Proceedings of the Biodiversity Facilities Workshop : June 21-24, 2010, White Point Nova Scotia

D.L. MacDonald and S. M. Ratelle

Fisheries and Oceans Canada
Ecosystems and Oceans Science Sector, Maritime Region
Mactaquac Biodiversity Facility
French Village, New Brunswick
E3E 2C6

2011

Canadian Manuscript Report of Fisheries and Aquatic Sciences 2956

Fisheries and Oceans Canada | Pêches et Océans Canada

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Canadian Technical Report of Fisheries and Aquatic Sciences

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Fisheries and Oceans Canada
Ecosytems and Oceans Science Sector, Maritimes Region
Mactaquac Biodiversity Facility
French Village, New Brunswick
E3E 2C6

Cat. No. Fs97-4/2956E-PDF ISSN 1488-5387

Correct Citation for this publication:

MacDonald, D.L., and Ratelle, S.M. 2011. Proceedings of the Biodiversity Facilities Workshop: June 21-24, 2010, White Point, Nova Scotia. Can. Manuscr. Rep. Fish. Aquat. Sci. 2956 : v + 46p

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Biologists, technicians and research scientists from the Department of Fisheries and Ocean's (DFO) Population Ecology Division, Diadromous group and Parks Canada Agency met at White Point Beach Resort, June 21-24, 2010. The objectives of the meeting were to share information and to discuss ideas about the rearing, release and fitness of Atlantic salmon reared in the Maritimes region's three Biodiversity Facilities. The workshop included presentations and working group discussions of: Biodiversity Facilities' roles in Science, the past, present and future of fish culture, various technical aspects regarding rearing and treatments, marking and tagging, release strategies, conservation biology, data management and ways to improve fitness.

Information sharing was a key theme throughout the workshop presentations. Each of the biodiversity facilities presented information regarding their programs, including: stocks and stages of salmon reared in their facility, treatment types and techniques, and rearing methods for various life stages. Biologists and scientists working within or with the biodiversity facilities presented assessment and scientific analysis of work that the facilities had contributed towards the maintenance and restoration of Inner Bay of Fundy (IBoF) Atlantic salmon stocks. A complete understanding of the "how and why we do things" was lacking in the overall group and the presentations and break-out discussions were meant to fill this knowledge gap.

Workshop participants discussed modifying rearing techniques and release strategies (from minor to major changes) in order to more positively affect fitness and to minimize domestication and epigenetic effects. Evidence that the three facilities tend to do some things differently (due to site variation or human preference) became very clear during data management discussions and break-out group presentations. Efforts to standardize some aspects of our work (e.g., rearing techniques, data collection and management, release methodologies and stages) and to continue to enhance a team approach among the three facilities with their partners (both within and outside the DFO) were highlighted by the participants. Also of note was the overarching theme that the facilities should record what they do and compile this into an annual report. Communication about our programs and research through reports and publications was considered our paramount role in science and in ensuring our relevance to the department's mandates.

At the conclusion of the workshop, several items were actioned to move forward. These included: the establishment of a data management committee, plans to conduct a release strategy workshop, feasibility study on VIE tagging to replace (or be used in conjunction with) adipose clipping, the creation of a working group to look at current hatchery practices in relation to conservation and genetic effects of rearing, changes in treatment methodologies where feasible to minimize handling (especially on eggs); the creation of an annual report, and more cohesion among facilities working on similar programs. These action items will be monitored and reported on within the DFO by organizing staff.

RÉSUMÉ

MacDonald, D.L., et Ratelle, S.M. 2011. Compte rendu d'un atelier sur les Centres de Biodiversité : 21-24 juin 2010, White Point, Nouvelle-Écosse. Rapp. manuscr. can. des sci. halieut. et aquat. 2956 : v + 46p

Des biologistes, des techniciens(-iennes) et des chercheurs(-euses) scientifiques appartenant pour les uns à l'équipe chargée des poissons diadromes à la Division de l'écologie des populations de Pêches et Océans Canada (le MPO) et pour les autres à l'agence Parcs Canada ont pris part à un atelier au White Point Beach Resort du 21 au 24 juin 2010. Cette rencontre avait pour but de leur permettre d'échanger de l'information et des idées à propos des techniques d'élevage et de lâcher ainsi que du succès reproductif du saumon atlantique élevé dans les trois centres de biodiversité de la région des Maritimes. Les exposés et discussions en groupes de travail qui ont eu lieu à cette occasion ont porté sur le rôle scientifique des centres de biodiversité, sur le passé, le présent et l'avenir de l'aquaculture, sur divers aspects techniques de l'élevage et des traitements, sur le marquage des poissons, sur les stratégies de lâcher, sur la biologie de la conservation, sur la gestion des données et sur les moyens d'améliorer le succès reproductif.

Les exposés auxquels a donné lieu l'atelier étaient axés sur l'échange d'information. Chacun des centres de biodiversité a présenté des renseignements sur ses programmes, notamment sur les stocks et sur les stades du saumon qu'il élevait, sur les techniques et les types de traitement qu'il appliquait et sur ses méthodes d'élevage aux divers stades biologiques. Des biologistes et des scientifiques travaillant au sein de ces centres ou en collaboration avec eux ont présenté une analyse scientifique et une évaluation des travaux effectués par ces centres pour contribuer au rétablissement et au maintien des stocks de saumon de l'intérieur de la baie de Fundy. Il manquait au départ à l'ensemble des participants une compréhension globale « du pourquoi et du comment » des choses et les exposés et discussions en petits groupes avaient pour but de combler cette lacune.

Les participants ont discuté des modifications (certaines modestes, d'autres vastes) qui pouvaient être apportées aux techniques d'élevage et aux stratégies de lâcher pour influer plus favorablement sur le succès reproducteur et réduire les effets épigénétiques et ceux de la domestication. Au cours des discussions sur la gestion des données et des exposés en petits groupes sur le succès reproducteur, il est apparu très clairement que les trois centres ont tendance à faire certaines choses différemment (en raison de la différence de lieu ou de préférences humaines). Les participants ont toutefois souligné les efforts déployés pour standardiser certains aspects du travail (p. ex. les techniques d'élevage, la collecte et la gestion des données, les méthodes et les stades de lâcher) et pour continuer à favoriser le travail d'équipe entre les trois centres et leurs partenaires de l'intérieur et de l'extérieur du MPO. À noter aussi qu'ils ont jugé très important que les centres consignent ce qu'ils font et en rendent compte dans un rapport annuel. La communication, sous forme de rapports et de publications, au sujet de nos programmes et travaux de recherche est un de nos rôles scientifiques primordiaux et aussi une façon de nous assurer que nous nous inscrivons bien dans nos mandats ministériels.

À la conclusion de l’atelier, il a été convenu de prendre plusieurs mesures à l‘avenir. Celles-ci comprenaient de mettre sur pied un comité de gestion des données, de planifier un atelier sur les stratégies de lâcher, d’entreprendre une étude de faisabilité sur le marquage à l’aide d’étiquettes VIE pour soit remplacer l’incision de la nageoire adipeuse ou par être utilisé de pair avec elle, de créer un groupe de travail chargé d’étudier les pratiques ayant cours dans les écloseries eu égard à la conservation et aux effets génétiques de l’élevage, de modifier les méthodes de traitement, si possible, pour réduire les manipulations (des œufs en particulier), de produire un rapport annuel et d’assurer une meilleure cohésion entre les centres qui travaillent à des programmes similaires. Ces mesures feront l’objet d’un suivi et de comptes rendu au sein du MPO par le personnel compétent.

INTRODUCTION

The Department of Fisheries and Oceans Canada (DFO), Maritimes Region, supports three Biodiversity Facilities as part of its Population Ecology Division (PED). One facility is in New Brunswick: Mactaquac Biodiversity Facility: Coldbrook Biodiversity Facility and Mersey Biodiversity Facility are located in Nova Scotia. The historical focus of these facilities was once production and enhancement of Atlantic salmon but shifted to conservation, primarily of Inner Bay of Fundy (IBoF) stocks, in the late 1990s. Coldbrook and Mersey, once sold to private operating groups as a result of government downsizing in the late 1990s, returned to DFO in 2000 when their operating groups could no longer maintain their programs and faced closure. They became the primary Live Gene Banks (LGBs) for the Nova Scotia IBoF stocks that were being reviewed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Mactaquac Biodiversity Facility maintains the IBoF LGB program for New Brunswick as well as fulfilling its core obligations to compensate for salmon populations affected by the construction and operation of the three major hydro-electric dams on the Saint John River.

While the three facilities are operated in the same division (PED), only Mersey and Coldbrook Biodiversity Facilities have operated fully in conjunction with one another, a result of their linked programs. Coldbrook is primarily an adult rearing facility that produces broodstock and eggs. Approximately one third of these eggs are reared to unfed fry at Coldbrook Biodiversity Facility and the remainder of the eggs are reared at Mersey Biodiversity Facility, where they are grown to 6 week feeding fry and fall parr. All three facilities also work in conjunction with their provincial diadromous stock assessment teams. The team must provide each other with fish, data and personnel in order to achieve their goals. Because the teams are so reliant on one another, and because the three facilities have similar goals, staff felt that more information/idea sharing and an alignment of program objectives and methodologies could result in greater achievements. To this end, a Biodiversity Facility Annual Meeting was held in September 2007 at the Mactaquac facility. While attempts had been made to make this an annual event, the next meeting was not able to be held again until June 2010. Facility biologists and technicians drafted the meeting layout with the intention of including the sharing/gathering of technical information and the sharing/discussion of biological information pertaining to increasing fitness in each of the three facilities.

The workshop was attended by 14 DFO technicians (some in Biodiversity Facilities and others in assessment), 4 DFO biologists, one DFO scientist, and a technician and scientist from Parks Canada Agency. All of the participants were directly involved in conservation initiatives for IBoF salmon and were expected to participate through presentations and group discussions.

The workshop was expected to enhance the knowledge of its participants, to action new goals for the facilities, and to begin a science based framework to guide decisions around our programs. Action items arising from the meeting can be found throughout the document and are tabled in Appendix 3. It was also decided that some working groups would be struck in order to continue some of the work and information gathering that was begun at this workshop (Appendix 4) and that the framework for an annual

report would be started by representatives at each of the three facilities that winter. The following record reflects the presentations and break-out events at the Workshop.

PRESENTATIONS

Live Gene Banking- Adapting a New Strategy for Conservation: Why does everything seem so complicated?

Presenter(s): Shane O'Neil

Abstract:

After acknowledging the hard work put into organizing the workshop, it was pointed out that one of the key motivations for this workshop was the extreme change in status of Atlantic salmon and how that has changed the role of the biodiversity facilities. Stocking of fish in support of recreational fisheries occurred on many rivers in the region but declining stocks has restricted current action to populations at risk for rivers in the Inner Bay of Fundy, Southern Uplands, and in the Outer Bay of Fundy. As an ice breaker for the meeting, each participant was handed a scarf to wear. It was pointed out that the difference in the scarves could be considered symbolic of the uniqueness of the many salmon populations and that conserving those unique populations was our current mandate. Several cartoons were used to illustrate the point that we have to deal with change in our programs and that it is an ongoing challenge. Research into small populations, adult rearing of fish collected as parr, and use of unique markers for fish while they are held in captivity were some of the examples used to illustrate the changes to our programs and activities. Staff was reminded that workshops such as these can be used to deal with the change, aid in our understanding, and serve as a basis for training and information exchange. The output quality would depend on full staff involvement.

Biodiversity Facilities and DFO Priorities

Presenter(s): Ross Claytor

Abstract:

Biodiversity staff was encouraged to view their facilities as laboratories capable of carrying out controlled experiments in the areas of DFO priorities. Taking this approach would allow the science community to extrapolate from well understood causes and effects to the world at large. The DFO priorities for research were described as follows:

1. Fish Population and Community Productivity
2. Habitat and Population Linkages
3. Climate Change / Variability
4. Ecosystem assessment and management
5. Aquatic Invasive Species
6. Aquatic Animal Health
7. Sustainability of Aquaculture
8. Ecosystem Effects of Energy Production
9. Operational Oceanography

10. Emerging and enabling technologies for regulatory responsibilities.

In particular linkages between habitat and population dynamics have been studied in controlled situations such as could be created in our facilities. Understanding the links between genetic and environmental adaptations is another example of possible study areas.

Greater emphasis on research than in the past and forging scientific links with universities will be an important part of the next 5 – 10 years of work in the biodiversity facilities. Linking these research projects to DFO national priorities will be essential.

Discussion and Action(s):

Ross was asked to clarify or define the meaning/intention of each of the National Priorities. There was some concern that they were open to interpretation and how could we be sure that we interpret them correctly. Ross confirmed that the priorities are meant to be broad so that the researchers in the regions can determine how and where their studies fit in. Life history was given as a broad example. We could ask ourselves what it is that we don't yet know about a species life history. We could also look at our outstanding questions and try to see how these might fit into the priorities. Biodiversity staff was encouraged to view their facilities as laboratories capable of carrying out controlled experiments in the areas of DFO priorities. Discussion with other researchers was encouraged since they might have some insight on how to make linkages.

Ross also suggested a workshop on a particular priority and gave an example of "How do you manage a fishery based only on life history characteristics?" This type of workshop would involve a lot of people from many parts of the division. We were challenged to focus on our questions and to use the priorities as a leader for funding or as a stimulus to generate ideas.

Patrick O'Reilly brought up that there seems to be a lot of priority in the division to study specific species at risk. Given that, how do we prioritize our work when it may involve the following parameters: conservation biology in general versus conservation biology of salmonids versus conservation biology of Atlantic salmon? Ross indicated that research aimed at all three of these components would be of a high priority. We also need to look at research that is solvable and can lead to a specific answer. You should consider the likely impact of the results. Will they be useful today versus five years from now? Are you testing a new theory? It can be very exciting as long as it is easily managed.

Renée Wissink brought up that we are currently doing a lot of good and cutting edge research in the facilities and used Parks Canada Agency's joint projects with Mactaquac as an example. The facilities are doing what they do best in terms of rearing the fish. In addition, Mactaquac is also undertaking research like the spawning experiments in the substrate ponds. The sea pen trials currently undertaken by PCA were also given as an example. It was suggested that the work being done or already done could be better highlighted by management to management (up the line). Ross indicated that this is a very good reason why our work should be published.

Renée also brought up that we are currently trying to treat most of the things that we do as an experiment, even if it answers or sheds some light on a question and may not be publishable. We are all looking at better ways to raise the fish. An example of a place where we could do some great science in the near future is the Petitcodiac. We could design good experiments that will give us a lot of information about trying to recover salmon in this system.

Danielle asked Ross to think about how management could help the facilities and their people better understand their roles in research and where the various responsibilities lay. Ross indicated that he did not intend to overwhelm people. He asked the group to find their niche and become an expert in that area. We can't do everything but we can find a niche and gain a better understanding of certain aspects. Think about small experiments that answer parts of a bigger question. Once you do the work, get it out there and share it with the world. That is what science is all about.

Overview of the Maritime Biodiversity Facilities

Mactaquac Biodiversity Facility

Presenter(s): Trevor Goff

Abstract:

The Mactaquac Biodiversity Facility (BF) is located just below the Mactaquac Dam on the St John River, New Brunswick. The facility's programs fall into three main categories: core functions, collaborative research and client program agreements. The core functions include the fish collection/sorting/transport of sea-run salmon returning to the dam; operation of fish culture facilities to compensate for fish and habitat loss effects of hydroelectric development; and a Living Gene Bank (LGB) for endangered Atlantic salmon stocks. The presentation highlights the major roles that Mactaquac plays within each of its functions. Examples of collaborative research and client program agreements were presented. Changes to Mactaquac's original programs leading to today's initiatives were highlighted.

Mersey Biodiversity Facility

Presenter(s): John Whitelaw

Abstract:

Mersey Biodiversity Facility (Mersey BF) is one of two biodiversity facilities located in Nova Scotia, and is located on the South shore near Liverpool. The other facility is Coldbrook BF, which is located near Kentville in the Annapolis Valley. The two work in conjunction with each other, sharing programs and budget.

Infrastructure at Mersey BF consists of 36 exterior concrete Swede ponds, of these twenty are 7.6m ponds and sixteen are 11m ponds. Inside the incubation building is an ever changing layout of egg troughs (recirculation or flow through), heath units, upwelling incubators, and various sized tanks for rearing Atlantic salmon and Atlantic whitefish. Water to the facility is gravity-fed by gravity from the Mersey River, through surface and deep water intakes, and is treated with limestone to increase the low pH. To combat high, summer temperatures, water sources are mixed and oxygen is injected into the water with an oxygen injection system.

The key program at the Mersey BF, in association with Coldbrook BF, is the LGB of Inner Bay of Fundy (IBoF) Atlantic salmon for Nova Scotia Rivers. The IBoF Rivers supported by the LGB are the Stewiacke River, Gaspereau River, and North Minas Basin rivers. Mersey personnel assist in spawning at the Coldbrook BF and receive two-thirds of the green eggs to incubate through to hatch. Depending on the stock, juveniles are reared at the facility and released to the natural environment at various stages: unfed fry, 6-week fry, fall parr, and smolt. In addition to the LGB, Mersey BF has an Atlantic salmon adult rearing program to evaluate the potential of rearing parr through to spawning adults at the facility, which was previously not thought possible due to past water quality limitations. Long term assessment and monitoring of various factors are conducted and include: growth, maturation, fecundity, egg/milt quality, fertilization, and reconditioning potential.

A unique program to the Mersey Biodiversity Facility is the rearing of the endangered Atlantic whitefish. The facility was/is involved with the development of husbandry practices, collaborative research, and rearing of whitefish brood and progeny for the potential of future recovery efforts.

Coldbrook Biodiversity Facility

Presenter(s): Beth Lenentine

Abstract:

Coldbrook Biodiversity Facility, located in the Annapolis Valley of Nova Scotia is one of three Biodiversity Facilities in the Maritimes region operated by the Department of Fisheries and Oceans. While similar programs and practices exist between the three facilities, this presentation will highlight the live gene bank program for IBoF and Southern Uplands stocks of Atlantic salmon including the responsibility for fish collections. The Nova Scotia program annually collects juveniles via electrofishing, fyke nets, and downstream bypasses, while adults are collected through seining operations and fish ladders. An overview of the facility will be provided, highlighting the site infrastructure, rearing capacity, production, and research and biosecurity measures.

The Past, Present and Future of Fish Culture

Presenter(s): Trevor Goff

Abstract:

Federal Atlantic salmon culture has a rich history of excellence dating back to Confederation. The world's first production scale Atlantic salmon hatchery was built at Wilmot Creek on Lake Ontario in 1868. This model was highly successful and was copied world over and still has influences in modern hatcheries today. Just over a century later (1990's), the DFO, whose earliest roots were in salmon culture, moved away from hatchery practices in the Maritime Provinces. Remaining facilities adopted new roles (conservation) and more sound biological practices. It is an expansion of these roles, coupled with declining wild stocks, that will direct our activities in the future. The presentation expands on our past roles, highlights many notable achievements throughout history and describes our current and future roles as salmon conservation facilities.

Discussion:

Stephanie Ratelle asked for clarification about the number of families currently present in the New Brunswick IBoF LGB. She asked if we were creating new and different families each year that we spawn, families that would be different from the 150 or so that originally started the LGB. Patrick O'Reilly clarified that we are in fact creating new family combinations each year but that we try to do this with family members from the original lineage. In this way we can maintain the original and wild genetic lineage and try to maximize genetic diversity at the same time.

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Egg treatments at Coldbrook Biodiversity Facility

Presenter(s): Beth Lenentine

Abstract:

Uncontrolled fungal growth presents serious problems in the propagation of salmon eggs. Options to reduce the effects of fungus are to either manually remove dead eggs or to administer a prophylactic chemical treatment. Manual removal of dead eggs is labour intensive and poses potential risks to the developing embryos due to the sensitivity of the eggs prior to the eyed stage. Therefore, in 2005, various treatment methods and concentrations were tested at Coldbrook to establish the most effective treatment option. It is important to note that starting with quality gametes and performing optimal spawning procedures will be the first line of defence in controlling fungus during incubation. Ensuring the eggs are rinsed of all residual milt and not adhering to each other on incubation trays minimizes the medium and potential spread of fungal growth.

Results of the formalin treatment trials indicated that twice weekly formalin baths at 1:600 (1667ppm) for 20 minutes completely inhibited fungal growth on eggs. Safety aspects to be considered include the use of personal protective equipment such as a well fitted NIOSH respirator (with suitable filters for formalin), safety glasses, and gloves.

This presentation will provide the steps, procedures (pre and post treatment), and safety aspects of administering formalin treatments to control fungus during incubation. To

obtain copies of the video, please contact Beth Lenentine at beth.lenentine@dfo-mpo.gc.ca.

Discussion:

John Whitelaw asked if the formalin treatments eliminate the fungus completely on the eggs. Beth indicated that it is imperative to initiate the treatments early (within the first 48 hours). If this procedure is followed, fungus is virtually eliminated.

Egg development index

Presenter(s): Beth Lenentine

Abstract:

The recording of water temperature and accumulated thermal units has been an accepted fish culture practice used for many years to monitor the development of salmon eggs. The Maritime Biodiversity Facilities' live gene bank program relies on the accurate recording of incubation data to determine the appropriate stage for release that will yield optimal growth and survival of stocked, unfed fry. The release timing must coincide with the water temperature profile of the receiving watershed, while ensuring adequate forage base to initiate feeding.

In 2005, the Coldbrook Biodiversity Facility acquired a temperature profile program from the US Fish and Wildlife Service. The egg development program is based on a table of percent development for a range of incubation temperatures (Kane 1988).

Slight modifications to this program were made to suit the Coldbrook spawning data format while providing important milestones and dates in egg development. By maintaining a sum of percent development to date, it is possible to track different egg lots, spawning dates, and, if necessary, manipulate water temperature to achieve desired dates of initial feeding. An overview of the Coldbrook egg development profile was presented for discussion on the appropriateness of use at other facilities.

Discussion and Action(s):

The egg development program identifies the fish or egg developmental stage. The benefit of the program is that it takes away the subjectivity of "eye-balling" the eggs/fry to determine the stage. It can be especially useful for the less experienced fish culturist who has not yet made the visual connection between stage and appearance. Ideally the two methods (index and eye-balling) would be used in concert.

Admittedly the program was developed in the U.S. for one of their stocks of fish. There could be differences in development among stocks and even in the environmental

parameters under which the eggs are developed (e.g., incubator type and/or substrate type). **Beth recommended that the facilities tweak the index based on their developmental rates and stocks/rearing environment.** Milestones at the facilities should be based on the subjectivity of the fish culture experts combined with whatever other scale they have used. These milestones could then be incorporated into a site specific or stock specific index. For example, Mactaquac uses degree days as a benchmark and these could be incorporated into the index.

Patrick O'Reilly mentioned that by monitoring the developmental index for various stocks, we should be able to monitor it over time to see if there are any changes that evolve while the fish are in the facilities. The developmental index can also be used to identify life history differences among stocks as well.

Renée Wissink described an egg basket experiment that occurred in the Point Wolfe River. He indicated that having temperature loggers in the substrate, providing data input into the developmental index, would provide their researchers a better understanding of developmental stage of the eggs in the river.

Reference

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Salt Treatments at Mersey Biodiversity Facility

Presenter: John Whitelaw

Salt (NaCl) is a commonly used chemical in aquaculture for the treatment of fungal, bacterial, and parasitic infections. It is also an appetite inducer, stress reliever, and is one of the safest of all chemical treatments available. Fish at the Mersey Biodiversity Facility experience the common issues of secondary fungal infection as the result of injury or abrasion, and infection is often exasperated by elevated spring and summer water temperatures. There is a requirement to treat minor injuries and abrasions to the fish to avoid fungal infection and to stimulate appetite to minimize pinhead (starvation) mortalities in first feeding fry.

Mersey has developed methods of treating tanks and ponds of fish in an effective manner. These serve to mitigate increased mortality and efficiently allow frequent, full-scale treatments. Treatments are often administered routinely on all fish inventory and require minimal staff. Non-Iodized NaCl (Sifto Fine Hi-Grade) is dissolved in a water filled mixing chamber by highly agitated recirculation using the suction and discharge of a gas operated pump. Salt quantity for the concentrated solution is calculated relative to the eventual receiving pond volume to achieve a 2% concentration bath. While the dissolving process is occurring, water is drained in the tank/pond to a volume level dictated by fish size and density. This minimizes salt usage and mixing effort. Once the desired tank/pond level is reached, the pump discharge is removed from the mixing chamber and a mist is sprayed evenly over the surface area of the pond. Once the

concentrated brine solution from the chamber is dispensed, the pond is left to sit without inflow for a desired duration (~30 to 45 min or sooner if evidence of stress occurs) to allow fish to bathe in the 2% solution. Age, size and fish conditions affect fish tolerances and durations often vary. Concentrations and durations of baths are fine-tuned to Mersey's application and may differ for other sites, in large part due to water quality, so care must be taken for site specific applications. The focus of this presentation was mainly to highlight the application methods at Mersey BF.

Egg counter demonstration

Presenter(s): Beth Lenentine

Abstract:

Mactaquac Biodiversity Facility has a Jensorter, mechanical fish egg sorter with counters, that could potentially save manpower resources. This machine requires set up in an area with available water and electricity, so practical demonstration at this workshop was not possible. However, background information on capabilities and standard operating procedures was highlighted.

Egg sorting machines operate electronically on light sensitivity and are equipped with a vertical rotating disk. The egg sorter needs to be correctly fitted with the disk matching the egg diameter to be sorted. To operate, the eyed eggs are placed into the 5 gallon holding container. Water is introduced and washes the eggs into the hole openings of the vertical rotating disc. The eggs in the disk pass the light scanning device and the opaque or dead eggs are ejected from the disc by an air jet into a discard holding container. As the disc continues to rotate, the clean or good eggs are ejected by steady water current into a live holding container. The Jensorter machine is equipped with counters so that both live and dead eggs are counted.

Numerous egg sorting models are available and a proper working demonstration on use of the Jensorter was advised.

Discussion and action(s):

Of note is that the egg counter/sorter is not useful for counting individual trays of eggs. The hopper is large and meant to take a large volume of eggs. It can be very useful when you treat your eggs as batches. Part of the difficulty is that the egg sorter disk has to be calibrated for the size of eggs that you are running through it (the egg needs to pass through the hole in the disk). For this reason you cannot combine eggs from salmon and grilse into the same batch and run it through the machine. Females with varying sized eggs should not be combined. Trevor pointed out the machine's potential use in the Tobique and Aroostook stocks. Trevor indicated that he would contact Brian Glebe from SABS to train staff on actual use of the egg sorter this winter when the eggs are shocked. He will send a notice out to all facilities when the training occurs so that others may join the session.

Mactaquac Biodiversity Facility- Preventative and Outbreak Treatments

Presenter(s): Graham Chafe, Sean Dolan and Trevor Goff

Abstract:

A disease is an abnormality in form or function of an organism and occurs due to the interaction of three factors, the host, the agent and the environment. The most desirable option to deal with disease is to prevent the disease from occurring. Options include: vaccination, appropriate stocking densities, appropriate environmental variables, and biosecurity. Once clinical signs or symptoms of a disease are observed, prevention has failed. Outbreak treatments deal with a sudden appearance and quick increase in disease within a population and mortalities may spike within a day or two. Chemical or natural treatments, antibiotic measures, quarantine or culling are options when dealing with outbreaks.

We examined two examples of outbreak at the Mactaquac Biodiversity Facility (Mactaquac BF). The first was a case of *Ichthyophthirius Multifiliis* (Ich) in August 2008 when pond temperatures were high and the disease spread quickly. The life-cycle of this disease agent has free-swimming and cyst stages. The key to treatment was that only the free-swimming stage could be eradicated from the pond. Therefore, the fish were treated several days in a row and moved to a clean pond that had no Ich cysts in the debris at the bottom. The second example involved *Flavobacteria and Saprolegnia* and is an outbreak that occurs annually at MBF. It happens to a specific stock of salmon when the water reaches 11 degrees Celsius in the fall of the year. In past years, high proportions of the stock have been lost; However, with the right formalin and salt treatments before the outbreak occurs, the high loss is avoided. In this way it is both an outbreak and a preventative treatment.

Marking Techniques and Alternatives

Presenter(s): Sherisse McWilliam-Hughes and Stephanie Ratelle

Abstract:

There are various external and internal tagging and marking techniques available for various sized fish each with advantages and disadvantages. When choosing a tagging option, a number of criteria should be considered, such as: the number and size of fish, the scale of identification, and the cost. Currently, there are four components within our programs that require tagging/marking: gene bank, assessment, enhancement, and research. Each area has different tagging needs and therefore utilizes different tagging options (e.g., streamer tags, PIT tags, fin clipping). The most contentious of these techniques is adipose clipping. Once considered a vestigial fin, recent research indicates that the adipose fin contributes to water current displacement and detection of current in juvenile salmon, and may be a sexual dimorphism trait in adults. As salmon stocks are in decline, any practice which may affect fitness should be scrutinized. The use of other tagging techniques such as Visible Implant Elastomers (VIE), Calcein,

Alizarin Red S, and various external tags were presented and the uses and limitations discussed. The use of other tagging techniques such as VIE were suggested as an alternative to adipose clipping allowing for both a learning curve and trial period in altering the current practices.

Discussion and Actions:

Several comments and questions were raised regarding VIE tags and these included tag duration, time to tag and cost. The presenters indicated that the VIE tags, if implanted properly, should last for the life span of the fish. It was also noted that the placement of the tag is key and that areas where pigment is not likely to darken over the tag would be of better use. Newer tag colours also fluoresce so that only small amounts are needed to be visual under a black light. An experienced tagger can VIE tag almost as quickly or as quickly as a fin clipper. Hand tagging units are not expensive to purchase (about $45 USD) and the paint costs would have to be verified. An air injector system (single operator) is available for rent ($425 USD/month) or purchase ($5000 USD). Tokens programmed with an allocated amount of tags are then purchased from the company and vary in price depending on the volume of tags that you wish to use. These tokens are inserted into the air injector system and the numbers of tags used are tallied during the tagging event. Paint is included with the cost of the token.

In an effort to look at tag retention in the wild and as a prelude to a potential shift from adipose clipping to VIE tagging, Parks Canada suggested that they would be willing to do a study on this year's parr scheduled for release into the Upper Salmon River. This group of fish could be both VIE tagged and adipose clipped and the tag presence or absence confirmed as the fish are captured in the smolt wheel in subsequent years. Corey Clarke also discussed the potential benefits of using different coloured tags for different years of release so that the assessment team would readily know the year class of fish as it was captured. This would make the reading of scales to determine year of release and subsequent freshwater residency unnecessary and would cut down on a very time consuming job. It was also noted that after a couple of trials with both adipose clipping and VIE tagging, the later may be the only tag/mark used if it was deemed successful.

Shane O'Neil also asked the team to take the following into consideration:

- A study should be conducted to look at the impact of VIE versus streamer tags on smolts. Included in the study should be the retention of the two types of tags and the potential effects on the fish.
- Stephanie and Sherisse are to consider a type of manuscript report to summarize all of the papers reviewed to build this presentation. Even a review of papers and a summary would be a good first step.
- References used to build the presentation are to be included in the proceedings
- A steering committee is to be formed with representatives from the three facilities, assessment and PCA. The purpose of this group would be to look further at alternate tagging methods and to design a study to look at new techniques.

Shane also asked the group to consider new ways to tag fish, to not always fall back on adipose clipping just because that is what we have always done. Our interest is in getting adult salmon to return and spawn in our rivers and any new techniques that we can utilize to increase that likelihood should be considered.

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Fundy National Park IBoF Salmon Recovery Program Update Presentation, 2010

Presenter: Corey Clarke

Abstract:

Fundy National Park employs different release strategies on two park rivers. Mature adults have been released into the Point Wolfe River (PWR) each fall since 2003. Since 2006, two stages of juveniles have been released annually on the Upper Salmon River (USR): un-fed fry in spring and 0+ age parr in fall. Some effects of these different strategies are being detected through smolt data collected each spring via the operation of rotary screw traps (smolt wheels). Essentially, smolt collected on the PWR are more comparable in length, weight, and age to wild smolt collected on both the PWR and USR prior to the implementation of the 2003 and 2006 release strategies. Smolts resulting from juvenile releases on the USR are generally smaller and younger than the PWR smolt or smolt produced on the USR prior to LGB releases.

Increased smolt runs observed on the PWR may be attributed to the following release strategies: release of large numbers of mature adult salmon, release of mature adults that have had previous wild exposure (e.g., collected as parr or smolts from the river then grown to adults in captivity), and release of native strains to their river of origin.

Numerous variables for all release strategies affect the survival of any given cohort of smolt. The number and distribution patterns for releases have varied over time making a direct comparison of which strategy produces the most/least smolt impossible. For many possible reasons, the 2008-2010 USR smolt migration estimates have been several times higher than PWR migrations. However, adult observations from snorkel surveys each fall show no detectable difference in adults returning to spawn in either river. It should be noted that numbers of observed adults is extremely low on both systems and fish have not been sampled to determine origin during surveys (to date). It is suspected that the release of LGB program adults and juveniles has resulted in some returning adults, since none were observed in many surveys prior to expected returns of released fish.

Recovery program data, as well as a growing body of current conservation literature, suggest that increased rearing exposure to natural elements encourages increased natural behaviour compared to rearing in less natural, captive environments. As a result, Fundy National Park with government, non-government, academic, and industrial partners has developed and implemented a project in 2009 involving rearing salmon captured as smolt on the USR in saltwater sea cages during life stages they would be in saltwater in the wild. It is hoped that this project will result in increased natural behaviour and that significant differences in several fish attributes can be observed between individuals reared in salt compared and freshwater environments.

Break Out Session: RELEASE STRATEGY

Terms of Reference and Objectives

Working groups were formed to include representation from each of the facilities/teams present. Groups were assigned a life stage of the salmon and asked to itemize what could be done or considered before, during and after releases. This was to include ways to rear or prepare the fish for release, methods to ensure better survival and increased fitness in the wild, and ways to monitor these effects post release.

Groups met for one and a half hours and compiled their summaries on flipcharts and presented the information back to the larger group. A summary of each of the group sessions follows.

Notes from the flipcharts can be found in Appendix 4.

GROUP 1

Life Stage: Unfed fry and 6-week feeding fry

Participants- Sherisse McWilliam-Hughes, Alex Levy, Greg Perley, Mike Goguen, Mike Thorburne, and Bev Davison

Summary:

When releasing unfed or 6-week fry, many considerations must take place before the release. Fry development must be appropriate (i.e., 80% to 90% yolk sac absorption for unfed fry) and should match the natural regime of the wild stock. The location and timing of releases should coincide with natural emergence, and requires consideration of water temperature, water depth, food and habitat availability, and local population structures. Fry rearing practices such as exposure to live feed and gravel substrates should be considered, and release strategies and methodology should be determined prior to release. Contingency plans must also be put in place to cover mechanical issues that may arise, alternate release locations provided in case environmental or physical conditions are unsuitable, and training provided for personnel to make appropriate and informed decisions at point of release.

At the time of release, environmental and physical conditions of each release site must be assessed for suitability (if needed use alternate sites) and current conditions documented for future reference (e.g., GPS coordinates, water temperature, and predator presence). Although the method of release (i.e., sprinkle versus dump) should be discussed prior to the time of release, conditions at the time may require a different approach, leaving the decision to the distributor to follow procedures or make changes where necessary.

Documentation of information is a large consideration after releases. Reports of release locations, numbers of fish released, and conditions at time of release should be compiled and distributed. Assessment of fry densities at, and between, release sites should be conducted and similarly documented. Using the documented information, discussions should be held to decide if changes to procedures are necessary for future releases.

GROUP 2

Life Stage: Fall/Spring parr and Smolt

Participants- Danielle MacDonald, Stephanie Ratelle, Renée Wissink, Louise de Mestral-Bezanson, Sean Dolan and John Whitelaw

Summary:

There are several considerations when releasing live fish into a wild environment. These would include prior, during and post release factors whose purpose is to ensure

the success and fitness of the released fish. Fall and spring parr, as well as smolts, were considered in this group.

Several factors prior to release were indicated for parr stage salmon. These included: no longer accelerating the early growth stages of the fish so that they could be released at a size comparable to their wild counterpart (hatcheries tend to release fish much larger at same age), rearing in semi-natural habitat or with at least some substrate so fish are better habituated to the wild components of their new environments, temperature at time of release and timing of release, as thorough an understanding as possible regarding the recipient habitat (includes predator field, presence of other salmon at various stages, densities, suitable rearing space and type, etc.), potentially stop feeding in hatcheries for suitable time to induce hunting instinct by feeding some natural food (e.g., artemia and insects)

At release considerations for parr included how the fish are released (batch or scatter releases), type of habitat, and predators present. Post release considerations included assessment, hydrology, temperature and other water quality parameters, track all conditions from river survival to exodus to sea, and monitor predation fields throughout migration.

Smolt considerations prior to release were similar to parr and also included knowledge of the migratory distance, overall fish condition (shouldn't be small as this will hamper survival at sea), timing of release, sea-surface temperatures, river temperatures, synchronicity with wild smolt migration, acclimation period to river of release, photoperiod, flow regime, and osmoregulatory competence. At release considerations for smolt included release location, timing, habitat parameters, density at release, method of release and overall numbers. Post release considerations included: assessment needs, forecast flows and temperature data to relate to survival, monitor predation fields through migration.

Several overlaps for the two life stages were noted. Assessment is key for following up releases. A better understanding of the recipient habitat and its parameters is required. How we raise fish in the facilities prior to their release could be better done to prepare the salmon for their wild existence.

GROUP 3

Life Stage: Adults

Participants- Carolyn Harvie, Patrick O'Reilley, Shane O'Neil, Beth Lenentine, Corey Clarke, Trevor Goff and Graham Chafe

Summary:

The release of adult Atlantic salmon requires considerations that can be divided into three categories; prior to release, at release and post-release. While some overlap occurs, each time period has distinct aspects that need to be considered.

Before the release occurs, careful planning will include environmental, genetic and assessment/administrative factors. The environmental aspects of the release include: the time of year for release and location, water temperatures, diet of the fish to be released, the degree of fish maturity (immature fish would go to sea), the density of adults and precocious parr already in the system, and the accessibility of habitat. The length of time in captivity (life stage or generations), river of origin and the genetic variation within the native population are additional factors. Administrative/assessment factors such as data collection needs, accessibility and resource availability will influence how preparations for the release are carried out both during and after the release.

During the release, environmental conditions should be suitable. Certain factors, such as release site, may become more specific during the release. Double-checking preparations such as tagging, protection from poachers and data collection are critical to a good release program.

After the release considerations include follow-up assessments of survival, redd counts, spawning behaviour, reproductive success and movements. The fish may still need protection after spawning. Environmental conditions after spawning and subsequent hatch information may be required to predict survival and the size of future cohorts. Kelts may be captured for reconditioning and subsequent spawning. The media may be utilized to engage the public.

Data Management (Capture and Usage)

Presenter(s): Shane O'Neil and Bev Davison

Summary:

Data management is key to the research and projects being conducted at the biodiversity facilities. The focus of the presentation was the importance of establishing a plan to capture and analyze the data from a project and to document the results. Examples of data being captured associated with the live gene banking program include fish distribution data, the genetic database which incorporates DNA information and associated biological characteristics of the fish, egg and fish sizes, and mortality. Management of this information has been difficult because many investigators are involved. Setting a plan for data capture and follow up during the planning phase is necessary for the results to be useful and for them to be informative for other research or for adaptive management of the program. One example was cited where calcein was used in several trials to determine the feasibility for its use as a marker of very young fish. The results were not documented and others are now examining its utility because there was no information from that work to inform their preliminary investigations. Participants were asked to identify a data collection activity that they were involved with, where it was being captured, and whether it was readily accessible by others (e.g., in a centralized database) or analyzed or documented. This exercise pointed out the need for an improvement in the process as some of the data being captured remains in field books or biodiversity facility log books or has been filed without follow up. A data

management committee has been established to coordinate this process to include Bev Davison, Carolyn Harvie, Stephanie Ratelle, and Sherisse McWilliam-Hughes. Initial plans will include compiling a list of data being (or already) captured for inclusion in databases and documentation. The committee is to begin its work in the winter 2010-11.

Discussion:

Shane indicated that a data management committee would be struck this winter and would begin working out the types of data captured and where they are captured. Bev Davison is to steer the group with representation from each of the three facilities and will include Carolyn from the genetics committee.

Introduction to Conservation Biology

Presenter: Alex Levy

Abstract:

An introduction to conservation biology was provided along with an overview of the status of Atlantic salmon populations within the Maritimes Region of Canada and a summary of conservation measures. Topics included a general discussion of conservation biology, biodiversity, speciation, and extinction. Background information on the conservation of Atlantic salmon populations within the Maritimes Region was reviewed and an overview of the conservation spawner requirement, current status of Atlantic salmon populations within the IBoF, Eastern Cape Breton, Southern Upland, and Outer Bay of Fundy was discussed. An overview of conservation measures for Atlantic salmon was also provided with emphasis being placed on the Species at Risk Act (SARA) and Recovery Strategy for the IBoF populations, Live Gene Banking and Supportive Rearing.

Mitigating the effects of captive rearing on the fitness of Atlantic salmon in the wild

Presenter: Patrick O'Reilly

Abstract:

Several populations of Atlantic salmon, representative of what has been recognized as important components of the species biodiversity, have declined sharply in recent years, and are now being maintained under semi-captive conditions. Rearing salmon in captivity, however, can bring about phenotypic, genetic, and possibly epigenetic changes that may greatly reduce the ability of released salmon to survive and successfully reproduce in the wild. Some of the environmental conditions that recent research indicates may be affecting the phenotype of released salmon include substrate complexity, temperature, current speed, feeding, pathogen exposure, and predation.

Differences in the environments or selective regimes of hatchery and wild river habitat may also bring about genetic changes in hatchery salmon that can be more long term, impacting the fitness of releases, and possibly their decedents for one or more generations. Recommendations for minimizing potentially deleterious changes in Atlantic Salmon associated with captive rearing include 1) minimizing the number of generations spent in captivity (this includes the cryopreservation of milt from P1 and F1 males), 2) increasing the portion of the life cycle maintained in the wild (where feasible), 3) naturalizing hatchery conditions, 4) minimizing intentional selection for traits such as size at age, 5) minimizing unintentional selection for traits such as smolt run timing where possible, 6) equalizing family size at release and at spawning time, 7) to be aware of the mechanisms and types of change possible, 8) to measure morphological and life history traits and monitor rates of change over time, and 9) to modify and adapt practices if large amounts of change are detected that could impact survival and fitness in the wild.

Break Out Session: FITNESS

Terms of Reference and Objectives

Working groups were formed to include representation from each of the facilities/teams present. Groups were assigned a life stage of the salmon and asked to review current rearing practices at each of the three facilities and methods or ideas for improving fitness.

Groups met for one and a half hours and compiled their summaries on flipcharts and presented the information back to the larger group. A summary of each of the group sessions follows.

Notes from the flipcharts can be found in Appendix 5.

GROUP 1

Life Stage: Unfertilized Egg to Fall Parr

Participants- Danielle MacDonald, Graham Chafe, Craig Keddy, Renée Wissink, Louise de Mestral-Bezanson and Bev Davison

Much time was spent in group trying to summarize the current practices and conditions used at each facility for each of the stages and the rearing techniques. Since the life stages for the group spanned several critical life phases (fertilization, incubation, shock, unfed fry, first feeding, parr rearing and release of some of these stages), much time was spent trying to define how each stage was managed at each facility. The group decided to list the critical life phases and what is currently done at each facility in order to make parallels and differences more apparent. It became clear that the three facilities are not using identical rearing techniques or emphasizing the same rearing factors. This is partially due to location (e.g., temperature and quality of local water

supplies) and operator preference and experience. In order for success of stocks to be measured across locations and facilities it may become necessary to try to rear fish as similarly as possible. The group recommended that a table be built that would capture all the rearing data for all the life history stages in the facilities so that Patrick O'Reilly and scientists working on life history traits are able to quickly see how things are currently done. Due to the large exercise, there was not enough time for this group to consider their recommendations to increase fitness. This should be visited in the future at another session.

GROUP 2

Life Stage: Fall Parr to Smolt

Participants- Beth Lenentine, Sean Dolan, Carolyn Harvie, Trevor Goff, Alex Levy and Sherisse McWilliam-Hughes

In order to compare and contrast the current practices of the three facilities, when rearing fall parr through to smolt, a chart was constructed to outline the various abiotic, biotic, and physical parameters (see Appendix 5). Although general rearing practices (e.g., pond shape, density, photoperiod and feed) are similar among the facilities, the differences that exist are primarily related to the location of the facility and the properties of the water sources. Coldbrook Biodiversity Facility has cool temperatures; however water flow and oxygen levels are limited, while Mersey Biodiversity Facility has ample water amounts but deals with low pH and high summer temperatures. Mactaquac Biodiversity Facility has ample cool water supply, however exposure to local pathogens requires regular treatment with chemicals (i.e., formalin).

Considerations for improving fitness focused on changing rearing practices to more similarly reflect the natural environment, such as natural photoperiod, lower densities, and higher flow velocities. Supplying gravel substrate and 3-dimensional objects were discussed as a method to increase the flow dynamics, provide cover, and supply a more natural rearing environment. Changes to feeding practices included feeding on an irregular schedule, providing more live food items, and reducing food amounts to mimic natural growth rates. In addition to the above changes, it was unanimously agreed that whenever possible the environmental parameters of the river of origin, or destination, of stocks reared at the facilities should be similar to those at the facility.

GROUP 3

Life Stage: Post-Smolt to Spawning Adult

Participants- John Whitelaw, Greg Perley, Patrick O'Reilly, Shane O'Neil, Corey Clarke and Stephanie Ratelle

The group focused on how the rearing practices for post-smolts and adults at the three biodiversity facilities differed from wild conditions. Several factors were outlined: no saltwater influences throughout the life cycle, no substrate exposure, differing pathogen exposures, and unnatural feeding regimes. The group discussed a project conducted by the PCA where smolts were reared in saltwater and a cohort reared at the Mactaquac Biodiversity Facility. PCA noted that feeding behaviour in the sea cages was very different than in freshwater at the Mactaquac BF. The smolts in the cages were voracious and the feeding response was instant where smolts had to be coaxed to eat at the Mactaquac Biodiversity Facility. Are we altering feeding behaviours by omitting the saltwater rearing stage? The human impacts such as: noise pollution, 'daily' disturbances while cleaning ponds and collecting loss, and treatments were also discussed at length.

The group discussed how to improve fitness although time constraints limited the discussion to the released smolt stage. All agreed that a thorough evaluation of the smolts prior to release is important. Criteria such as fin index, condition factor, and coloration need to be captured to have a point of comparison when evaluating returning adults. Saltwater exposure in a land-based facility to avoid pathogen exposure in sea-cages, as well as exposure to natural conditions, was suggested. The group agreed that all options for rearing the most 'natural' salmon should be thoroughly investigated/trialed and as much data needs to be captured from the onset.

Adult release stocking programs in the Maritimes

Presenter: Patrick O'Reilly

Abstract:

In response to severe declines in anadromous Atlantic Salmon runs in southern Nova Scotia and New Brunswick, several groups have released mature adult salmon into natural river habitat, with the intent of increasing egg deposition, smolt production, number of returning adults, and population viability. Potential advantages of this approach over the more common practice of releasing juveniles produced through artificial spawning include: 1) possible genetic benefits of mate choice and breeding competition, 2) allowing embryological and early juvenile development to occur under natural river environmental conditions, 3) reduced costs associated with rearing and spawning activities, and 4) potentially reduced time spent in captivity. Potential disadvantages of this strategy include: 1) possible failure to spawn, 2) low breeding success, 3) low egg survival, 4) low and variable production of juveniles and returning adults, 5) reduced effective population size and maintenance of genetic variation

because of poor spawning success and/or high variance in family survival, 6) possible maternal or epigenetic effects of captive rearing from the smolt to the adult stage. Initial investigations into some aspects of the efficacy of this strategy have been carried out for two Maritime programs, the first involving the release of adults of Big Salmon River (BSR) origin, reared throughout their life in captivity, into the Point Wolfe River (PWR), and the second involving the release of adults of Gold River (GLD) origin, reared from the parr to adult stage in captivity, back into native GLD habitat. Microsatellite and subsequent exclusion analyses were then used to assess the parentage of juveniles sampled in 2004 and 2005, and hence the spawning efficacy of adults released in 2003 and 2004. In the PWF and GLD rivers, spawning success was moderate in the year 2003, with contributions from approximately 20 and 40 percent of the adult releases, respectively, detected. In 2004, however, spawning success was less than half that reported in 2003 in the two rivers. Levels of genetic variation were also, in all instances, lower in the offspring group sampled relative to their corresponding parental groups, indicating that without an increase in spawning efficacy, long term rates of loss of genetic variation could be quite high. Overall, these results indicate that efforts should be directed at increasing the spawning efficacy of released adults. However, given the potential fitness benefits of this approach, it may be a valuable strategy in maintaining populations that are not presently viable in the wild, particularly if spawning efficiency can be increased, or if carried out in parallel with a program directed at maintaining levels of genetic variation.

WRAP UP AND DEBRIEF

The objectives of the final session were to evaluate the format and topics of the workshop and to provide any suggestions to make future sessions successful. Each participant was given a post-it note and asked to write their overall feelings or summary thought of the last few days and then to put that up on a wall in the conference room. In addition, the title of each presentation was written on flip chart paper and the group was given post-it notes of three colors which each represented a rating scale: orange: topic not well received/ lost in translation; pink: topic well covered and left attendees wanting more; green: topic well received and adequately covered. They were asked to place one of the post-it notes of their color choice under each presentation title (Appendix 3).

Overall workshop comments were very positive; the overarching comments included the relaxed and inclusive atmosphere of the workshop (as evidenced by the lack of footwear in the room!) and the wonderful exchange of ideas and information that had taken place. It was fully agreed that the location at White Point was ideal. Attendees appreciated the participation of staff from a variety of job functions, the inclusion of teams from outside the facilities, and that every person had a chance to participate and share their ideas. The workshop was considered a great success by the group.

Most presentations were highlighted by green post-it notes. Those that attendees felt required further clarification or more explanation included: the Links to National and Regional Priorities (group wanted more concrete examples of links), Salt and Egg Counter Demo (Mactaquac would like more hands on training so that it can be incorporated in their facility), and the Fitness Breakout Group (required more time in group to complete the large exercise).

Pink highlighted talks (well covered but group wants more discussions and/or information) included: Conservation Biology (group wants to have more educational talks like this in the future, perhaps as part of a lunch and learn series), Adult Release Strategies (more discussion and understanding of what happened on the Gold River), Marking and Tagging Techniques (summary of literature requested, investigate VIE versus adipose clipping efficacy and longevity of mark).

Other recommendations that were made included: large group should make effort to meet once a year at a venue like this one, staff are interested in doing some technical swapping or swapping work locations from time to time (i.e., Mactaquac staff to try working at Mersey or Coldbrook), lunch and learns for the facilities via Webex or a video conferencing platform, and more communication/brainstorming of ideas in the future.

APPENDIX 1- Workshop Agenda

Maritime Biodiversity Facility Workshop

Theme: ***Live Gene Banking - Adapting a New strategy for Conservation***

Chairpersons; Bev Davison and Stephanie Ratelle

Date	Time	Topic	Presenter
June	Evening	Meet and greet poster session	Group
21st		Live Gene Banking- Adapting a New Strategy for Conservation: Why does everything seem so complicated?	S. O'Neil
		Biodiversity Facilities and DFO Priorities	R. Claytor
		Overview of the Biodiversity Facilities Mactaquac	T. Goff
		Overview of the Biodiversity Facilities Coldbrook	B. Lenentine
		Overview of the Biodiversity Facilities: Mersey	J. Whitelaw

Date	Time	Topic	Presenter
June	8:30-9:15	The Past, Present and Future of Fish Culture	T. Goff
22nd	9:15-10:30	Egg Treatments at Coldbrook	B. Lenentine
	9:45- 10:00	Egg Development Index	B. Lenentine
	10:00-10:15	Break	
	10:15-10:45	Salt Treatment at Mersey Biodiversity Facility	J. Whitelaw
	10:45-11:15	Egg Counter Demonstration	B. Lenentine
	11:15-11:45	Mactaquac Biodiversity Facility- Preventative and Outbreak Treatments	G. Chafe S. Dolan
	11:45-1:00	Lunch	
	1:00-1:30	Marking techniques and alternatives	S. Ratelle and S. McWilliam-Hughes
	1:30-2:00	Discussion on marking techniques	Group
	2:00-2:30	Fundy National Park IBoF Salmon Recovery Program Update Presentation, 2010	C. Clarke
	2:30-2:40	Release strategy break-out groups guidelines	D. MacDonald
	2:40-3:45	Break out group sessions - Release strategy by stage	Group

Date	Time	Topic	Presenter
	3:45-4:00	Break out presentations	Group
	4:00-4:45	Data management (Capture and Handling)	S.O'Neil and B. Davison
Date	**Time**	**Topic**	**Presenter**
June 23rd	9:00-9:45	Conservation biology	A. Levy
	9:45-10:45	Mitigating the effects of captive rearing on the fitness of Atlantic salmon in the wild	P. O'Reilly
	10:45-11:00	Break	
	11:00-12:00	Break out sessions - Fitness	Group
	12:00-1:00	Lunch	
	1:00-2:00	Continuation of Fitness breakout session	Group
	2:00-2:45	Adult release stocking strategies, examples from the Maritimes	P. O'Reilly
	2:45-3:00	Break	
	3:00-4:00	Break out presentations	By group
	4:00-4:30	Wrap up debriefing: How did we do	Group
Date	**Time**	**Topic**	**Presenter**
June 24th	8:30	Leave White Point Beach Resort for tours of Mersey and Coldbrook Biodiversity Facilities	Group

APPENDIX 2- List of Attendees

Attendees: Biodiversity Facilities Workshop 2010: Live Gene Banking: Adapting a New Strategy for Conservation, White Point Beach Resort, Queens County, Nova Scotia – June 21-24, 2010

NAME	ORGANIZATION	ADDRESS	E MAIL
Chafe, Graham	DFO Science Mactaquac Biodiversity Facility	French Village, NB	Graham.chafe@dfo-mpo.gc.ca
Clarke, Corey	Parks Canada Agency Fundy National Park	Alma, NB	Corey.clarke@pc.gc.ca
Davison, Bev	DFO Science BIO	Liverpool, NS	Bev.davison@dfo-mpo.gc.ca
de Mestral-Bezanson, Louise	DFO Science BIO	Dartmouth, NS	Louise.demestralbezanson@dfo-mpo.gc.ca
Dolan, Sean	DFO Science Mactaquac Biodiversity Facility	French Village, NB	Sean.dolan@dfo-mpo.gc.ca
Goff, Trevor	DFO Science Mactaquac Biodiversity Facility	French Village, NB	Trevor.goff@dfo-mpo.gc.ca
Goguen, Mike	DFO Science Coldbrook Biodiversity Facility	Coldbrook, NS	Michael.goguen@dfo-mpo.gc.ca
Harvie, Carolyn	DFO Science BIO	Dartmouth, NS	Carolyn.harvie@dfo-mpo.gc.ca
Keddy, Craig	DFO Science Coldbrook Biodiversity Facility	Coldbrook, NS	Craig.keddy@dfo-mpo.gc.ca
Lenentine, Beth	DFO Science Coldbrook Biodiversity Facility	Coldbrook, NS	Beth.lenentine@dfo-mpo.gc.ca
Levy, Alex	DFO Science BIO	Dartmouth, NS	Alex.levy@dfo-mpo.gc.ca
MacDonald, Danielle	DFO Science Mactaquac Biodiversity Facility	French Village, NB	Danielle.macdonald@dfo-mpo.gc.ca
McWilliam-Hughes, Sherisse	DFO Science Mersey Biodiversity Facility	Milton, NS	Sherisse.mcwilliam-hughes@dfo-mpo.gc.ca
O'Neil, Shane	DFO Science BIO	Dartmouth, NS	Shane.oneil@dfo-mpo.gc.ca
O'Reilly, Patrick	DFO Science BIO	Dartmouth, NS	Patrick.oreilly@dfo-mpo.gc.ca
Perley, Greg	DFO Science Mactaquac Biodiversity Facility	French Village, NB	Greg.perley@dfo-mpo.gc.ca
Ratelle, Stephanie	DFO Science Mactaquac Biodiversity Facility	French Village, NB	Stephanie.ratelle@dfo-mpo.gc.ca

NAME	ORGANIZATION	ADDRESS	E MAIL
Thorburne, Mike	DFO Science Mersey Biodiversity Facility	Milton, NS	Mike.thorburne@dfo-mpo.gc.ca
Whitelaw, John	DFO Science Mersey Biodiversity Facility	Milton, NS	John.whitelaw@dfo-mpo.gc.ca
Whynot, Rick	DFO Science Mersey Biodiversity Facility	Milton, NS	Richard.whynot@dfo-mpo.gc.ca
Wissink, Renée	Parks Canada Agency Fundy National Park	Alma, NB	Renee.wissink@pc.gc.ca

APPENDIX 3- Tables of Actions

Action Item	Person Responsible	Timeline
Reports to come out of facilities to highlight work being done	Biodiversity Facility staff responsible for various report formats	annual
Facilities to consider themselves laboratories- group to be established to further this initiative	Committee to be formed to include members from Biodiversity Facilities and BIO staff	Start in 2010/11
Egg development index to be modified for each facility and stock	Technical staff from 3 Biodiversity Facilities	Start fall 2010 with new spawning season
Brian Glebe (SABS) to be contacted to train staff further on use of egg sorter/counter	Trevor Goff	Winter 2011 at time of egg shocking
VIE tag retention study: Adipose clip and VIE group of spring parr to be released in Upper Salmon River and look at visibility of tags when captured as smolts in the smolt wheel	Parks Canada Agency and Mactaquac Biodiversity Facility staff	Tag and clip fall of 2010 for spring parr release 2011
Study should be conducted to look at the impact of garment versus streamer tags on smolts. Included in the study should be the retention of the two types of tags and the potential effects on the fish.	Shane O'Neil to work with facilities to scope out	2011/2012
Preparation of a manuscript report regarding fish marking techniques to summarize all of the papers reviewed to build the presentation. Even a review of papers and a summary would be a good first step.	Sherisse McWilliam-Hughes and Stephanie Ratelle	2011/2012
A Fish Marking steering committee is to be formed with representatives from the three facilities, assessment and PCA. The purpose of this group would be to look further at alternate tagging methods and to design a study to look at new techniques.	Shane O'Neil	2011/2012
References used to build the fish marking presentation to be included in the proceedings	Sherisse McWilliam-Hughes and Stephanie Ratelle	ASAP
Release strategy considerations to be further examined to build framework for release strategy workshop in future	To be determined	2011/2012
Data Management Committee to be formed to capture types, use and location of data in the three facilities	Bev Davison	Start winter 2010/2011
Facilities group to compile data on rearing parameters for use in life history analysis and to compare potential parameters affecting fitness	Danielle MacDonald, John Whitelaw, Beth Lenentine, Bev Davison	Winter 2010/2011

Action Item	Person Responsible	Timeline
On-line lunch and learns set up to share information and training/learning for the three facilities	All staff	Start winter 2010/2011
Prepare skeleton framework for Biodiversity Facility Annual report	Bev Davison with input from facility staff	Winter 2011

APPENDIX 4- Raw Notes from Break-Out Session: Release Strategies

GROUP 1

Participants- Sherisse McWilliam-Hughes, Alex Levy, Greg Perley, Mike Goguen, Mike Thorburne, and Bev Davison

Life Stage Considered: Unfed fry and 6-week feeding fry

Summary of Group Discussions (taken from group flipcharts)

Before release considerations:

- Physical condition of the fry: yolk sac absorption (80%), match development with natural regimes, release fry similar to natural emergence, expose fry to gravel substrate before release, dry versus live food for 6-week fry
- Environmental conditions for location and timing: river temperatures, water flows/depths, community/population structures, population densities (competition for wild fish), habitat/food availability, and site access
- Stakeholder capacity: willingness to assist in efforts, river system knowledge (and the communication of such)
- Contingency plans: release locations/alternate sites, mechanical issues, changing strategies based on environmental conditions
- Provide training for distribution personnel so that decisions about site suitability and proper release methods can be made at site
- Tagging for future assessments, if a proper mark can be determined for fry

At release considerations:

- Environmental/physical conditions: change site if needed
- Method of release: 'sprinkle' versus 'dump', start at the bottom of the site and work upstream
- Documentation of current conditions: river temp., GPS, predator presence

Post-release considerations:

- Follow up assessment of fry: densities at and between release sites
- Reporting/Documentation: info required for future release locations or strategies
- Monitor conditions to help with assessment interpretations

GROUP 2

Participants- Danielle MacDonald, Stephanie Ratelle, Renée Wissink, Louise de Mestral-Bezanson, Sean Dolan and John Whitelaw

PART A- Life Stage Considered: Smolt

Summary of Group Discussions (taken from group flipcharts)

Before release considerations (IF we continue):

- Fish not to be accelerated
- Length of migration: river specific i.e., St. John River versus Point Wolf River
- Reared in semi-natural conditions (substrate, food, light)
- Fish condition: are they too small?
- Timing of release
- Sea-surface temperatures
- River temperatures
- Synchronicity with wild smolt
- Acclimation to specific river (cost consideration) e.g., hold smolts streamside for X amount of time before release.
- Photoperiod
- Flow regime
- Feeding "cut-off"
- Determine osmoregulatory competence

At release considerations:

- Where to release: habitat survey, high in the stream for better imprinting
- Timing: synchronization with wild run, before 'exodus', or X-time before
- Monitor habitat: temperature, oxygen, and other physical characteristics
- Match up water temperature from hatchery and river.
- Predator field in/out water e.g., bird, fish, and mammals.
- Density at release
- Method of release: batch, scatter
- Consider life history/adaptations of specific stock when using donor stock or hybrids
- Overall release numbers.

Post-release considerations (< 2-4 weeks post):

- Assessment
- "Forecast" flow/temperature regimes to relate to survival. NEED to be released in "window" e.g., 100-year flood not a good release time
- Monitor predation fields on migration
- Ran out of discussion time…

PART B- Life Stage Considered: Fall or Spring Parr

Summary of Group Discussions (taken from group flipcharts)

Before release considerations:

- Do NOT accelerate: mimic size of wild parr
- Habitat survey before release: e.g., substrate, predator field, prey availability, and existing populations.
- Don't stock overtop of unfed fry
- Reared in semi-natural habitat: develop territoriality from hatch
- Some natural feed
- Timing
- Temperature
- Stop feeding?
- Overwintering habitat availability: e.g., cobble and water depth.

At release considerations:

- How we release: big batch or scatter small groups (density effects)
- Where: parr specific habitat
- Same as smolt considerations
- Fall parr predation/spring parr: link to merganser migration or other environmental parameters.

Post-release considerations (< 2-4 weeks post):

- Assessment
- Monitor hydrology, temperature and other water quality parameters
- Track all conditions from river survival to exodus to sea.
- "Monitor predation fields on migration
- Ran out of discussion time…

GROUP 3

Participants- Carolyn Harvie, Patrick O'Reilly, Shane O'Neil, Beth Lenentine, Corey Clarke, Trevor Goff, and Graham Chafe

Life Stage Considered: Adult

Summary of Group Discussions (taken from group flipcharts)

Before release considerations:

- Do NOT stock immature fish as they will go to sea
- Time of year to release: all fall/late fall/early fall, type of fish (wild exposed versus lack of wild exposure)
- Amount of time captive reared: smolt to adult or other options
- Assessment: photos, length, weight and marks
- F1's: influence of origin (captivity versus wild exposed)
- Fish health clearance: donor stock versus recipient river
- Number of generations in captivity
- Proximity to aquaculture operations

- Native versus non-native (river of origin): water temperature and synchronicity
- Diet and egg quality: size of egg
- Rate of growth as a juvenile
- Number of adult present in the system as well as precocious parr
- Genetic variation of adults of adults and wild parr present
- Experimental design: ability to follow up on spawning success (non-genotyped salmon)
- Accessible habitat: barriers, monitoring kelts, salt versus fresh water
- Rearing environment of adults: Parks Canada work, substrate versus non-substrate
- Degree of maturity: hormone injection to synchronize with wild counterparts
- Availability of resources: may not be best method i.e., helicopter versus truck

At release considerations:

- Environmental conditions: temperatures, water levels, suitable spawning habitat
- Predator avoidance
- Release location: lower/upper sites, different imprinting strategies, near suitable habitat
- Concentration of released fish: spawning competition
- Release close to spawning time
- Poachers: protection of the fish
- Check to make sure fish have been tagged and genotyped
- Gender recorded, as well as record of tags/marks
- Pedigree/family of origin
- Other phenotypic characteristics: secondary sex characteristics for example
- Know background: e.g., tracking rearing history of 2007 smolt.
- Ratio of male: female in group
- Considerations for distance from rearing environment i.e., saltwater reared versus freshwater reared

Post-release considerations:

- Assessment: release timing follow-up, reproductive success (genetics), redd counts, breeding/spawning behaviour
- Tracking post release
- Protection of the fish
- Kelt monitoring: emigration timing
- Kelt capture and reconditioning of wild adults
- Monitor environmental conditions to correlate over winter survival of adult and offspring: mild winter, heavy spring flooding
- Follow up on next generations
- Media to engage Public: possibly during release

APPENDIX 5- Raw Notes from Break-Out Session Fitness

GROUP 1

Participants- Danielle MacDonald, Graham Chafe, Craig Keddy, Renée Wissink, Louise de Mestral-Bezanson and Bev Davison

Life Stage Considered: Unfertilized Egg to Fall Parr (end in September)

Summary of Group Discussions (taken from group flipcharts)

Current practices (Initial):

- Egg/sperm: pedigreed spawn and paired up in bins as per Carolyn Harvie's plan. Sperm cryopreserved
- Maturation/gender sorts
- Manual strip MS222 to anaesthetize: Mactaquac female only and Coldbrook male and female.
- Rinse and towel (Mactaquac not as thorough)
- Water harden and rinse, rinse, rinse: Mactaquac and Coldbrook for 1-1.5 hours
- Leave eggs and milt mix for 1.5 minutes at Coldbrook and add water. Leaver for 1.5 minutes, then rinse, rinse, rinse.
- Mactaquac similar but without timer
- NS- ships to Mersey once water hardened in labeled egg jars in coolers.
- Surface disinfection: NS happens at Mersey at least 3 hours post spawn
- Coldbrook and Mactaquac- surface disinfect immediately after water hardening: Ovadine bath as per bottle instructions
- Prior to Ovadine bath: eggs are laid in trays, ideally one layer of eggs but at Mactaquac 2 layers
- Placed in trough: Mactaquac typically has 1 layer of trays but can be up to 3, Coldbrook has 3-6 layers but typically 5, and Mersey has 4-5 layers
- Mersey may acclimate eggs due to temperature variation between facilities and due to transport. Could have a 3-7°C variance!

Current practices (eggs in trough):

- Mersey keeps egg in dark always (covered), Coldbrook also use covered trays and Mactaquac covers after eyed.
- All facilities do an initial pick at green egg stage (24-48 hours post spawn)
- Mactaquac continues to pick throughout incubation period. Careful picking but not reference to sensitive stages, Mersey picks but avoid sensitive stages as per model + test-pick eggs (move and see results), Coldbrook treat twice a week with formalin (1:6,000) for 20 minutes
- Water in troughs: Mactaquac uses river water filtered through sand filters. LGB on well water. Coldbrook filtered (sediment) surface water from spring fed lake but can switch to well water if storm conditions (regulates sediments) although temperature fluctuations can occur, Mersey has acidic water therefore 90% water from recirculated chilled, UV-filtered and

use a controlled temperature regime to maintain temperature based on wild river temperatures (mostly toward egg of incubation).
- ALL sites: temperature variation on eggs based on environments, water selection or human choice.

Current practices (@ and post shock):

- Mactaquac shocks at 250° days and 'eyeball', Coldbrook and Mersey use developmental index and eyeball. All remove mortalities and clean the eggs.
- Mactaquac transfer most (for fall parr) to the Early Rearing Facility (ERF) and transfer in egg jars, plant into upwelling incubators (up to 40K/incubator).
- Coldbrook place in Heath trays with Koch rings or upwelling boxes (modified Heath trays, baskets). Water same as previously described.
- Mersey use mat substrate in upwelling incubators, flow through Heath incubators for EQU and AB groups (Water is ambient with limestone treatment).
- LGB selections for x#/family
- All do fecundities
- Mactaquac at the ERF use warm water from turbines gradually raised to 46°F and maintained. Can manipulate if needed to accelerate or decelerate prior to ponding. At the hatchery (no substrate), the LGB selects are in troughs. Manipulate temperature to meet with operational date. Eggs are picked and treated as needed with formalin or salt and feeding is started in trough.

Current practices (Unfed fry):

- All sites protect from light at this stage.
- Coldbrook reared in substrate. Check a lot and compare river temperatures and look at developmental index and fish.
- All release at 80% absorption in good years- this year 0% yolk sac left.
- Mersey hand feeds 1st 4 weeks then auto-feeders/hand combo. Outside 25' Swedes with 60-100K/pond. Start feed is commercial diet with no oil.
- Mactaquac at ERF use substrate incubators, ponded at 90% yolk sac absorption. Handled to remove from incubators, weighed and counted. Ponded in 10' squarish tanks in aquadomes (20K/pond). Feed with commercial feed with herring oil coating (hand and automatic feeders). Hand feed 9x/day and auto-feed when no humans on site (evenings).
- Mactaquac Main site use no substrate in troughs. Release with 80-90% yolk-sac absorption, No correlation with natural emergence.
- Goal is to maintain 15°C water temperatures.

Current practices (parr through summer):

- Coldbrook: Only for research. A and B pool comes back from Mersey post 1st feeding and kept on a commercial diet/hand fed. On surface water ambient temperature
- Mersey: Start feed A and B pools on Artemia (live) and ship to Coldbrook once established on regular feed (12 weeks feeding). Divide ponds in summer. Water source is surface and bottom mixture to manipulate temperature and treated for pH and O_2 injected.
- Mactaquac: Selects (LGB) start feed in trough with Artemia and the moved to 10' circulars ~3,000 fry. Fed commercial food with oil and ground up krill (sometimes) by hand and belt feeder. Fish are on St. John River water. Fall parr releases go through the ERF. They are moved over to main site in mid-June as water temperature can reach >17°C at ERF. The 25' Swedes have well water (12-13°C max temperatures). They are fed a commercial diet by hand and auto-feeder throughout the summer.

Current practices (@ release):

- Mersey and Mactaquac adipose clip at release
- Mersey releases in mid-October to November by correlating with river temperatures (Xactic tanks, O2, dip and sluice release) with a pre-set distribution plan.
- Mactaquac releases in September to October (if late) by trucks, dip, sluice (open back and let them go) and helicopter with a pre-set distribution plan. NO correlation considered for river temperatures.

Considerations for improving fitness

- Not enough time to discuss.

GROUP 2

Participants- Beth Lenentine, Sean Dolan, Carolyn Harvie, Trevor Goff, Alex Levy and Sherisse McWilliam-Hughes

Life Stage Considered: Fall Parr to Smolt

Summary of Group Discussions (taken from group flipcharts)

Current practices:

Category	**Mactaquac** Biodiversity Facility	**Mersey** Biodiversity Facility	**Coldbrook** Biodiversity Facility
Pond type	Swede Pond: concrete and substrate (8)	Swede Pond: concrete	Swede Pond: concrete
Colour	Light/dark green	Mostly concrete with patchy green	Green
Photoperiod	Natural		
Inside/Outside pond	Partially covered	Outside	Inside
Water source	River and well	Lake (surface/deep intake)	River and well
Water temperature	River: 1°C-14°C Well: 4°C-14°C *BSR similar temps	0.1°C-24°C *Ambient Mersey River with deep water max. 18C	River: 1°C-16°C Ground: 6°C-8°C *Stewiacke similar temps
Chemical exposure	Salt, Formalin, Chloramine-T	Salt	Salt
pH	7	5-5.8	7
Density	25' Pond- 2,500 (2-3) 36' Pond- 5,000 (4-6) smolts <4kg/m^3	25' Pond- ~3,500 max 6kg/m^3	Tanks: 50-300 Max 8kg/m^3
Pathogens	Furunculosis, Ich, Fungus, Saddleback	Fungus	Parasites
Feed	Krill Corey Feeds	Corey Feeds	Krill Corey/EWOS
Feed Size	Consistent size (all surface feeding)		
Flows	25' Pond- 100gpm 36' Pond- 400gpm	25' Pond- 100gpm	Limited water intake
Oxygen	Aeration tower	O_2 injected	Limited to water intake

Considerations for improving fitness

- Pond: substrate addition (gravel), different coloured bottom (darker), patterned colours, other 3-dimensional objects in pond
- Photoperiod: keep natural
- Inside/outside pond: add cover for shade, predator introduction for chemical cues
- Water source: match environmental parameters of facility with stocks reared/destination
- Chemical exposure: limit/reduce routine exposure to treatments, change type of salt to marine/natural source
- Density: lower stocking densities
- Feed: more live prey, more size variability, vary feed schedule (not consistent), more natural components to feed
- Reduce amounts of feed to more natural amounts (try to mimic growth rate) i.e., produce 1 year parr versus 1 year smolt.
- Flows: vary flow rates, use 3-dimensional objects, increase flow dynamics, use pumps etc.- to increase flows.

GROUP 3

Participants- John Whitelaw, Greg Perley, Patrick O'Reilly, Shane O'Neil, Corey Clarke and Stephanie Ratelle

Life Stage Considered: Post-smolt to spawning adult

Summary of Group Discussions (taken from group flipcharts)

Current practices (Post-smolt to adult):

**group discussed how rearing practices differed from wild conditions*

- Post-smolt densities typically 8-15kg/m^3
- Flow is lower than wild conditions. No major current changes 'in house'
- Temperatures not mimic wild (well water may be more representative of ocean conditions?)
- No saltwater rearing stage
- Feed regimes: limited starvation (just before spawning for about a month)
- No substrate exposure (mature adult)
- No natural selection/mortality
- Water depth not wild
- Fish are treated with formalin, salt, vaccines
- Exposed to 'unnatural' noise pollutions. Waterfall effect from packed columns (NOT ocean conditions)
- Habitat disturbance: people
- Photoperiod could be disrupted
- Pathogen exposure: different species (salt/fresh)
- "unnatural" coloration/luminosity

- Water quality: pH, turbidity, DO and not exposed to ‘water layering’ (e.g., halocline, thermocline)
- Toxins
- Organic acid stains (tea-colored water at Mersey): fish are transferred to and from clear to tea-stain
- “Cataracts”: eye clouding at the Mersey Hatchery
- Behaviour differences: does saltwater trigger feeding behaviour?
- Freshwater feeding NOT as ravenous as saltwater.

Considerations for improving fitness

- Smolt evaluations at outset: fish quality, eye clouding, fin index, condition factor, coloration, disease
- Salt exposure: land-based facility to avoid pathogen exposure from cage-rearing OR straight to sea-cage and ‘hedge your bets’
- Adjust temperature regimes to mimic ocean conditions “constant”
- ALL data captures with ‘data about the data” i.e., background info
- ** Consider natural environment for specific stage**
- Coloration consideration
- Options for maximum wild exposure
- Smolt releases?
- Need to evaluate all options.