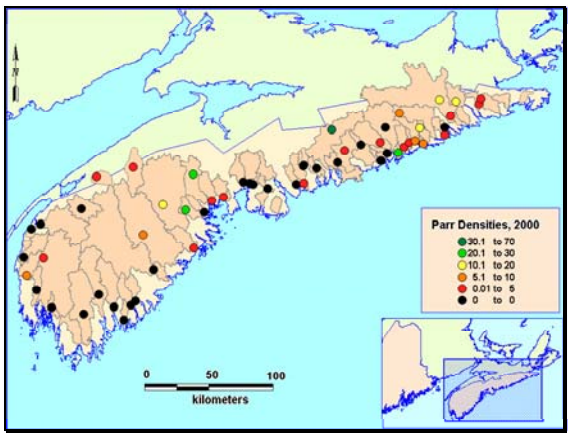
Juvenile Atlantic salmon densities, per 100 m^2, determined at standard electrofishing locations in the St. Mary's River, 1985 to 2000 and LaHave River 1979 to 2000.

Slide 24



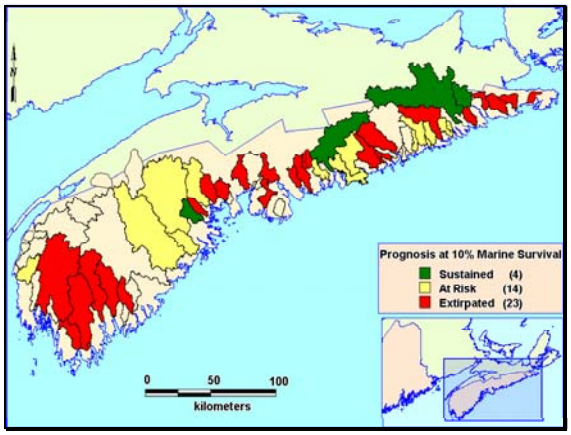
Spatial distribution and quantitative categorization of the densities (per 100 m^2) of juvenile Atlantic salmon determined by electrofishing in rivers of the Southern Upland of Nova Scotia prior to 1990.

Slide 25



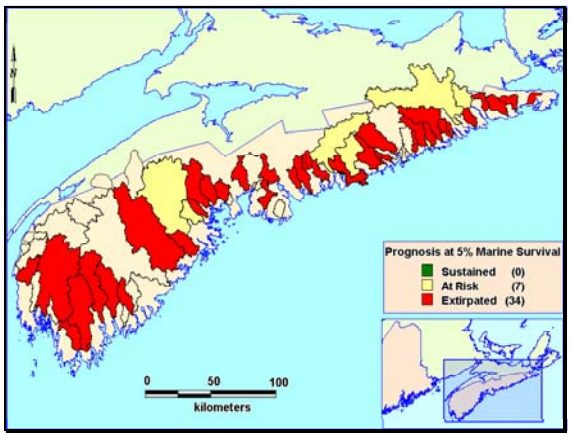
Spatial distribution and quantitative categorization of the densities (per 100 m^2) of juvenile Atlantic salmon determined by electrofishing in rivers of the Southern Upland of Nova Scotia in 2000.

Slide 26



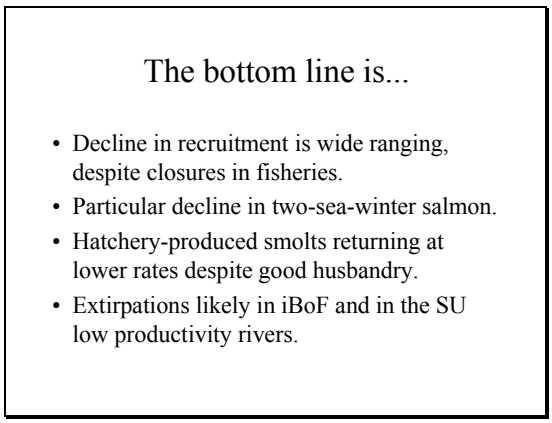
Prognosis determined by population simulation by the Atlantic Salmon Regional Acidification Model for the sustainability of Atlantic salmon in rivers of the Southern Upland of Nova Scotia. Simulations were made assuming 10% marine survival.

Slide 27



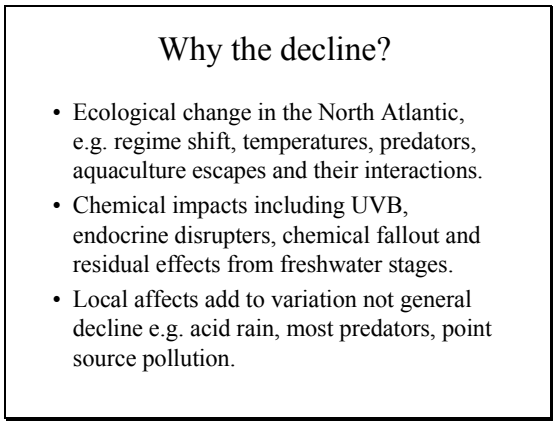
Prognosis determined by population simulation by the Atlantic Salmon Regional Acidification Model for the sustainability of Atlantic salmon in rivers of the Southern Upland of Nova Scotia. Simulations were made assuming 5% marine survival.

Slide 28



The synopsis.

Slide 29



The possible causes.

Presentation 3. Live Gene Banking
Patrick O'Reilly

Slide 1

Inner Bay of Fundy Live Genebank Program

(Genetic Technical Group)

Roger Doyle (mating plan and general consulting)
Andrea Cox (technician)
Ellen Kenchington (general advisor)
Christophe Herbinger (kinship analysis, general advisor)
Matt Jones (general advisor)
Patrick O'Reilly (technician, analyses, etc)

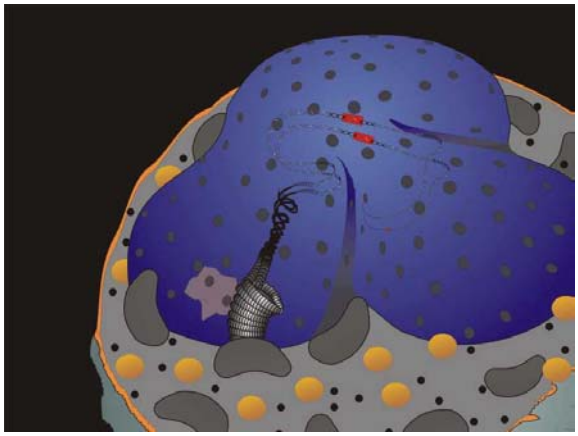
Slide 2

Inner Bay of Fundy Live Genebank Program

OBJECTIVES

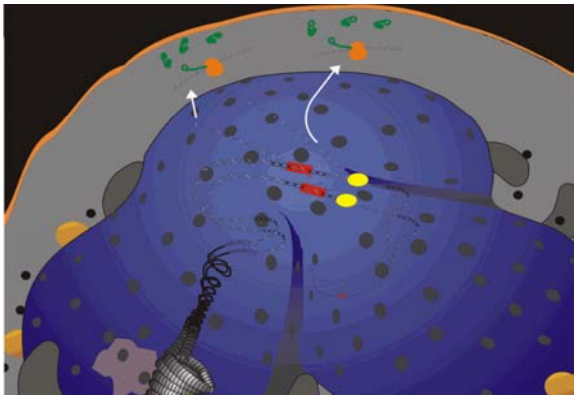
1) Minimise Inbreeding
2) Minimise loss of genetic variation
3) Minimise OTHER (known and unknown) changes

Slide 3



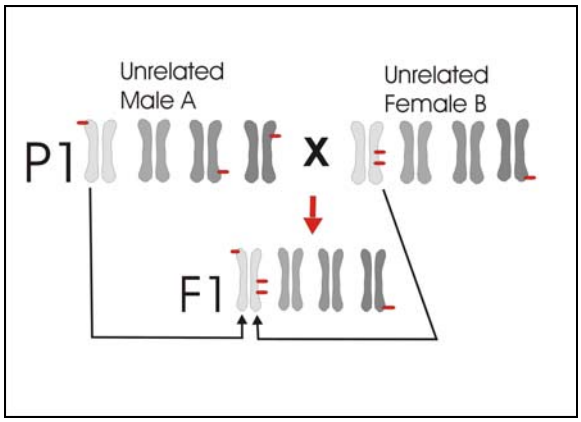
The molecular genetic basis of inbreeding.

Slide 4



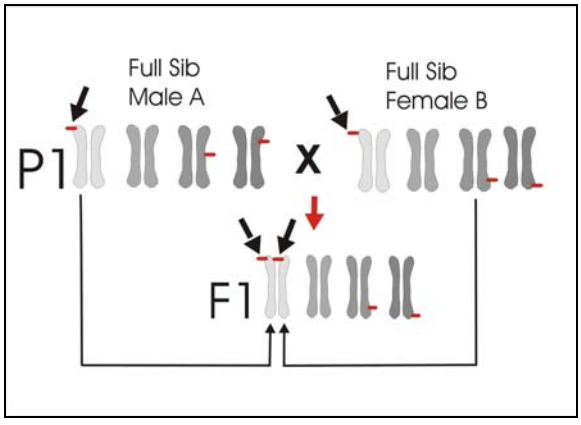
The molecular genetic basis of inbreeding, continued.

Slide 5



Phenotypic consequences of inbreeding.

Slide 6



Progeny of sibs are more likely to carry two copies of deleterious recessive alleles.

Slide 7

Implications of Inbreeding

- elevated EARLY mortality (lower hatching, lower survival to first feeding)
- decreased parasite/pathogen (disease?) resistance
- decreased growth rates and fecundity

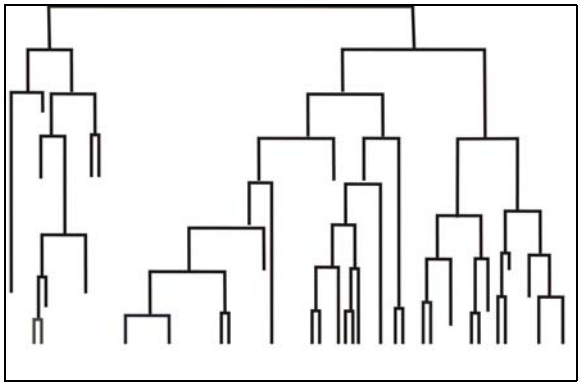
Slide 8

Inner Bay of Fundy Live Genebank Program

OBJECTIVES

1) Minimise Inbreeding
2) **Minimise loss of genetic variation**
3) Minimise OTHER (known and unknown) changes

Slide 9



The importance of genetic diversity.

Slide 10

Importance of Genetic Diversity

- necessary for adaptation to natural ecological changes (different prey species abundance, river water levels, etc.).
- evading and avoiding parasites and pathogens
- Necessary for adaptation to anthropomorphic environmental conditions (temperature, pollutants etc.).

Slide 11

Inner Bay of Fundy Live Genebank Program

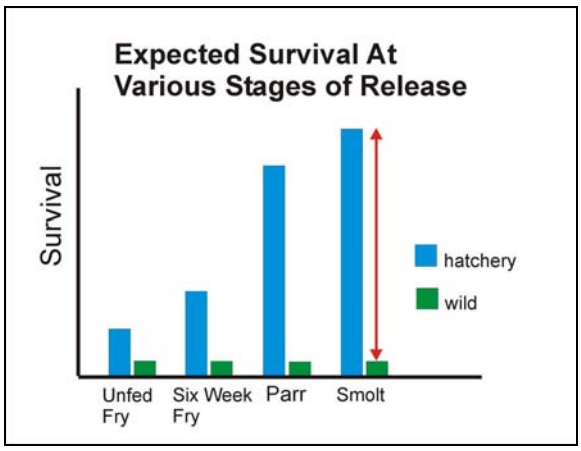
OBJECTIVES

1) Minimise Inbreeding
2) Minimise loss of genetic variation
3) **Minimise OTHER (known and unknown) changes**

Slide 12

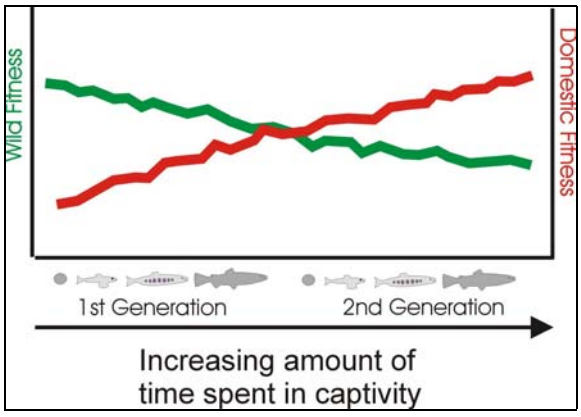
- **Domestication selection**
- Combining of sub-optimal or possibly incompatible genotypes (Mart Gross' mate choice paradigm)
- Genotype frequency changes in gene bank population (for example, run timing, migratory patterns, etc).
- Outbreeding depression and/or introgression of non-native genes
- Others?

Slide 13



The longer salmon are harboured in captivity, the greater their survival to adulthood.

Slide 14

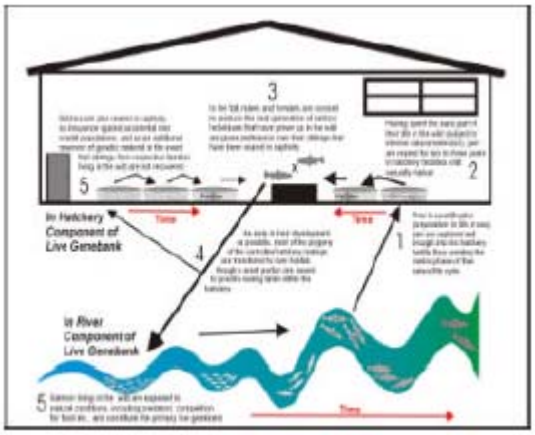


Increased exposure to captive conditions decreases their fitness in the wild.

Slide 15

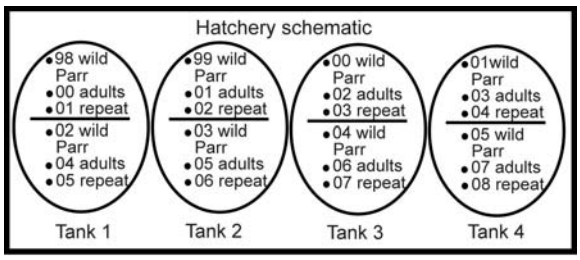
- Domestication selection – this is a genetic change, and occurs in addition to learned changes occurring over the lifespan of an individual
- **Combining of sub-optimal or possibly incompatible genotypes (Mart Gross' mate choice paradigm)**
- **Genotype frequency changes in gene bank population (for example, run timing, migratory patterns, etc).**
- **Outbreeding depression and/or introgression of non-native genes**
- **Others?**

Slide 16



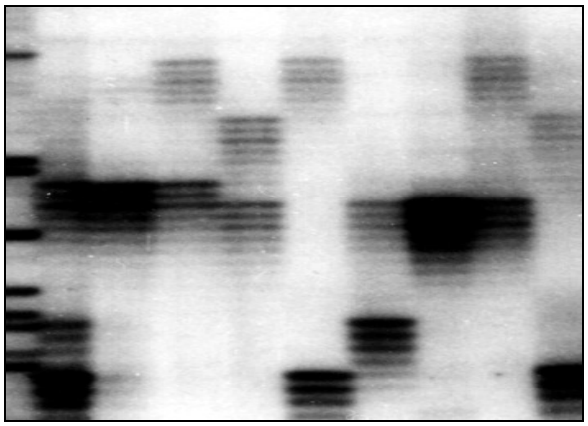
The IBF LGB program incorporates an “in river” and “captive” component in an attempt to mitigate some of the negative side effects of captive rearing on wild fitness.

Slide 17



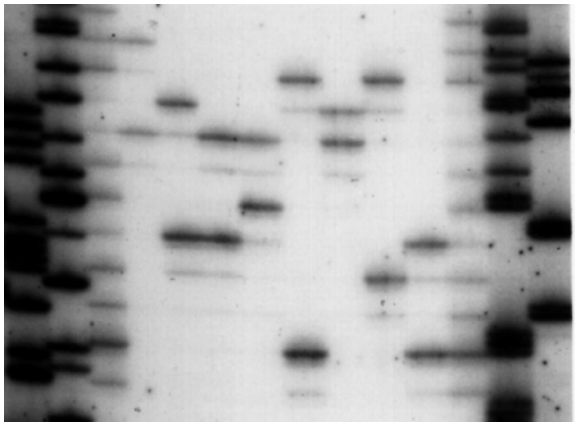
Use of hatchery tanks.

Slide 18



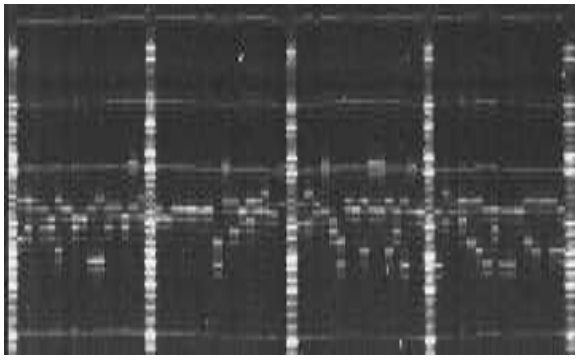
Evolving technology in genotyping Atlantic salmon.

Slide 19



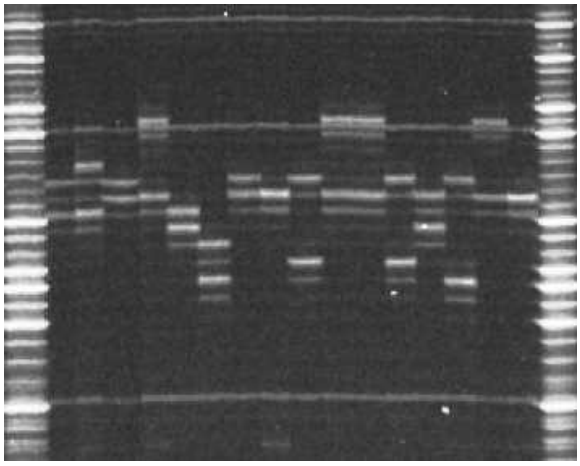
Evolving technology, continued.

Slide 20



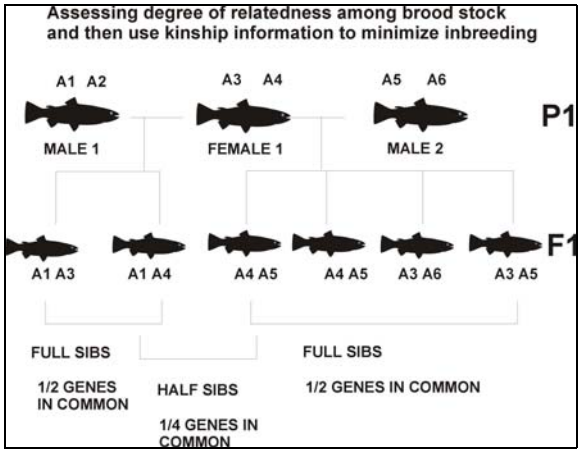
Evolving technology, continued.

Slide 21



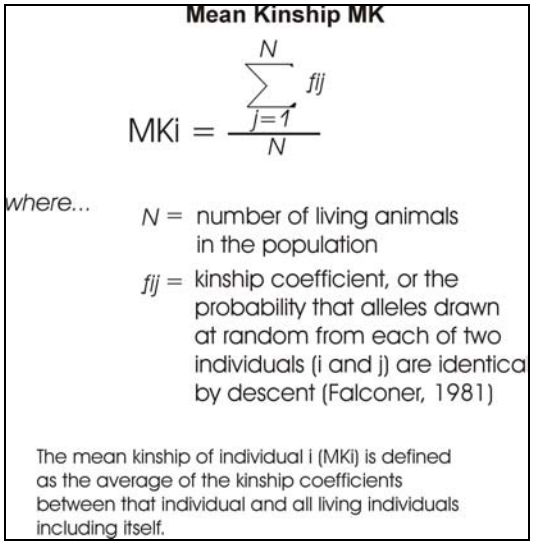
Evolving technology, continued.

Slide 22



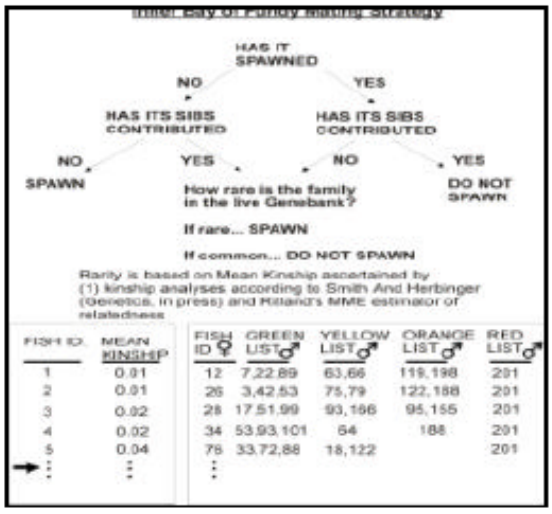
Pedigree of salmon and number of genes in common among broodstock related at various levels.

Slide 23



Formula for calculating mean kinship.

Slide 24



Spawning strategy employed in 2001 for minimizing inbreeding and loss of genetic variation.

Slide 25

Steps Taken to address LGB concerns

Inbreeding Depression

-Kinship analyses and prescriptive mating according to relatedness

Loss of Genetic variation

-Kinship analyses and prescriptive mating according to MK approach

Other Genetic changes

-*In river* LGB

-2nd, 3rd spawning "natural"

-assignment tests for Origin of broodstock

-experiments(?), observations, analyses (database)

Summary reviewing all measures taken to mitigate small population size and domestication in Atlantic salmon.

Presentation 4. Nova Scotia Biodiversity Centres Programs 2001
Shane O'Neil

Program Details for Biodiversity Centres

For 2001, the existing programs will be continued with a view towards planning for the future. Existing program details year 2001:

Inner Bay of Fundy Live Gene Bank

Stewiacke River Atlantic Salmon

1. Broodstock from parr at Coldbrook
   1998 – 400 fish @ 2 kg each
   1999 – 190 fish @ approx. 1.1 kg each
   2000 – 280 fish @ approx. 0.5 kg each

2. Juveniles from the autumn 2000 live gene bank spawning are at Mersey. About 350,000 eggs were taken; about 13,000 fry were released as unfed fry in May and 30,000 as six-week-old feeding fry in early July. Remainder, about 40,000 are in ponds at Mersey. About 6,000 of these will be held for release as one-year-old smolt in 2002 and the remainder will be released as fall parr in late October.

3. Almost 600 brood fish from the Stewiacke parr collections will be spawned in autumn 2001. Almost 1 million eggs are expected from that spawning group. Most of the fish will be released as unfed fry, six-week-old fry or fall parr in 2002. The eggs will be held at Coldbrook (10-20%) and the remainder at Mersey until just before hatch when they will be transferred to incubators at Mersey.

   Pond requirements for the brood fish and juveniles are provided in Table 1.

Gaspereau River Atlantic salmon

Program plans for Gaspereau River are not finalized. The current program includes an adult salmon capture and parr and smolt grow-out plan.

Genetic analysis of samples from Inner Bay of Fundy Atlantic salmon indicated the unique nature of the Gaspereau River fish. They exhibit a genetic makeup similar to the other Inner Bay of Fundy salmon but migrate to the Northwest Atlantic Ocean, a trait unlike the more localized migrations of other inner bay stocks. A key feature of the status of the Gaspereau River stock is the marine survival rate for the distantly migrating fish. Although survival rates are low for all distant migrating salmon relative to those observed a decade ago, survival of smolts back to the Gaspereau River is high relative to rates for the other Inner Bay of Fundy rivers.

Fish passage is being modified on the Gaspereau River in 2001. The construction activities prompted DFO, the river association and NSPI to move all adult salmon that entered White Rock Fishway to the Coldbrook Biodiversity Centre. Tissue samples have been taken from the fish for analyses to ascertain the diversity in the fish at Coldbrook. If the data indicates that few families are represented in the adult fish, parr (precocious males) will be collected to broaden the genetic base.

Other Minas Basin stocks

No other stocks are in captivity at this time. Parr from a number of Inner Bay of Fundy rivers will be collected in late September 2001 for holding for broodstock. Target number of parr will be 300 to 500 fish of the combined year classes available in the rivers fished. Preliminary evidence from electrofishing in 2001 indicates finding sufficient parr to meet the brood fish target will be difficult.

Tentative collection of parr for a Southern Upland live gene bank

Analysis of tissue samples is underway to define the stock characterization for Southern Upland salmon stocks. The data may not be available to guide us in identifying stocks necessary of special concern this autumn so parr will be collected on at least one river (probably the Gold) with the intention of developing a live gene bank for that stock. The results of the genetic analysis will dictate our plans for the parr captured this autumn.

Live gene bank for Atlantic whitefish

The endangered Atlantic whitefish are being cultured towards establishing a restoration effort. Fish were successfully spawned in 2000 and juveniles are being reared at Mersey. Adult fish are being collected in 2001 for holding at Mersey and Coldbrook.

Program specifics as to total number of fish to be expected and holding details are being worked out. Juvenile whitefish are currently held in chilled water at Mersey. The capacity for chilling water at Mersey is limited so plans include holding whitefish at Coldbrook as well.

Mitigation for fish losses due to acid precipitation

Several river programs have been maintained during the past decade because of losses in wild salmon production due to acidification of the rivers. Recent examination of water quality in these rivers has identified them among those most at risk to lose resident stocks. This program activity is currently directed towards growing fish for release as smolts with fall fingerlings being a product of that program. One benefit of releasing smolts is the limited time exposure to the acidic waters. There is little expectation that the fall parr released as a by-product of the program (at least in most rivers in this group) will survive. This is currently a continuation of the existing practice.

Note: Past egg collection practices were based on an approximate production of one smolt for every three eggs taken. Recent improvements in survival and growth rates (1997-2000) have resulted in higher numbers of large smolt and additional space requirements in the biodiversity centres.

Salmon River, Digby: About 20,000 smolts released and another 12,000 fall parr slated for release in 2001. Previous collections of brood fish were directed at meeting a target of producing about 20,000 one-year-old smolts. Attempts at brood collections in 2001 have resulted in 40 fish, 39 of which are hatchery fish. This is possibly indicative of the low survival of wild fish in this acid-impacted system.

Medway River: The Medway River salmon population has been supplemented with what has generally been regarded as two separate components of the river stock. Although never confirmed by examination of the genetics, the Harmony Mills and Ponhook or lower river stock components were treated separately in the supplementation program until 1999. About 11,000 smolts were released earlier this year and there are about 30,000 fish at Mersey for

release in fall 2001 (15,000 parr) with the balance as smolts in spring 2002 (Table 2). If the past program target for brood fish is set as the objective for 2001, it would be expected to yield about 100,000 eggs for production of 30,000 parr and 40,000 smolt (smolt release in 2003). Some consideration may be warranted to determine whether there are two separate stock components on the Medway.

Gold River: Currently, there are no Gold River fish under culture. The last fish were released in spring of 2001 (approx. 9900 smolts). We were unable to collect sufficient adults during each of past two years. Early attempts in 2001 resulted in the collection of four females and five males. This is well short of the 30 (minimum) to 50 (desirable) adults to address genetic concerns about mating too few individuals. Plans this year include attempts to collect adults but also to do a "pre-emptive" collection of parr towards a possible Southern Upland live gene bank.

Proposed number of eggs to be taken and parr and smolts produced as per Table 2.

Contributions to Integrated Fisheries Management Plan

Fish releases have occurred in several rivers because of historic stocking practices and to provide recreational fishery and Aboriginal food fishery access.

Determining the amount of the biodiversity facilities' capacities that can be devoted to these purposes is one of the objectives of this workshop.

Tusket River: Only the Carleton River portion of the Tusket is considered capable of supporting Atlantic salmon because of the acidity in the remainder of the system. The Carleton River habitat area has been estimated at 50,600 rearing units (rearing unit = 100 m^2), or 34% of the estimated 150,780 rearing units in the Tusket system. The Tusket River was stocked with LaHave River salmon after the fish passage was improved to allow migration. Consequently, the Tusket fish are not considered a unique stock but of LaHave River origin. About 40,000 smolt were released into the Tusket in 2001, 25,000 parr are to be released this autumn and about 30,000 smolt for spring 2002. The collection of brood fish in 2001 has resulted in approximately 185,000 eggs on hand, somewhat more than the preliminary target of 150,000 eggs (Table 2).

Musquodoboit River: The underlying geology of the Musquodoboit River watershed has protected the water quality from impacts from acid precipitation. Stocking of the river began in the mid-1980s to augment natural production thought to be impacted by land use practices and to provide an enhanced recreational fishery in a river near the largest population base in Nova Scotia. Twenty thousand smolt were released in 2001. Brood collections in 2000 resulted in 40,000 fish in production (20,000 smolt to be released in 2002).

LaHave River: The release of Atlantic salmon into the LaHave River began in the 1940s and has continued for a variety of reasons, such as colonization of the area above Morgans Falls, enhancement of fish stocks in support of recreational fisheries and for food, and research. About 100,000 smolt were released into the LaHave in 2001 and on hand are 40,000 parr for release this autumn and about 50,000 smolt in spring 2002 (Table 2). The broodstock collection planned for 2001 would provide about 150,000 eggs, down from the 180,000 taken in 2000 and the almost 300,000 taken the year before (Table 2).

Sackville River: A restoration project which began in 1986. Stocking was initiated to restore Atlantic salmon runs to the river and, subject to success, to contribute to the recreational fishery. Juveniles will be released in 2001 (10,000 parr) and in 2002, about 10,000 smolt. Some broodstock have been collected in 2001 towards a target of 50,000 eggs or about 15-

20,000 smolt for release in 2003. The donor stock for the Sackville was the LaHave River so the Sackville River Atlantic salmon is not considered a separate stock.

Aboriginal Programs

Indian Brook: Eskasoni First Nation has been collecting brood fish and releasing fish (grown by DFO) into Indian Brook in Cape Breton. There are about 6,000 fish on hand for release as smolt in 2002. Current plans by Eskasoni include collection of brood fish in 2001 towards a target of 30,000 eggs and 10,000 smolt for release in 2003.

Bear River: Atlantic salmon juveniles from the Tusket River stock have been released into a tributary of the Bear River for several years. Returning adults have contributed to some limited angling and a food fishery.

Mersey River: Fish were released into the acid- and hydro-development impacted Mersey River in support of a recreational fishery and an Aboriginal Food Fishery. The donor stock has previously come from the LaHave River (e.g., 10,000 smolt in 2001) but a decline in returns to LaHave dictate a modification to the program if it is to continue. In 2000 and 2001, there was an attempt to collect brood fish from the Mersey River. Currently (2001) the brood collection on hand is expected to provide about 18,000 eggs.

Research

The Biodiversity Centres are moving into a broader range of research efforts. The nature of the research and need for this capacity will be subject to resources and the questions being examined, but focused on biodiversity and primarily, survival of the stocks in jeopardy. Research program needs will probably place additional demands on the centres for laboratory space, juvenile rearing space, and so on.

Following is a list of current projects and is not exhaustive. These could change annually.

Atlantic salmon colonization: A project which may not have a future given the low marine survival. In the past, several rivers where salmon populations had been eradicated were stocked to establish runs. The capacity for this effort may no longer exist given that marine survival for hatchery grilse is about 0.5 to 1%.

If we assume some aspect of this program will continue, even if related to expansion of the Southern Upland stocks, capacity needs are uncertain.

Acidification impacts on smolt performance: An East River, Sheet Harbour, project with a planned egg take of 60,000 to produce about 20,000 smolt. This culture program is also contributing to the Integrated Fisheries Management Plan.

Feasibility of culture of other species: Space and equipment requirements to grow suitable food for such species as the Atlantic whitefish, and possibly other diadromous species.

Atlantic whitefish program directed at restoration: Research related to this project is ongoing and not completely defined at this stage. Directions will be dependent on results of various research initiatives but towards expansion of the current range of the species. This will require an examination of temperature and pH tolerance among other things.

Marking and growth and survival of LGB fish: Attempting to mark sac fry with ability to distinguish among various groups stocked. Marking in other manners will also occur this year.

Monitoring survival and growth of the various groups of fish will be an ongoing activity with human resource costs associated with it.

Other

Fish Friends: Education program linked with Atlantic Salmon Federation. The staff at Coldbrook spend considerable time assisting with this program. The Nova Scotia Department of Agriculture and Fisheries (NSDAF) may become involved in this program with Northumberland Strait area stocks in 2001 or 2002.

Water quality monitoring: Monitoring water quality (pH and oxygen) to maintain fish condition and control costs.

Liming of water at the Mersey Biodiversity Centre: Low pH river water requires constant treatment with limestone to avoid pH induced mortality. This is an ongoing program cost.

Some of the Guiding Principles for the Biodiversity Programs

1. Priority one is the preservation of stocks or groups of stocks at risk of extirpation.
2. Live gene banks are expected to run for ten years from the time fish are produced for release.
3. Live gene bank fish production will include production of 25,000 smolts per gene bank.
4. Program plans are proceeding with anticipation of up to four live gene banks.
5. Costs for running the facilities (exclusive of capital upgrades subject to alternate review) cannot increase.

Capacity of the Biodiversity Centres

Mersey Biodiversity Centre (Figure 1):

Mersey can accommodate the following estimates of eggs, fry, parr and smolt depending on temperature and oxygen levels. The following numbers for fish assume installation of an oxygen injection system.

Eggs:	2,000,000
Six week fry:	1,000,000
Fall parr:	800,000
Smolts:	300,000

Coldbrook Biodiversity Centre (Figure 2):

Coldbrook has about 400 gpm surface water and 200 or more gpm of well water. Capacity is limited by water availability. Since the site houses adult brood fish that do not eat and the LGB brood fish, capacity could accommodate up to three live gene banks plus some non-gene bank programs. A fourth live gene bank could be handled given some modification to the facility. Water availability would have to be confirmed.

Human resources: Staff levels at the Biodiversity Centres would be capable of managing three live gene banks and some additional program activities but at certain times of the year, staff and facility limitations might compromise capacity. A fourth live gene bank could not be handled with current staff levels if any other programs are in place.

Table 1. Number of brood fish and pond and water requirements for delivery of a program with up to three live gene banks at the Coldbrook Biodiversity Centre, 2001-2005.

Year 2001							
Gene Bank	Year Class	# Fish	Females	Avg/Wt	Eggs/Fish	Eggs	Pond Requirements
#1	1998	300	150	2,000	3,500	525,000	2X25
#1	1999	190	75	1,100	2,500	187,500	1X25+1X10
#1	2000	280					2X10
#1	2001	300					2X8
#2	2001	300					2X8
#3	2001	300					2X8
						712,500	**Total Eggs**
This program can be carried out with the existing facilities							
Requirements:		Ponds	Water/gpm				
		9X25	370				
		3X10	45				
		6X8	45				
		Total	460				
Year 2002							
Gene Bank	Year Class	# Fish	Females	Avg/Wt	Eggs/Fish	Eggs	Pond Requirements
#1	1999	100	50	2,000	3,500	150,000	1X25
#1	2000	280	100	1,500	2,500	250,000	1X25+1X10
#1	2001	200					2X10
#1	2002	300					2X8
#2	2001	200					2X10
#2	2002	300					2X8
#3	2001	200					2X10
#3	2002	300					2X8
						400,000	**Total Eggs**
It may be possible to carry out this program but it would be very tight and spawning would be a nightmare							
Requirements:		Ponds	Water/gpm				
		9X25	370				
		7X10	105				
		6X8	45				
		Total	520				
Installation of 10' swede tanks would greatly improve the situation. 4X10' swede tanks are required to replace each 25' circular. By the year 2003 to carry out this program it would require the replacement of 6X25' circ ponds with 24X10' swede tanks. The requirement would be for 32X10' swede tanks by 2005.							
Year 2003							
Gene Bank	Year Class	# Fish	Females	Avg/Wt	Eggs/Fish	Eggs	Pond Requirements
#1	2000	100	50	2,000	3,500	175,000	1X25
#1	2001	200	75	1,500	2,500	187,500	1X25+1X10
#1	2002	200					2X10

#1	2003	300					2X8
#2	2001	200	75	1,500	2,500	187,500	1X25
#2	2002	200					2X10
#2	2003	300					2X8
#3	2001	200	75	1,500	2,500	187,500	1X25+1X10
#3	2002	200					2X10
#3	2003	300					2X8
						737,500	**Total Eggs**
Year 2004							
Gene Bank	Year Class	# Fish	Females	Avg/Wt	Eggs/Fish	Eggs	Pond Requirements
#1	2001	100	50	2,000	3,500	175,000	1X25
#1	2002	200	75	1,500	2,500	187,500	1x25 + 1x10
#1	2003	300					2x10
#1	2004	300					2x8
#2	2001	100	50	2,000	3,500	175,000	1x25
#2	2002	200	75	1,500	2,500	187,500	1x25 + 1x10
#2	2003	300					2x10
#2	2004	300					2x8
#3	2001	200	50	2,000	3,500	175,000	1x25
#3	2002	200	75	1,500	2,500	187,500	1x25 + 1x10
#3	2003	300					2x10
#3	2004	300					2x8
						1,087,500	**Total Eggs**
Year 2005							
Gene Bank	Year Class	# Fish	Females	Avg/Wt	Eggs/Fish	Eggs	Pond Requirements
#1	2002	100	50	2,000	3,500	175,000	1x25
#1	2003	200	75	1,500	2,500	187,500	1x25 + 1x10
#2	2004	300					2x10
#2	2005	300					2x8
#2	2002	100	50	2,000	3,500	175,000	1x25
#2	2003	200	75	1,500	2,500	187,500	1x25 + 1x10
#3	2004	300					2x10
#3	2005	300					2x8
#3	2002	100	50	2,000	3,500	175,000	1x25
#3	2003	200	75	1,500	2,500	187,500	1x25 2x10
#3	2004	300					2x10
#3	2005	300					2x8
						1,087,500	**Total Eggs**

Table 2. Nova Scotia biodiversity centre programs including the number of eggs and target number of juveniles by program activity and stage, 1998-2005. Except for live gene bank activities, program plans after 2002 are uncertain. River programs are for Atlantic salmon unless otherwise indicated.

		1998	1999	2000	2000	2000	1999	2000	2001	2000	2001	2001	2001	2002	2001	2002	2002	2002	2003
		Eggs	Parr	Parr	Smolt	2+ Smolt	Eggs	Parr	Smolt	Eggs	Unfed fry	6 wk fry	Parr	Smolt	Eggs	Unfed fry	6 Wk Fry	Parr	Smolt
Program / River	**Stock**																		
Live Gene Bank																			
Stewiacke	Stewiacke									343,328	13,000	30,000	33,000	6,000	815,500	122,325	122,325	97,860	50,000
Gaspereau	Gaspereau	47,998	22,312		15,899		45,802	13,500	15,000	68,817			20,000	15,000	80,000	20,000		20,000	20,000
Other Inner Bay of Fundy	Inner Bay																		
Atlantic whitefish	Petite Riviere														?100,000?			?10,000?	
Southern Uplands 1	SU1																		
Southern Uplands 2	SU2																		
Mitigate losses due to acidity																			
Salmon (Digby)	Salmon (Digby)	42,385	14,292		23,999		62,809	18,500	20,000	33,075			12,000	15,000	50,000			15,000	20,000
Medway[b]	Medway	94,813	24,854		46,097		28,532	9,000	10,000	42,961			15,000	15,000	100,000			30,000	40,000
Gold	Gold					11,000	29,243	9,000	10,000						50,000			15,000	15,000
Integrated Fisheries Management Plan																			
East River, Sheet Harbour	Mixed	18,710	4,364	1,500	1,500	6,700	41,044	10,000	10,000	56,841			20,000	15,000	60,000			20,000	20,000
Musquodoboit	Musquodoboit	54,815	28,000	5,000	15,000		58,945	18,000	20,000	56,574			20,000	20,000					
Sackville[c]	LaHave	47,960	26,599		23,987		76,400	22,000	25,000	26,961			10,000	10,000	50,000			15,000	20,000
LaHave[c]	LaHave	311,641	61,564	9,500	44,800		297,438	72,000	90,000	181,234			40,000	50,000	150,000			40,000	50,000
Tusket[c]	LaHave	124,062	28,260		50,388		99,138	15,000	40,000	129,818			25,000	30,000	150,000			25,000	40,000
Colonization																			
Mushamush (LaHave)	LaHave		12,936		12,000														
Aboriginal																			
Bear	Tusket				15,000				10,000					15,000					
Mersey	LaHave				10,000									15,000	30,000			10,000	10,000
Indian Brook	Indian Brook						13,116			24,513			7,800	6,000	30,000			10,000	10,000
Other																			
East River, Pictou[c]	East River, Pic						7,253			11,478					8,000				
River Philip[c]	River Philip						6,944								7,000				
Annapolis	Annapolis	7,303			2,000														
Liscomb	Liscomb	68,768	23,197	11,000	10,000		40,480	10,000	10,000	*									
Meteghan	Tusket		28,260					15,000					15,000						
Petite	LaHave		12,936		12,000														
Clyde	LaHave				10,000														
Jordan	LaHave																		
Biodiversity Centers Capacity															2,000,000				300,000

* Fish released in the East River, Sheet Harbour

a Research program also conducted on East River, Sheet Harbour, directed at survival rates of smolts at different pH exposures.

b Medway information includes the Harmony Mills and Ponhook programs prior to 2000. In 1999 and 2000 the broodstock collections at Ponhook were not successful so fish in the program were based on the Harmony Mills collection only.

c Fish friends in addition to program listed

……continued

Table 2 continued.

		2002	2003	2003	2003	2004		2003	2004	2004	2004	2005
		Eggs	Unfed fry	6 Wk Fry	Parr	Smolt		Eggs	Unfed fry	6 Wk Fry	Parr	Smolt
Program / River	**Stock**											
Live Gene Bank												
Stewiacke	Stewiacke	400,000	60,000	60,000	48,000	50,000		365,000	54,750	54,750	43,800	50,000
Gaspereau	Gaspereau	80,000	20,000		25,000	25,000		80,000	20,000		25,000	25,000
Other Inner Bay of Fundy	Inner Bay							187,500	28,125	28,125	22,500	25,000
Atlantic whitefish	Petite Riviere											
Southern Uplands 1	SU1							187,500	28,125	28,125	22,500	25,000
Southern Uplands 2	SU2											
Mitigate losses due to acidity												
Salmon (Digby)	Salmon (Digby)											
Medway[b]	Medway											
Gold	Gold											
Integrated Fisheries Management Plan												
East River, Sheet Harbour	Mixed											
Musquodoboit	Musquodoboit											
Sackville[c]	LaHave											
LaHave[c]	LaHave											
Tusket[c]	LaHave											
Colonization												
Mushamush (LaHave)	LaHave											
Aboriginal												
Bear	Tusket											
Mersey	LaHave											
Indian Brook	Indian Brook											
Other												
East River, Pictou[c]	East River, Pic											
River Philip[c]	River Philip											
Annapolis	Annapolis											
Liscomb	Liscomb											
Meteghan	Tusket											
Petite	LaHave											
Clyde	LaHave											
Jordan	LaHave											

* Fish released in the East River, Sheet Harbour

a Research program also conducted on East River, Sheet Harbour, directed at survival rates of smolts at different pH exposures.

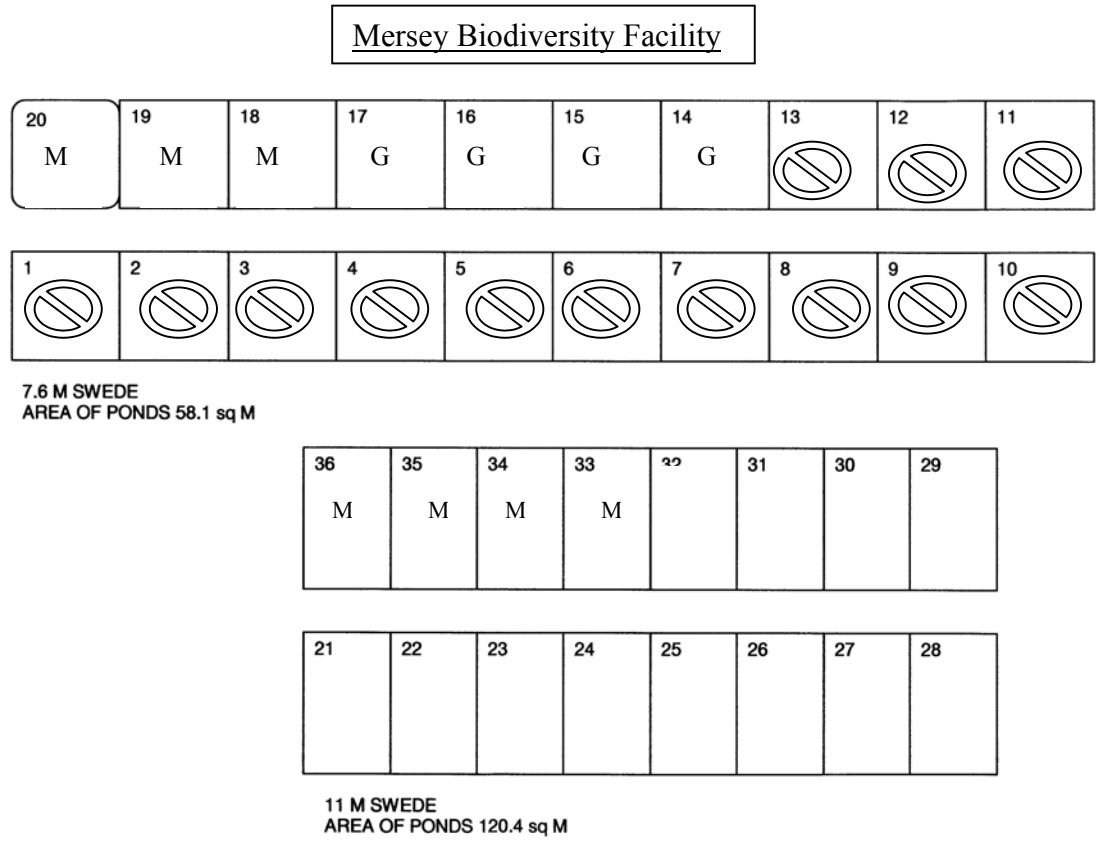
b Medway information includes the Harmony Mills and Ponhook programs prior to 2000. In 1999 and 2000 the broodstock collections at Ponhook were not successful so fish in the program were based on the Harmony Mills collection only.

c Fish friends in addition to program listed

Figure 1. Capacity of the Mersey Biodiversity Centre Based on Forecast for 2004

Scenario 1 : Three live gene banks (including the Gold River) based on parr plus Gaspereau River program. This scenario assumes that smolts for the LGB will only be produced from the second spawning for each live gene bank year group. Provision of fish for mitigating losses due to acidity is the second priority and assumed to be in the program for the Medway and Salmon rivers as described in the text (Gold is LGB).

⊘ = Tanks occupied by live gene bank; M = Mitigation of losses due to acid precip; G = Gaspereau

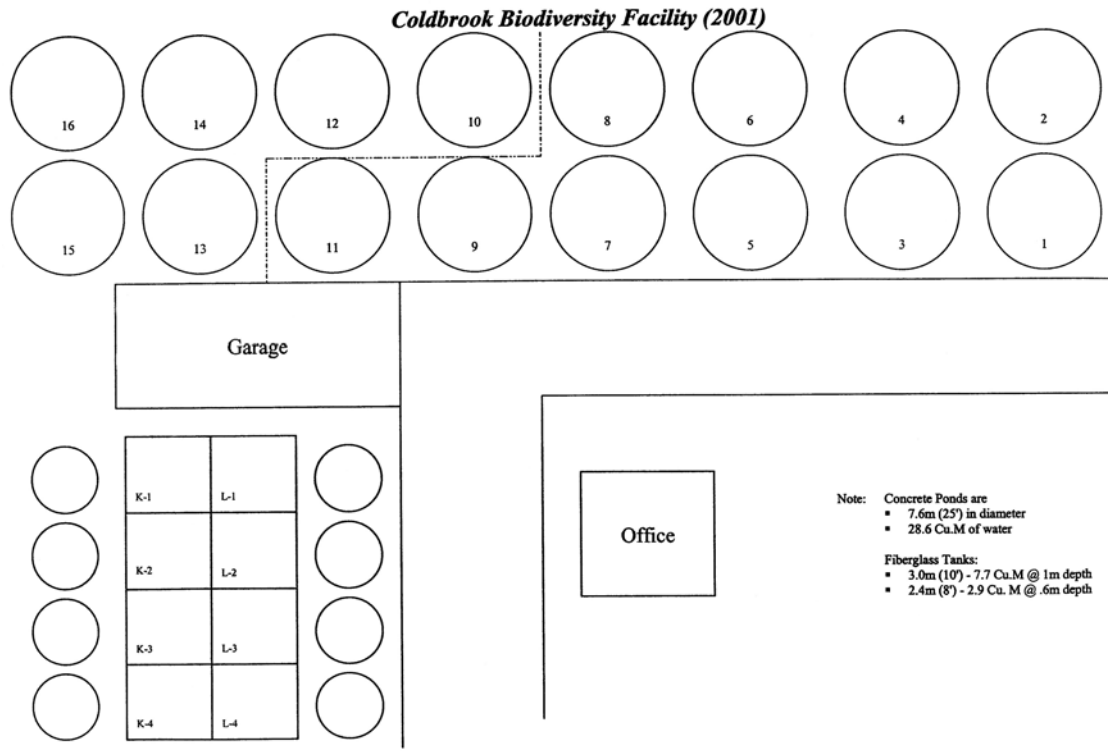


Available space for scenario 1 is 12 large ponds at Mersey for smolt production of up to 120,000 to 140,000 smolts.

Scenario 2: Assumes there are 25,000 smolt produced both years that a year group is spawned from each gene bank. Everything else is the same as scenario 1.

Available space for scenario 2 is six large ponds at Mersey for smolt production of up to 60,000 to 75,000 smolts.

Figure 2. Coldbrook Biodiversity Centre layout schematic.



Presentation 5. Past hatchery programs, broodstock shortfalls, and program requests.
Peter Amiro

Slide 1

Performance of hatchery programs

Requests
Shortfalls
Performance

Slide 2

Program requests and Problems

- Development of new or opened habitat.
- Aboriginal commitments.
- Enhancement for economic benefit.
- Research.
- Reluctance to stop (social dependence)
- Can be dependant on borrowing.
- Economics not assessed.
- Research needs differ from others and are expanding.

Slide 3

Requirements of a program from the biological perspective

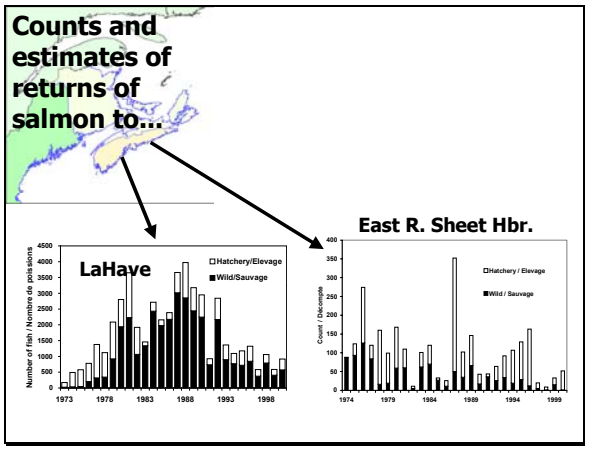
Principle:

- Do no harm numerically and genetically.
- Criteria for broodstock selection are uncertain.
- Not always possible to get representative sample.
- Minimum supplementation size unknown (interim 30 individuals min.)

Slide 4

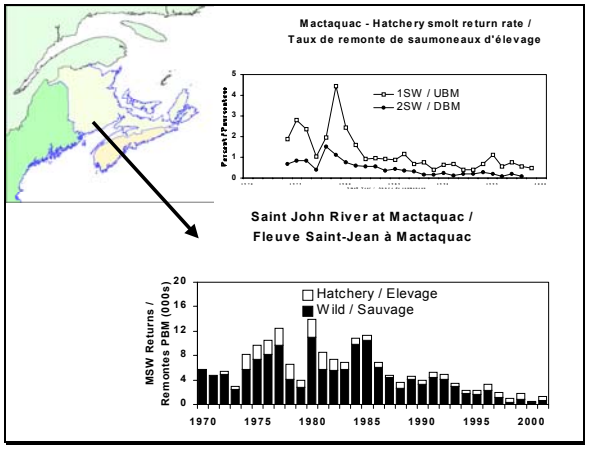
Effectiveness of hatchery supplementation…the track record.

Slide 5



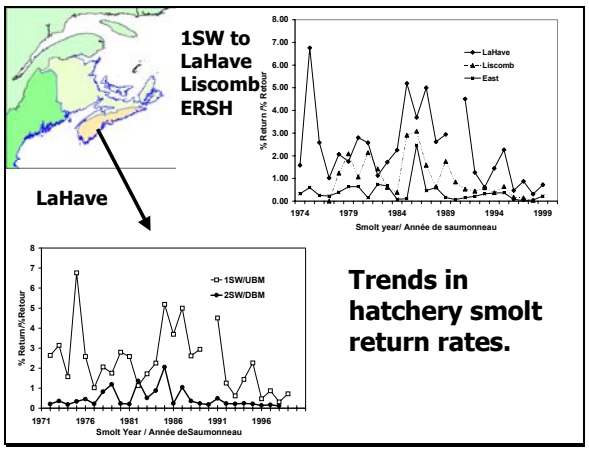
Counts and estimates of returns of salmon to the LaHave River and East River Sheet Harbour.

Slide 6



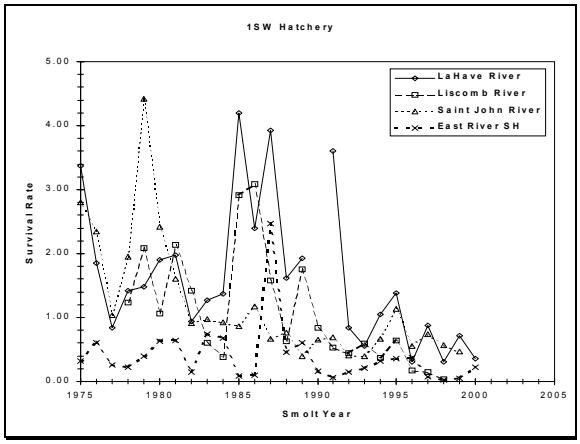
Smolt return rate to Mactaquac, Saint John River, New Brunswick.

Slide 7



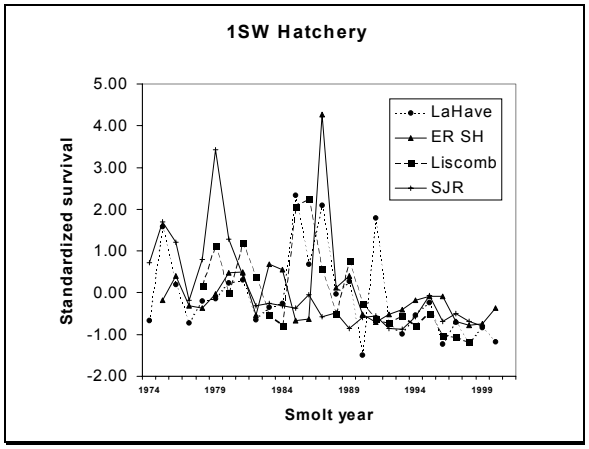
Trends in hatchery smolt return rates.

Slide 8



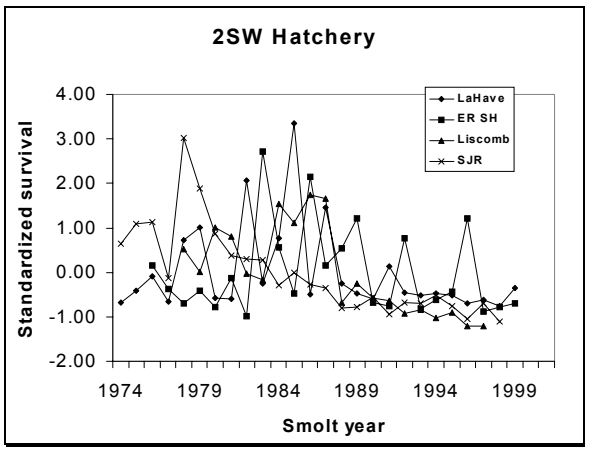
Many similarities among hatchery return rates since 1988.

Slide 9



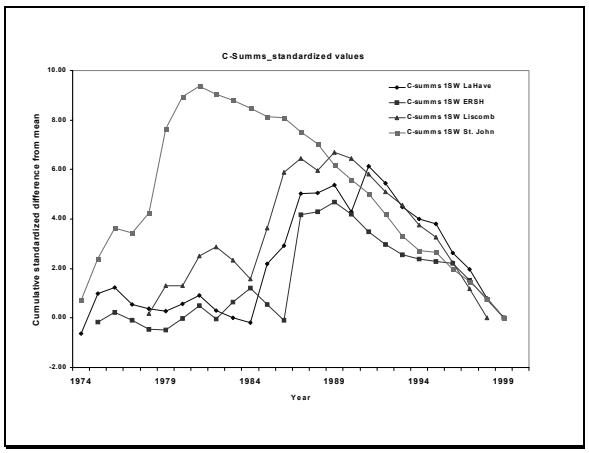
More easily seen when data are standardized, i.e. divided by their respective means. For 1SW…

Slide 10



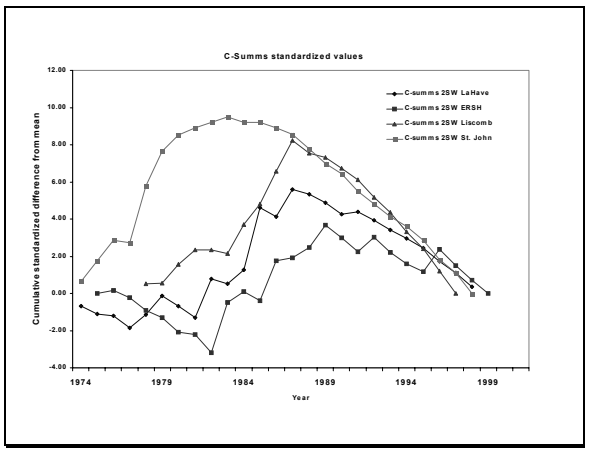
And for 2SW.

Slide 11



Cumulative difference from means plot show similarities among stocks for hatchery return rates. For 1SW…

Slide 12

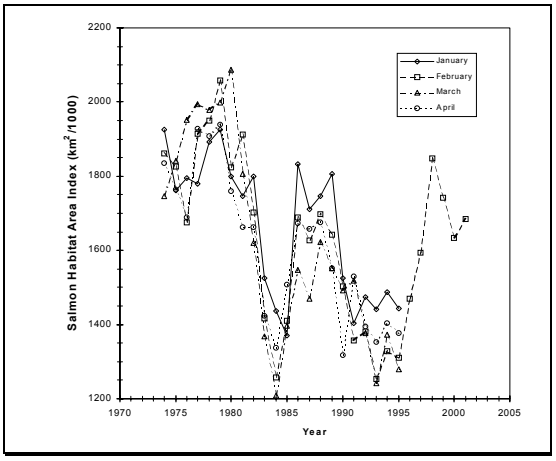


And for 2SW.

Slide 13

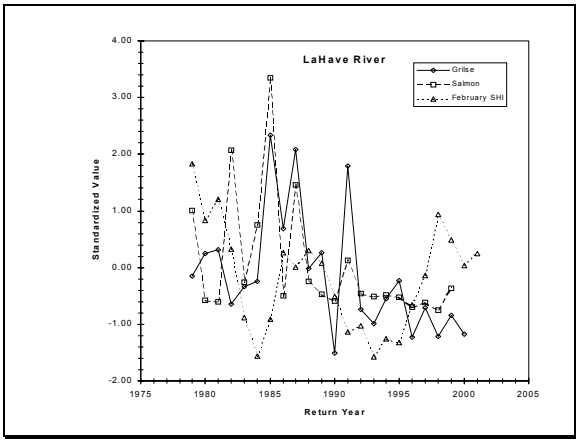
Does the marine environment play a role in survival?

Slide 14



The index of marine salmon habitat (SHI) is highly correlated among months, particularly during the winter.

Slide 15



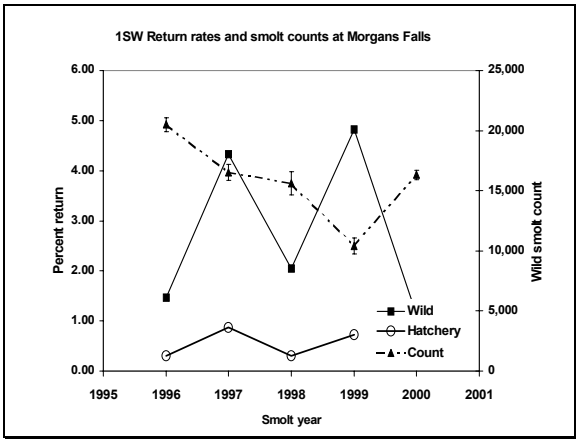
Return rates at Morgans Falls, LaHave River do not follow the February index of marine salmon habitat area, particularly since 1996.

Slide 16

How does the hatchery compare to the wild?

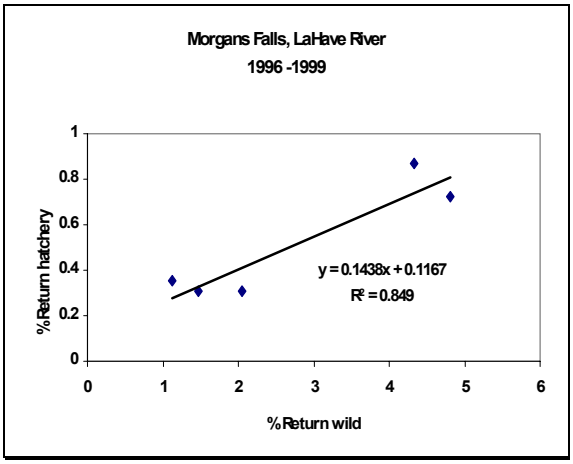
Simultaneous measures of wild and hatchery smolts at Morgans Falls on the LaHave River.

Slide 17



1SW return rate and smolt counts at Morgans Falls, LaHave River.

Slide 18



The first and only direct comparison of hatchery and wild smolt survival within a river. Above Morgans Falls on the LaHave River.

Slide 19

Number of hatchery smolts required to equal a wild smolt at MF

From previous equation:

•1wild smolt = 1 / 0.14 hatchery smolts

•or 6.75 hatchery smolts

Slide 20

Smolts per egg
Hatchery and Wild
1996 and 1997

- About 38 and 66% of the eggs made smolt equivalents
- Return rates (to 1SW and 2SW) were 0.14 and 0.17%
- About 1.3 and 1.1% of eggs survived to smolts.
- Return rates (to 1SW and 2SW) were 1.7 and 4.8%

Comparison of hatchery and wild stock and recruitment.

Slide 21

How large is the hatchery numerical advantage?

- In 1996 and 1997 for the LaHave river, above Morgans Falls, the advantage was about 5 and 9 times that of wild released eggs.
- Number is biased because not all smolts were stocked in LaHave River.
- This multiplier is only transportable to similar habitat productivity and escapement levels.

The size of the hatchery lever was five to nine times in 1996 and 1997.

The leverage may be greater if all hatchery products were returned to the source.

Transportability of these values has not been assessed.

Slide 22

Sustainability for a salmon population.

- Each generation must replace itself.
- Data collection problem with generation cohort analysis.
- Simple and transportable method is to estimate productivity of a stock and river in smolts produced per spawning adult.
- LaHave 1996 - 2001 average smolt per spawner was 14.6.

Addressing sustainability in a salmon population.

Slide 23

Sustainability continued...

- At 14.6 smolts per spawner, survival to spawning needs to be 6.9%.
- With hatchery support the total smolt per spawner was 41smolts in 1996 and 25 smolts in 1997.
- The required survival would have to have been 2.4% and 4% for replacement.

The LaHave River case. Hatchery support almost doubles a river and stock's resistance to low marine survival.

Slide 24

Take home message...

- Hatchery can increase productivity…but
- Genetics are important.
- Population level is important (density dependant effects).
- Habitat constraints affect outcomes e.g. dams, pH, river hydraulics.
- There are many balls to juggle.

Presentation 6. Liming for Acid Rain Mitigation
Wesley White

Acid rain has eliminated salmon entirely from some rivers in Nova Scotia and reduced salmon production in many others. As an interim measure, lime can be added to acidified surface waters to raise their pH and protect salmon populations.

This paper briefly describes some techniques that may be applicable to liming acid rivers in Nova Scotia. More detailed descriptions are given by White (2000). Salmon require a pH of at least 5.3 until they begin feeding. Salmon parr and smolt require a pH of 5.0 or higher. Liming operations that can not produce these minimum pH values will not significantly increase salmon production. Liming adds calcium to natural waters and this may confer additional benefits on fish besides raising the pH of their habitat. Liming does not usually increase toxic metal concentrations, even when the limestone used contains some metal contaminants.

Limestone is usually the best neutralising substance owing to its safety and low cost. Other substances are available but these are more expensive and may be dangerous to personnel handling them and to the fish. Different methods of spreading limestone vary considerably in cost and reliability. Once liming has been carried out, the pH will decline quickly unless liming is continued.

Table 1. Minimum pH objectives for liming projects to protect Atlantic salmon in Nova Scotia.

Stage	Tolerance
Incubation to hatching	5.3
Swim-up	5.3
Parr	5.0
Smolts	5.0

Table 2. Summary of annual costs and cost/tonne of liming by different methods (from White, 2000)

Method	Tonnes of lime	Total cost of lime	Capital and equipment	Labour	Cost per tonne
Lake liming	135	$ 4,050	$ 3,500	$ 6,750	$ 105
Revolving drum (manually fed)	23	$ 690	$ 3,350	$ 1,950	$ 260
Revolving drum (self-feeding)	138	$ 4,140	$ 15,550	$ 1,950	$ 156
Lime doser (Silo)	1,000	$ 30,000	$ 17,942	$ 2,100	$ 50
Diversion well	1,000	$ 30,000	$ 5,110	$ 2,100	$ 37

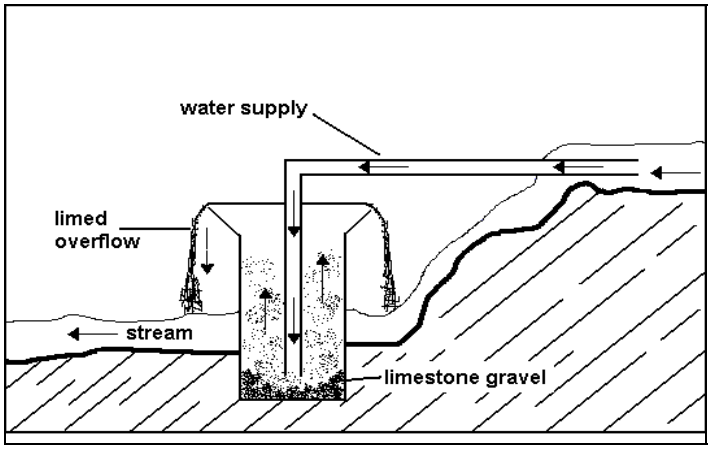


Figure 1. Diagram of diversion well for liming acidified streams.

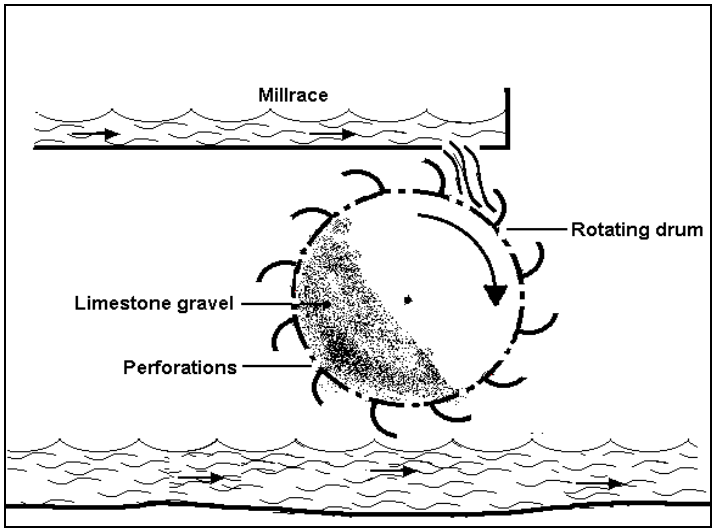


Figure 2. Diagram of rotating drum for liming acidified streams.

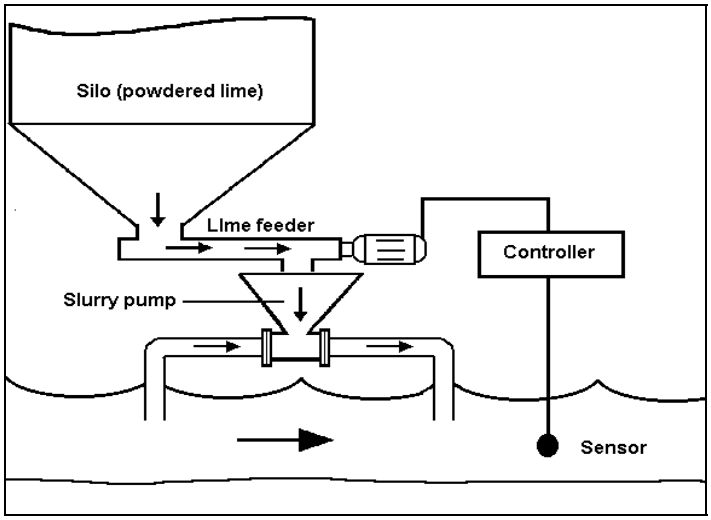
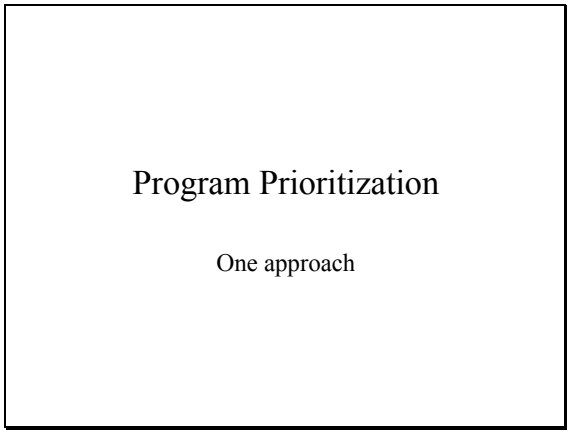


Figure 3. Diagram of lime doser (silo) for liming acidified streams.

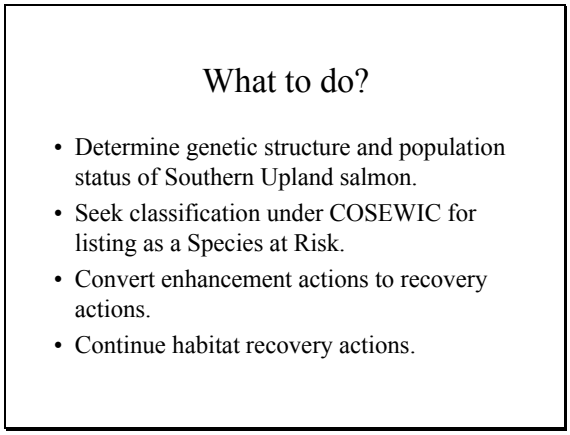
Presentation 7. Possible program approaches by Fisheries and Oceans
Peter Amiro

Slide 1

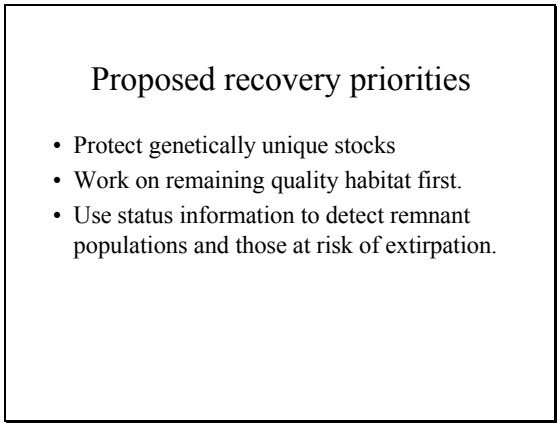


One approach to resolving the dilemma of the dependence on enhancement and its physical demand on hatchery resources versus the under capacity of those same facilities to fulfill the requirements for sustainability of the salmon population for the future. A triage approach based on evaluating biological value and potential for recovery.

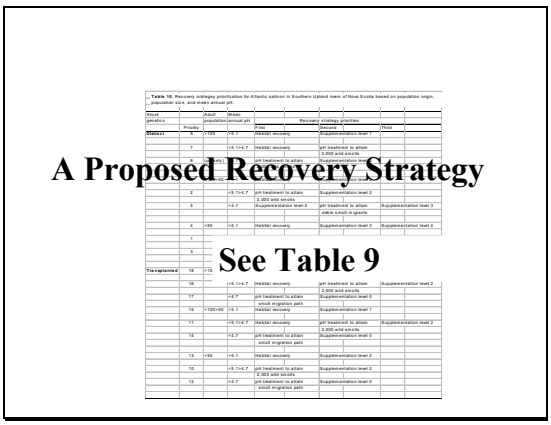
Slide 2



Slide 3



Slide 4



See Table 9.

Slide 5

Intervention levels

>**0.** **Transplantation from another source.**

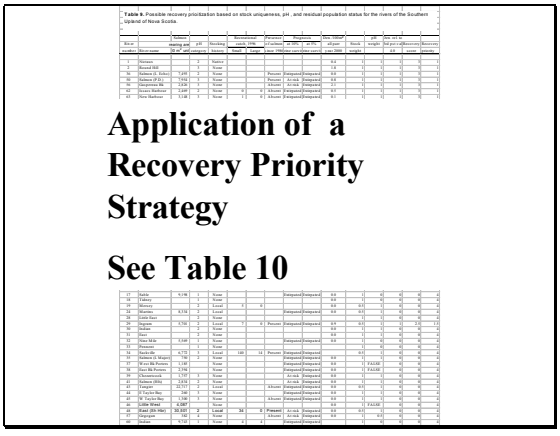
>**1.** **30-50 wild adult broodstock collected annually, five year program.**

>**2.** **30-50 wild and hatchery adult broodstock collected annually, five year program.**

>**3.** **30-50 wild broodstock, mixture of adult and juvenile males or juvenile females grown to maturity, five year program.**

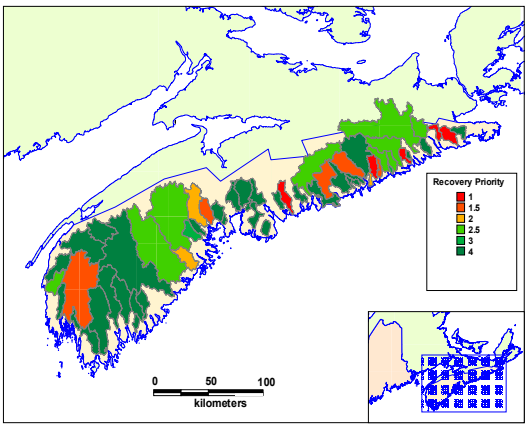
>**4.** **100-300 wild broodstock from wild juvenile collections, Recovery Program indefinite. (Live Gene Bank)**

Slide 6



See Table 10.

Slide 7



Spatial distribution of recovery priorities from highest RED to lowest DARK GREEN.

Table 9. Recovery strategy prioritization for Atlantic salmon in Southern Upland rivers of Nova Scotia based on population origin, population size, and mean annual pH.

Stock genetics		Adult population	Mean annual pH	Recovery strategy priorities		
	Priority			First	Second	Third
Distinct	9	>100	>5.1	Habitat recovery	Supplementation level 1	
	7		<5.1>4.7	Habitat recovery	pH treatment to attain 2,000 wild smolts	
	8	(unlikely)	<4.7	pH treatment to attain 2,000 wild smolts	Supplementation level 3	
	6	<100>50	>5.1	Habitat recovery	Supplementation level 2	
	2		<5.1>4.7	pH treatment to attain 2,000 wild smolts	Supplementation level 2	
	5		<4.7	Supplementation level 2	pH treatment to attain viable smolt migrants	Supplementation level 3
	4	<50	>5.1	Habitat recovery	Supplementation level 3	Supplementation level 4
	1		<5.1>4.7	pH treatment to attain 2,000 wild smolts	Supplementation level 3	Supplementation level 4
	3		<4.7	pH treatment to attain smolt migration path	Supplementation level 3	Supplementation level 4
Transplanted	18	>100	>5.1	Habitat recovery	Supplementation level 1	
	16		<5.1>4.7	Habitat recovery	pH treatment to attain 2,000 wild smolts	Supplementation level 2
	17		<4.7	pH treatment to attain smolt migration path	Supplementation level 0	
	15	<100>50	>5.1	Habitat recovery	Supplementation level 1	
	11		<5.1>4.7	Habitat recovery	pH treatment to attain 2,000 wild smolts	Supplementation level 2
	14		<4.7	pH treatment to attain smolt migration path	Supplementation level 0	
	13	<50	>5.1	Habitat recovery	Supplementation level 2	
	10		<5.1>4.7	pH treatment to attain 2,000 wild smolts	Supplementation level 2	
	12		<4.7	pH treatment to attain smolt migration path	Supplementation level 0	

Supplementation level:

0 Tranplantation from another source.
1 30-50 wild adult broodstock collected annually, 5 year program.
2 30-50 wild and hatchery adult broodstock collected annually, 5 year program.
3 30-50 wild broodstock, mixture of adult and juvenile males or juvenile females grown to maturity, 5 year program.
4 100-300 wild broodstock from wild juvenile collections, Recovery Program indefinite. (Live Gene Bank)

Table 10. Possible recovery prioritization based on stock uniqueness, pH, and residual population status for the rivers of the Southern Upland of Nova Scotia.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1			Salmon			Recreational		Presence	Prognosis		Den./100m^2			Den. rel. to	
2	River		rearing area	pH	Stocking	catch, 1996		of salmon	at 10%	at 5%	all parr	Stock	pH	3rd pst.val	Recovery
3	number	River name	100 m^2 units	category	history	Small	Large	since 1986	marine survival	marine survival	year 2000	weight	weight	4.2	score
4															
5	1	Nictaux		2	Native						0.4	1	1	1	3
6	2	Round Hill		3	None						1.8	1	1	1	3
7	36	Salmon (L. Echo)	7,493	2	None			Present	Extirpated	Extirpated	0.0	1	1	1	3
8	50	Salmon (P.D.)	7,954	3	None			Present	At risk	Extirpated	0.8	1	1	1	3
9	56	Gaspereau Bk	2,826	3	None			Absent	At risk	Extirpated	2.1	1	1	1	3
10	62	Issacs Harbour	2,469	2	None	0	0	Absent	Extirpated	Extirpated	0.5	1	1	1	3
11	63	New Harbour	3,148	3	None	1	0	Absent	Extirpated	Extirpated	0.1	1	1	1	3
12	10	Tusket	150,780	2	Local	133	55	Present	Extirpated	Extirpated	2.0	0.5	1	1	2.5
13	26	Middle	12,290	2	Local	14	0	Present	Extirpated	Extirpated	2.8	0.5	1	1	2.5
14	29	Ingram	5,701	2	Local	7	0	Present	Extirpated	Extirpated	0.9	0.5	1	1	2.5
15	42	Ship Harbour	20,518	4	None	1	0		At risk	At risk	3.4	1	0.5	1	2.5
16	47	West (Sh Hbr)	20,079	2	Local	20	1	Present	Extirpated	Extirpated	3.5	0.5	1	1	2.5
17	51	Quoddy	6,849	4	None				At risk	Extirpated	0.8	1	0.5	1	2.5
18	59	Indian Harbour Lakes		4	None						0.3	1	0.5	1	2.5
19	21	Petite	7,174	4	Local	126	16	Present	At risk	Extirpated	4.0	0.5	0.5	1	2
20	25	Gold	21,962	3	Native	188	71	Present	At risk	Extirpated	26.8	1	1	0	2
21	27	East (Chester)	4,598	2	None	1	2	Absent	Extirpated	Extirpated	4.8	1	1	0	2
22	49	Kirby	1,604	3	None				At risk	Extirpated	27.0	1	1	0	2
23	8	Salmon (Digby)	9,797	3	Local	94	44	Present	At risk	Extirpated	7.6	0.5	1	0	1.5
24	20	Medway	99,174	3	Local	490	88	Present	At risk	Extirpated	6.6	0.5	1	0	1.5
25	22	LaHave	75,046	3	Local	1,514	327	Present	At risk	At risk	13.0	0.5	1	0	1.5
26	40	Musquodoboit	23,125	4	Native	209	116	Present	Sustained	At risk	47.4	1	0.5	0	1.5
27	52	Moser	15,270	3	Local	35	0	Absent	At risk	Extirpated	9.2	0.5	1	0	1.5
28	54	Ecum Secum	9,894	4	None	27	5	Present	At risk	Extirpated	10.8	1	0.5	0	1.5
29	55	Liscomb	34,960	2	Local	1	0	Absent	Extirpated	Extirpated	9.1	0.5	1	0	1.5
30	58	St Marys	58,717	4	Native	596	177	Present	Sustained	At risk	15.5	1	0.5	0	1.5
31	61	Country Harbour	3,457	4	None	4	5	Present	Sustained	At risk	19.7	1	0.5	0	1.5
32	23	Mushamush	2,743	4	Local	20	2		Sustained	At risk	29.2	0.5	0.5	0	1
33	53	Smith	1,055		None				At risk	At risk	9.4	1	FALSE	0	1
34	3	Bear		2	Local						0.0	0.5	1	0	0
35	4	Sissibo		2	None						0.0	1	1	0	0
36	5	Beliveau		4	None						0.0	1	0.5	0	0
37	6	Boudreau		4	None							1	0.5	0	0
38	7	Meteghan		4	Local	12	5				0.0	0.5	0.5	0	0
39	9	Annis		3	None						0.0	1	1	0	0
40	11	Argyle		1	None						0.0	1	0	0	0
41	12	Barrington	8,877	1	None			Absent	Extirpated	Extirpated		1	0	0	0
42	13	Clyde	55,348	1	Local	46	14		Extirpated	Extirpated	0.0	0.5	0	0	0
43	14	Roseway	33,012	1	None			Absent	Extirpated	Extirpated	0.0	1	0	0	0
44	15	Jordan	29,206	1	Local	0	0	Absent	Extirpated	Extirpated	0.0	0.5	0	0	0
45	16	East		1	None						0.0	1	0	0	0
46	17	Sable	9,198	1	None				Extirpated	Extirpated	0.0	1	0	0	0
47	18	Tidney		1	None						0.0	1	0	0	0
48	19	Mersey		2	Local	5	0				0.0	0.5	1	0	0
49	24	Martins	8,334	2	Local				Extirpated	Extirpated	0.0	0.5	1	0	0
50	28	Little East		2	None							1	1	0	0
51	30	Indian		2	None						0.0	1	1	0	0
52	31	East		2	None						0.0	1	1	0	0
53	32	Nine Mile	5,569	1	None				Extirpated	Extirpated	0.0	1	0	0	0
54	33	Pennent		1	None							1	0	0	0
55	34	Sackville	6,772	3	Local	140	14	Present	Extirpated	Extirpated		0.5	1	0	0
56	35	Salmon (L Major)	750	2	None				Extirpated	Extirpated	0.0	1	1	0	0
57	37	West Bk Porters	1,185		None				Extirpated	Extirpated	0.0	1	FALSE	0	0
58	38	East Bk Porters	2,394		None				Extirpated	Extirpated	0.0	1	FALSE	0	0
59	39	Chezzetcook		3	None				At risk	Extirpated	0.0	1	1	0	0
60	41	Salmon (Hfx)	2,834	2	None				At risk	Extirpated	0.0	1	1	0	0
61	43	Tangier	22,717	2	Local			Absent	Extirpated	Extirpated	0.0	0.5	1	0	0
62	44	E Taylor Bay	260	3	None				Extirpated	Extirpated	0.0	1	1	0	0
63	45	W Taylor Bay	1,300	3	None			Absent	Extirpated	Extirpated	0.0	1	1	0	0
64	46	Little West	4,087		None						0.0	1	FALSE	0	0
65	48	East (Sh Hbr)	30,501	2	Local	34	0	Present	At risk	Extirpated	0.0	0.5	1	0	0
66	57	Gegogan	382	4	None			Absent	At risk	Extirpated	0.0	1	0.5	0	0
67	60	Indian	9,743	1	None	4	4		Extirpated	Extirpated		1	0	0	0
68	64	Larrys	2,632	1	None			Absent	Extirpated	Extirpated		1	0	0	0
69	65	Cole Harbour	2,730	2	None	0	0		Extirpated	Extirpated		1	1	0	0

Weights and sums formulae:

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=IF(M10=1,0,IF(M10=2,1,IF(M10=3,1,IF(M10=4,0.5))))
=IF(N10=0,0,IF(N10>N$8,0,1))
=IF(O10<>0,SUM(L10:N10),0)

DISCUSSION GROUP REPORTS

Minutes from Group 1

Group 1 Participants: Eugene Denny
George Ferguson
Warren Hamilton
Ken Meade
Ron Seeney
Rapporteur: Dave Dagley
Facilitator: Shane O'Neil

Resource persons included all on site, but Bev Davison sat in on the majority of the discussion sessions.

- Input based on the five guiding principles for recreational Fisheries, which guide Fisheries & Oceans to provide sustainable recreational harvesting opportunities and conservation of the angling species resource.

- It is recognized that Fisheries & Oceans mandate will provide for protection, restoration and enhancement of fisheries resources and habitat.

DFO is Directed to Access Funding to

1. Develop a current data base of genetic stocks.
2. Determine the reasons for ocean mortality of salmon and attempt to correct the problems.
3. Review predator issues and resolve.
4. Initiate a comprehensive habitat improvement program.
5. Initiate an acid rain mitigation program.
6. Increase enforcement efforts.
7. Review stocks needed to be referred to COSEWIC for designation under Endangered Species Legislation.
8. Operate a comprehensive Biodiversity Centre Program.

Requirements of a Biodiversity Program to Operate Under a Precautionary Approach to Maintain Stocks Until Complete Genetic Mapping of Stocks is Done

1. Current stocks to be maintained so sufficient numbers (salmon) exist for gene banking when required.
2. Stock recovery tool.
3. Aboriginal programs.
4. Mitigate for acid rain.
5. Colonization.
6. Gene Banking.
7. Enhance genetic components of stocks.
8. Integrated fisheries management plan for sustainable recreational and economic activities benefit.
9. Research.
10. Education.

Required Infastructure Upgrades

1. Enlarge Mersey/Coldbrook facilities.
2. Improve Infastructure services at Mersey/Coldbrook as necessary to operate efficiently and productively.

- DFO must move forward to maintain stocks and volunteers on a sustainable basis.

- The cost of stock support currently will be born later in gene banking costs and facilities if efforts are not increased on a priority basis – Biodiversity facilities' focus will be:

    1. Preservation of endangered stocks through a gene banking process.
    2. Conservation of genetically distinct stocks and genetic diversity.
    3. Conserving existing stocks to provide sustainable recreational and aboriginal harvesting opportunities and re-colonization.

A priority ranking system will not allow an objective decision to be made on the best river and stock to be focused on due to budgetary constraints. Overriding factors – volunteers, economics, or other priorities may be the only criteria required to justify re-colonization or support of a specific river or stock.

Criteria – Important Considerations

1. Water quality - pH – temp, etc.
2. Habitat – physical (i.e., % of area classified as optimal or good and fair habitat), run, pool.
3. Stock size – health.
4. Social values – volunteer, educational, hope.
5. Historical return.
6. Physical enhancement – tree planting /green belts.
7. Water quality improvement potential.
8. Economic generator - Recreational fishing.
9. Aesthetics.
10. Colonization.
11. Aboriginal food fishing.
12. Illegal introductions.
13. Water flow controls – to protect habitat quality.
14. Historical and recent stock returns.

One practice used in the past to accomplish some of the protection and monitoring objectives was a river guardian program. Consideration should be given to the potential merits of such a program during this period of low stock status.

General recommendations

- DFO is obligated to deliver all objectives/activities provided currently and as outlined in the booklet "An Operational Policy Framework" containing five guiding principles for sustainability and conservation of the recreational fisheries.

- Dollars need to be accessed to place Atlantic stock resources and habitat on the priority basis currently being extended for funding on the West coast.

- DFO has never approached the contribution provided by the volunteer sector to conserve stocks. Volunteers are every bit as endangered as the salmon and a major commitment by DFO is required to convince volunteer that DFO is committed to supporting existing stocks.

- Lack of DFO action has led to the problem of illegal introduction of species such as bass and pickerel to allow an angling experience at the expense of salmon, trout, and Acadian whitefish.

- Participants and invitees be kept informed of follow-up summaries and actions by DFO as available.

- Considerable discussion was held on the priority ranking issue for support of necessary projects. Total agreement was not reached due to meeting time constraints and the potential for discrimination of denying deserving projects under a ranking priority basis.

- We request a report on the result of this exercise by spring of 2002.

- The adopt-a-stream program funding was provided to NS Salmon Association for delivery at small management cost. Habitat funding may be directed in the same manner as that program.

Minutes from Group 2

Group 2 participants:
Don MacLean
Trevor Goff
Ian Mckay
Steven Dennis
Rannie Gillis
John Swim
Doug Aitken
Facilitator: Rod Bradford
Rapporteur: Scott Cook

Group discussion began with a general description of the three options available for the allocation of surplus space at the Biodiversity Centres: 1) unlimited resources and space; 2) limited resources and space; and 3) limited resources with an equal allocation of the space among salmon fishing areas.

The participants were unanimous in their reluctance to discuss the differing possible scenarios in the absence of clear commitments from DFO regarding its recreational fishery responsibilities. There was much discussion on the usefulness/intent of prioritizing river stocks, as would need to be the case under options 2 and 3 above. Generally, the group wanted some assurance that the department viewed the prioritized rivers as a starting point, and that with time restoration/recovery activities would be extended to all Nova Scotia salmon rivers. It was noted that the river associations had in the mid-1980s entered ‘in good faith’ into partnerships with DFO to expand the fish culture facilities in the mid-1980s, and that these were abandoned (as a consequence of program review) before completion. For example, a pipeline to expand the

water supply to the (then named) Mersey Fish Culture Station, was purchased, in part with client money, but never installed.

The group discussion then turned towards the causes for the decline in Atlantic salmon throughout Nova Scotia. It was agreed that there was a need to maintain hatchery-based programs to preserve Atlantic salmon in the province during the present period of extremely low marine survival. Nonetheless, the group also discussed the usefulness of stocking salmon into rivers where habitat had been severely degraded (e.g., acid rain, land-based activities affecting water quality etc.). This brought the discussion full circle to the issue of there being a need for DFO to state clearly its intent to work towards recovery of Atlantic salmon to all of Nova Scotia's salmon rivers, and not just the few presently targeted in the gene bank program. In light of the numerous watersheds where freshwater salmon habitat has deteriorated, it was concluded that DFO-led recovery activities would need to extend beyond the Biodiversity Centre programs.

Thus so, the group agreed that any further discussion, or written record of the groups' discussion/decisions on the subject of space allocations would need to be prefaced by the following statements:

1) The Department of Fisheries and Oceans must live up to its Recreational Fishery responsibilities as outlined in its Operational Policy Framework (2001), specifically the five guiding principles for recreational fisheries, and

2) The Biodiversity Centre (hatchery) programs will need to be integrated with habitat restoration (including acid mitigation) and effective habitat protection (no net loss habitat policy).

Subsequent discussion on the individual options was brief, with no real decisions made as to how one should proceed in the absence of a DFO commitment to provide the resources to restore salmon to all Nova Scotia salmon rivers. The following accounts reflect the nature of the discussions and not necessarily any conclusions.

Discussion on Option 1. Unlimited Resources

It was noted that after gene banking and all other urgent commitments are met, there are presently no facilities left to have an effective management program of any significance for recreational fisheries. Maintaining existing stocking programs (and if need be expanding facilities to ensure that these continue) was regarded to be an absolute minimum requirement.

Under a scenario where resources were not limited, the group agreed that the first priority would be to expand the Biodiversity Centre facilities to meet the recreational fishery needs as defined within the Integrated Fisheries Management Plan. The specific elements of the stocking programs would need to consider in priority:

1. The need to preserve unique strains of Atlantic salmon in quality freshwater habitat (as outlined in Table "10").
2. The historical and cultural needs for access to the resource (both aboriginal and recreational fishing).
3. The economic and other commitments shown by the community and angling groups in the past (i.e., work with groups that have shown a commitment to resource stewardship in the past).

Discussion on Option 2. Limited Resources

Present day constraints limit excess capacity to 60,000 to approximately 120,000 smolts. It was noted that these translate roughly to about 300 to 600 adult fish (at a present survival rate of 0.5%).

The group agreed that the first priority would remain unchanged; unique strains of Atlantic salmon would need to be maintained in river systems containing quality habitat. At this point the discussion focussed on the need to broaden the definitions of quality habitat in order to prioritize the salmon rivers. It was suggested that the following elements be included:

1. Riparian zone usage/protection. Is the habitat affected by commercial or residential development and/or forestry operations?
2. Have other fish species (chain pickerel, smallmouth bass) been introduced into the watershed?
3. What hydroelectric developments are in place within the watercourse?
4. Are there finfish aquaculture operations in the vicinity of the river?

The group further agreed that any plan of action had to accommodate/commit to restoring salmon to their historical area of occupancy. Also, the group felt that there needs to be:
1) full utilization of the egg rearing capacity at the existing facilities.

Discussion on Option 3. Limited Resources split among SFAs

Group discussion did not extend beyond subjects raised previously during debate on the other two options. It was noted, however, that in order to negate defeatist attitudes within the communities that there have to be ongoing recreational fishery enhancement programs throughout the province. The unsanctioned introductions of chain pickerel and smallmouth bass into many Nova Scotia waterways in recent years was cited as evidence of what can happen when individuals no longer see a future that includes angling for Atlantic salmon.

General Recommendations

There are several general points/issues that need to be dealt with:
1. The Department of Fisheries and Oceans must live up to its Recreational Fishery responsibilities as outlined in its Operational Policy Framework (2001),
2. There is a need to integrate the hatchery program with:
   - habitat restoration (including acid mitigation), and
   - effective habitat protection (no net loss habitat policy).
3. The marine survival problem needs to be addressed, and
4. DFO must implement a plan to restore salmon to their historical area of occupancy and provide the necessary resources to accomplish this.

<u>Allocation of Space Within the Biodiversity Centres</u>

The group did not proceed with the river prioritization exercise, in the absence of any explicit commitments by DFO to restore salmon to all of Nova Scotia's salmon rivers.
The following represents the consensus view on the subject.

The problem is that, after gene banking and all other urgent commitments are met, there are no facilities left to have an effective management program of any significance for recreational fisheries. Also, previous commitments to expand the facilities in the mid-1980s were

abandoned mid-stream, highlighting the need for a clear long-term commitment from the department.

Over and above gene banking and protection of unique stocks, there is a need to:
- maintain current hatchery capacity for the present stocking programs, so if need be
- DFO must expand facilities to maintain these present stocking programs (should gene banking activities expand).

There is a clear need to ensure the preservation of unique salmon stocks. However, actions taken beyond that to identify what other stocks will be brought into the hatchery will need to be based on criteria in addition to those presented at this workshop (Table 10 in Presentation 6). Those identified by the group are (not necessarily in order):
1. Societal support. Have the communities been actively involved in resource stewardship?
2. Was the resource utilized in the past?
3. Habitat, there will need to be resources available to restore and protect lost habitat (especially that lost since the 'no net loss' habitat policy came into effect).

And, we need to expand and re-define the measures of habitat quality to include:
1. Riparian zone usage/protection. Is the habitat affected by commercial or residential development and/or forestry operations?
2. Have other fish species (chain pickeral, smallmouth bass) been introduced into the watershed?
3. What hydroelectric developments are in place within the watercourse?
4. Are there finfish aquaculture operations in the vicinity of the river?

It was also recommended that the minutes of the group discussions be sent to the entire list of workshop invitees.

SUMMARY REMARKS
Greg Stevens

These summary remarks are made in response to a number of interesting and provocative points raised by our guest speaker, Jim Gourley, and to the summaries provided by the two Working Groups.

1. With respect to the question raised by Mr. Gourley, i.e., "Who is going to pay?" (for salmon preservation and restoration) the following comments are offered.
   - Provincial legislation prohibits private access and control of waters in Nova Scotia.
   - The general public and anglers have never supported any concept that would result in salmon angling becoming a "rich man's" sport in this province.
   - The example of someone paying up to $7,000 for a rod day of salmon fishing in Iceland is not a reality for NS in the foreseeable future. This is not an option for funding in Nova Scotia.

2. The apparent dual role being played by DFO with respect to fisheries management and enforcement on one hand versus aquaculture development and promotion on the other was raised as a concern. This is not the first time DFO has been confronted with this issue.

   We agree that this may be perceived as a difficult position. However, if the development and promotion of aquaculture and the federal monies associated with it come with the

caveat that aquaculture must move ahead on and environmentally sound and sustainable basis, then the roles are, in fact, complementary. The aquaculture industry is a legitimate one and was once promoted as a favored option for moving away from commercial salmon fisheries in the Maritimes.

3. In my view, waiting for, or actively seeking a listing of salmon under COSEWIC or SARA before funding is made available, is tantamount to an abdication of responsibility.

   A direct infusion of money is needed now … as a "stitch in time"! It is an investment in the future. It's the presence of fish that generates revenue and provides a return on investment … not the absence of fish.

4. Prior to the 2000-federal election there were two proposals for funding under consideration by DFO. One was for an Atlantic Salmon Endowment Fund (i.e., $30 million that would provide annual funding from investment earnings in perpetuity for specific projects). The other proposal was for a multi-million dollar research fund for Atlantic salmon. Both proposals need to be re-activated.

5. There is a lot of talk about Community Watershed Management. What is it? Perhaps it's just a good "buzz word". There is no question we have Community Watershed involvement. The people sitting around these tables are testament to this involvement … proof that small investments can be multiplied many times over through in-kind and volunteer efforts.

   True Community Watershed Management assumes, however, that there is some ability to generate monies derived from charging for access to a resource. It presumes there is a resource. Because of low stock conditions, access to salmon resources in Nova Scotia is currently denied on as many rivers, or more, than access is permitted. This poses a significant challenge, to say the least, for Community Watershed Management for salmon.

6. The Atlantic salmon resource is not a DFO resource…it is a public resource and the public should have a say in how the resource is protected, restored and enhanced. Part of DFO's role is to provide the best information available on which the public can make informed decisions with respect to the future direction government takes on Atlantic salmon.

   We have attempted to provide you with that information over the past two days. I would like to thank each of the participants for the time and effort they put into this Workshop. I know how hard you worked and how difficult a task this has been.

REFERENCES

Meffe, G.K. 1992. Techno-arrogance and halfway technologies: salmon hatcheries on the Pacific coast of North America. Conservation Biology 6(3): 350-354.

White, W.J. 2000. A review of the effectiveness and feasibility of alternate liming techniques to mitigate for acid rain effects in Nova Scotia. RAP Working Paper 2000/15.

Appendix 1. List of Participants. (Atlantic Salmon Workshop, Ramada Inn, Dartmouth, Sept 12-13, 2001.)

Name	Affiliation/Address	Phone	Fax	E-mail
Larry Marshall (Co-chair)	DFO, Science Branch, BIO PO Box 1006 Dartmouth, NS B2Y 4A2	902-426-3605	902-426-6814	MarshallL@mar.dfo-mpo.gc.ca
Greg Stevens (Co-chair)	DFO, Fisheries Management Branch PO Box 1035 Dartmouth NS B2Y 4T3	902-426-5433		StevensG@mar.dfo-mpo.gc.ca
Trevor Goff	DFO, Mactaquac Biodiversity Facility 114 Fish Hatchery Lane French Village, NB B3E 2C6	506-363-3126		GoffT@mar.dfo-mpo.gc.ca
Doug Aitken	DFO, Science Branch, BIO PO Box 1006 Dartmouth, NS B2Y 4A2	902-426-2954		AitkenD@mar.dfo-mpo.gc.ca
Shane O'Neil	DFO, Science Branch, BIO PO Box 1006 Dartmouth, NS B2Y 4A2	902-426-1579		OneilS@mar.dfo-mpo.gc.ca
Rod Bradford	DFO Science Branch, BIO PO Box 1006 Dartmouth, NS B2Y 4A2	902-426-4555		BradfordR@mar.dfo-mpo.gc.ca
Bev Davison	DFO Mersey Biodiversity Facility Milton, NS B0T 1P0	902-354-5443	902-354-5441	DavisonBG@mar.dfo-mpo.gc.ca
Ellen Kenchington	DFO Science Branch, BIO PO Box 1006 Dartmouth, NS B2Y 4A2	902-426-2030		KenchingtonE@mar.dfo-mpo.gc.ca
Karen Rutherford	DFO Science Branch, BIO PO Box 1006 Dartmouth, NS B2Y 4A2	902-426-3150		RutherfordK@mar.dfo-mpo.gc.ca
Steven Denny	Eskasoni Fish & Wildlife Commission, Eskasoni, Cape Breton NS B0A 1J0			
Stephen Dennis	Eskasoni Fish & Wildlife Commission, Eskasoni, Cape Breton NS B0A 1J0			
Ron Seney	LaHave River Watershed Enhancement Foundation		902-527-8727	Rseney@hotmail.com
Scott Cook	NS Federation of Hunters and Anglers		902-542-2661	
George Ferguson	NS Salmon Association			Nssa@ns.sympatico.ca

Name	Affiliation/Address	Phone	Fax	E-mail
Ian McKay	Sackville Rivers Association			Ian.mckay@ns.sympatico.ca
Rannie Gillis	Cape Breton Sport Fishing Association			
John Swim	East Shelburne County Rivers Association			
David Dagley	Queens Co Fish @ Game Association			
Ken Meade	NS Power			Ken.meade@nspower.ca
Warren Hamilton	Tusket River Salmon Association			
Don MacLean	NS Agriculture and Fisheries			Macleand@gov.ns.ca
Wes White	DFO retiree			WesleyW@ns.sympatico.ca

Appendix 2. Letter of Invitation

P.O. Box 1006
Dartmouth, N.S.
B2Y 4A2
August 09, 2001

Mr. Charlie Dennis
Eskasoni Fish & Wildlife Commission
4123 Shore Road
Eskasoni, NS
B0A 1J0

Dear Mr. Dennis:

The purpose of this letter is to invite you to participate in an important Workshop pertaining to the future use of Fisheries and Oceans (DFO) hatcheries (Science's biodiversity facilities) in Nova Scotia. DFO is seeking input from Aboriginal groups, recreational users and the Province in developing guidelines for hatchery support of Southern Upland and Eastern Cape Breton Island salmon.

The Workshop will be held at the SeaKing Club, Warrior Drive, CFB Shearwater, commencing at 10:00 a.m. on Wednesday, September 12 and concluding at noon on Thursday, September 13. Please see the enclosed package for additional details on the format and specific agenda items to be covered at the Workshop.

For non-government individuals who reside outside HRM and who do not have corporate travel allowances, DFO will pay for overnight accommodations on September 12. (Please see attached list of invitees and designation.) A block of rooms is reserved at the Future Inn, (20 Highfield Park Drive, Dartmouth (902) 465-6555) for this purpose. If you are one of these individuals, please call and reserve one of the blocked rooms before August 31. (Directions to Future Inn, Highway 111 towards the MacKay Bridge, take exit 3, turn left at stop sign, cross overpass, you are now on Highfield Park Drive). As well, DFO will be providing lunch and dinner to all participants on September 12.

Your attendance and participation is important to us and to the outcome of this Workshop. If you are unable to attend, we would appreciate if you would ask a designate in your group or organization to attend on your behalf.

If you have any questions regarding this invitation, please contact either Greg Stevens at (902) 426-5433 or Peter Amiro at (902) 426-8104.

Sincerely yours,
T.L. Marshall, Manager
Diadromous Fish Division
Science Branch
Maritimes Region
Encls.

Appendix 3. List of Invitees

Salmon Fishing Area 19
Charlie Dennis**
Eskasoni Fish & Wildlife Commission

Marshall Kaizer**
Highlands-Bras d'Or Sports Fishing Association

Chief Blair Francis**
Eskasoni First Nation

Chief Morley Googoo**
Whycomagh First Nation

Chief Mary Louise Bernard**
Wagmatcook First Nation

Chief Terrance Paul**
Membertou First Nation

Chief Lindsay Marshall**
Chapel Island First Nation

Salmon Fishing Area 20

Bill Carpan**
St. Mary's River Association

Jack MacDonald**
Eastern Shore Fish & Game Association

Marie O'Melia**
Musquodoboit River Association

Chief Lawrence Paul**
Millbrook First Nation

Salmon Fishing Area 21

Larry Short
Sackville Rivers Association

Paul Merriner**
Mushamush Salmon Association

Carroll Randall**
LaHave Salmon Association

Ron Seney**

LaHave River Watershed Enhancement Foundation

Doug Bell**
Petite Riviere Affiliate NSSA

Dave Dagley**
Queens County Fish & Game Association

Hobey Blades**
East Shelburne County Rivers Association

Warren Hamilton**
Tusket River Salmon Association

Roland LeBlanc**
Salmon River Salmon Association

Chief Frank Meuse**
Bear River First Nation

Salmon Fishing Area 22

Scott Cook**
Nova Scotia Federation of Anglers & Hunters

Jack Johnson**
Cobequid Salmon Association

Chief Lawrence Toney**
Annapolis Valley First Nation

Chief Shirley Clarke**
Glooscap First Nation

Chief Reg Maloney**
Indian Brook First Nation

Other

Murray Hill
Nova Scotia Department of Agriculture and Fisheries

Alan MacNeil
Nova Scotia Department of Agriculture and Fisheries

Tim Martin**
Netukulimkewe'l Commission Native Council of Nova Scotia

George Ferguson
Nova Scotia Salmon Association

Lewis Hinks
Atlantic Salmon Federation

Terry Toner
Nova Scotia Power Inc.

Larry Marshall
Dept. Fisheries and Oceans

Shane O'Neil
Dept. Fisheries and Oceans

Peter Amiro
Dept. Fisheries and Oceans

Doug Aitken
Dept. Fisheries and Oceans

Greg Stevens
Dept. Fisheries and Oceans

Trevor Goff
Dept. Fisheries and Oceans

Rod Bradford
Dept. Fisheries and Oceans

Tim Surette
Dept. Fisheries and Oceans

Gus vanHelvoort
Dept. Fisheries and Oceans

Bev Davison
Dept. Fisheries and Oceans

_____
** DFO to cover accommodations

Appendix 4. Agenda

Wednesday September 12
10:00 AM – Session 1: Plenary
(presentations or summaries to be made available on hard copy)

- Introduction and opening remarks 10:00 AM. (Marshall and Stevens)
- Status of salmon in NS Southern Uplands and Cape Breton 10:30 – 11:00. (Amiro)
- The principles of live gene banking 11:00 – 11:30 (O'Reilly)
- Constraints of biodiversity facilities 11:30 – 12:30.(O'Neil)

Lunch: 12:30- 1:15 (provided)

- Past hatchery programs, broodstock shortfalls, and program requests. 1:15 – 2:00. (Amiro)
- Potential for liming 2:00 – 2:30 (White)
- Possible program approaches by DFO 2:30 – 3:00.

(Health break)

3:00- 5:00 PM – Session 2: Workshops

Discussion Groups: (facilitators to suggest leading questions)

1. Salmon Fishing Area 19 (Cape Breton East).
- Review three options
  1. Unlimited BDC resources.
  2. Limited BDC resources at present day capacities.
  3. Limited BDC resources and fixed proportions by SFA and conservation/enhancement.

2. Salmon Fishing Area 20 (Eastern Shore).

3. Salmon Fishing Area 21 (Southern Shore).

5:30 PM – Mixer (cash bar)

6:30 PM – Dinner

Speaker
Raffle

Thursday, September 13
8:30 AM – 12:00

Group Presentations and Discussion

Closing Remarks (Stevens)

Appendix 5. List of Background Presentations

Presentation 1.	Opening Remarks
Presentation 2.	Status of salmon in NS Southern Uplands and Cape Breton
Presentation 3.	Live gene banking
Presentation 4.	Constraints of biodiversity facilities
Presentation 5.	Past hatchery programs, broodstock shortfalls, and program requests
Presentation 6.	Potential for liming
Presentation 7.	Possible program approaches for Fisheries and Oceans

Appendix 6.

MARITIMES REGION SALMON HATCHERIES (BIODIVERSITY FACILITIES)

SUMMARY

- Under Program Review, the three mainland Nova Scotia salmon hatcheries were divested by 1997, bankrupted by 1999, and returned without funding to the Department of Fisheries and Ocean's (DFO's) Science Branch by 2000. Two facilities in New Brunswick were deemed to be ineligible for divestiture; one has been transferred to Real Property, the other is funded and in production.

- Science Branch has re-focussed its role for the reacquired hatcheries (now considered biodiversity facilities) from one of "enhancement" of public fisheries for salmon to that of preservation and recovery of threatened Southern Upland salmon populations, endangered Atlantic whitefish and inner Bay of Fundy salmon.

- Although some new funding for this role has been obtained from Species-at-Risk funds, operation of the biodiversity facilities remains a significant drain on Science A-base resources.

- Client groups, including some Aboriginal organizations, note that the Department has a nationally stated obligation to support Fisheries Management with hatchery production for fishery access purposes. The Province of Nova Scotia has indicated to the Minister that the federal government fish culture facilities should contribute to the maintenance of access to public fisheries for salmon and has asked that DFO reinstate fish culture for "enhancement" purposes.

- While DFO's current position is that fish culture production to support salmon fisheries would not be effective in this area during the ongoing period of low marine survival and that the focus should be preservation and recovery of endangered species, nevertheless, DFO's latest Stock Status Report indicates that the only river in Southwest Nova Scotia that has a 95% chance of achieving its conservation requirement in 2002 is the LaHave River which benefited from the stocking of 93,500 smolt in 2001.

Background

- Under "Program Review" the Department elected to divest all five (5) Maritimes Region hatcheries supporting public fisheries to "not-for-profit" groups dedicated to the conservation and sustainable use of Atlantic salmon, on the grounds that these were not essential to the core conservation mandate.

- None of the hatcheries in Maritimes Region were successfully divested to non-profit "recipient groups". Two units in New Brunswick were determined to be essentially ineligible for divestiture. Three units in Nova Scotia were operated briefly by a non-profit group but were returned to DFO for financial reasons.

New Brunswick

- The former Saint John Hatchery is "licensed" to the Canadian Sturgeon Conservation Center, a non-profit organization that in addition to researching sturgeon in association with the University of New Brunswick (UNB), rear small numbers of salmon destined for the St. Croix River. DFO has made no financial contributions to the operation; the Center has been paying the lease to the City of Saint John and the lease is now in the hands of Real Property.

- The Mactaquac Fish Collection, Fish Sorting and Fish Culture facilities were built by New Brunswick Electric Power Commission in the mid-1960s. A Memorandum of Agreement between the Commission and the Minister of Fisheries (1968) stipulated that the Minister would operate the facilities for the "maintenance of salmon and other fishes in the Saint John River" through the "life of the project".

- Funding that had been withdrawn in 1997, was partially ($400 K) restored by National Headquarters (NHQ) Science in 2000. Costs in the intervening years and the difference between NHQ provision and the $600^{+} K annual operating costs have been absorbed by Regional Science.

- Significant changes are being made in the fish culture program at the re-named Mactaquac Biodiversity Facility. Changes are in response to recent dramatic declines in marine survival and resultant near-extirpation of inner and outer Bay of Fundy salmon stocks. Changes include gene banking of the Big Salmon and Magaguadavic river stocks, and most recently, captive rearing of broodfish for stocks originating upriver of Mactaquac.

Nova Scotia

- The three mainland Nova Scotia hatcheries were divested by 1997, bankrupted by 1999, and returned without funding to Science Branch by 2000. Mersey and Coldbrook have been retained and Cobequid has been transferred to Real Property for disposal.

- The loss of federal hatcheries in NS coincided with the documentation of the demise of inner Bay of Fundy salmon, the loss of salmon to at least 14 acidified rivers of the Southern Upland of Nova Scotia and the decline of stocks in the remaining Southern Upland rivers either because of low marine survival or partial acidification of rivers and low marine survival.

- Inner Bay of Fundy salmon were subsequently listed by COSEWIC as "endangered". A DFO national prioritization scheme ranked Southern Upland Atlantic salmon stocks 16th among 103 aquatic "species-at-risk"; (inner Bay salmon were ranked 7th). Atlantic whitefish are also listed as endangered and nationally ranked 2nd among aquatic species at risk.

- Fish cultivation techniques are being promoted for use in strategic intervention to preserve populations at greatest risk of extirpation (DFO Pacific Region, 2000. Wild Salmon Policy – Discussion Paper).

- Science Branch is funding, in part with Species-at-Risk money, and re-focusing Mersey and Coldbrook Biodiversity facilities from "enhancement" of public fisheries for Atlantic salmon (the activity that precipitated their divestiture under Program Review) to that of preservation

and recovery of threatened Southern Upland salmon populations, endangered Atlantic whitefish and inner Bay of Fundy salmon populations.

- Nova Scotia Client groups adhere to the principles of DFO's "Operational Policy Framework for Recreational Fisheries in Canada" and indicate that some significant production at Science's Biodiversity facilities should be maintained to support access by Aboriginal and recreational fishers to select salmon stocks.

- A Client Workshop sponsored by the Diadromous Fish Division (DFD) and Resource Management Branch, September 12-13, 2001 in Dartmouth, NS attracted representatives from the Tusket River Salmon Association, LaHave River Watershed Enhancement Foundation, Sackville Rivers Association, Nova Scotia Salmon Association, Queens County Fish and Game Association, East Shelburne County River Association, Eskasoni Fish and Wildlife Commission, Cape Breton Sport Fishery Advisory Committee, Nova Scotia Federation of Hunters and Anglers, Nova Scotia Power Incorporated and Nova Scotia Department of Agriculture and Fisheries (approximately 30 associations/aboriginal groups were invited).

- At the Workshop, DFO outlined the Biodiversity Facilities' limited capacity to conserve/mitigate increasing numbers of threatened/endangered salmon stocks and Management's challenge to both recognize and address constitutional/treaty rights and foster access for recreational use.

- Clients were provided a half-day to develop written recommendations on appropriate deployment of Nova Scotia Biodiversity Facilities for conservation, mitigation, integrated fisheries management plans (IFMP's), Aboriginal food fisheries and research needs on Southern Upland salmon rivers.

- Client groups failed to advise on a proportionate allocation of conservation/gene banking and IFMP/Aboriginal initiatives, noting that the Department has a nationally stated obligation to support Fisheries Management with hatchery production.

- The Province of Nova Scotia's position is that federal government fish culture facilities should contribute to the maintenance of public fisheries for Atlantic salmon. On November 27, 2001 the Provincial Minister for the Department of Agriculture and Fisheries in Nova Scotia wrote to Minister Dhaliwal on this specific issue. In that letter, Minister Fage expressed alarm at DFO's apparent re-focusing exercise and asked that DFO revisit its approach with the intent of reinstating hatchery capacity for enhancement purposes.

- Complete funding of Nova Scotia Biodiversity Facilities under Regional Science initiatives will result in a continued increasing emphasis on preservation initiatives for endangered salmon and whitefish as well as threatened salmon populations and the continued phase-out of support for aboriginal and recreational access to fisheries.

- Base costs to operate NS Biodiversity Facilities in 2002 are $495 K ($375 K salaries and $120 K O&M); DFD and Maritimes Science Branch are committing $95 K A-base salaries, another $180K salaries will come from Species-at-Risk. The remaining $100 K salaries and $120 K O&M will again have to be risk-managed by Science Branch. (Costs do not include the 1.5 PY of professional (BI) A-base currently committed to administer/operate/co-ordinate, or those costs necessary to modify sites for program efficiency.)

- Provision within the existing facilities (along side Science's core initiatives to preserve/position for recovery) of up to 120,000 smolts or approximately 40% of pre-divestiture "enhancement" for client access to fisheries would cost upwards of $225 K in operations and $125 K in facility modifications.

- Support of "enhancement" initiatives at the pre-Program Review level, as well as current core Science needs, require a new facility costing $6-10 million.

- A-base commitments by DFD to the Biodiversity facilities continue to erode salmon assessment/monitoring capacity and further distance the Division from an ability to monitor acidity in Southern Upland rivers (requiring an additional $100 K every 5 years) or investigate the potential for recovery through liming and acid-free sanctuaries.

Recommendation

- The operation of Maritimes Region Biodiversity facilities are important to the preservation and recovery of threatened and endangered anadromous fish species, and as such, their operation is consistent with the core conservation mandate and "no-enhancement" policy of the Department for Atlantic salmon.

- Science is operating with limited funds to ensure that these facilities support the new strategy.

- The policy to discontinue federal "enhancement" of Atlantic Canada's salmon fisheries through the stocking of hatchery-reared fish was enunciated during Program Review and its implementation is impacting on recreational fisheries, aboriginal fisheries and stakeholders including the Nova Scotia government who have made representations to continue enhancement. Up until the present we have responded that we are following our stated policy approach.

- Without a policy change and new funding, discontinuing "enhancement" will essentially eliminate Aboriginal and recreational access to salmon fishing in the Scotia–Fundy portion of mainland NS for the 2003 season and beyond.