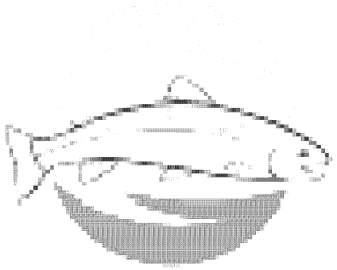

Freshwater Fisheries Society of BC

Fish Health Management Plan
Fraser Valley Trout Hatchery
Revised-November 2010

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~Freshwater Fisheries Society of BC~ Overview

The Freshwater Fisheries Society of BC (FFSBC) is a non-profit society which was been created to deliver all of the services formerly provided by the Ministry's Fish Culture Section (Provincial Hatcheries).

The purposes of FFSBC are to:

- provide fish culture and stocking services that support freshwater recreational fishing and the conservation and restoration of wild freshwater fish,
- promote and market recreational fishing, and
- inform and educate the public about fish, conservation and fishing.

In the delivery of its programs and services, the Society works closely with the Ministry of Environment and other partners.

The FFSBC annually stocks approximately 7 million fish into about 8,000 lakes and streams throughout the province and provides conservation fish culture services that support three sturgeon recovery programs. Society personnel work with the Ministry of Environment regional fisheries staff to improve existing and create new recreational fisheries. The Society is also actively involved in developing programs to inform and educate the public about fishing and fish conservation. While carrying out the activities associated with the Ministry of the Environment Stocking Programme, the FFSBC is considered an 'agency of the Province'.

The FFSBC provides a range of fish culture and related services including:

Recreational fish culture and related services

- All services associated with the development and delivery of a quality product to help create or improve recreational fishing opportunities such as:
  - Broodstock management
  - Fish production and release
  - Strain performance improvements
  - Sterile stock technology.

Conservation fish culture and related services

- All services associated with the development and delivery of fish culture programs to assist in the recovery of native fish species at risk such as:
  - Program design
  - Captive broodstock development
  - Fish production and release.

The following is a description of the facilities, their programmes and capacities that exist within the FFSBC fish culture programme.

Freshwater Fisheries Society of BC

~Hatcheries and Fish Health Unit~

Fraser Valley Trout Hatchery

The Fraser Valley Trout Hatchery (FVTH), located in Abbotsford, BC, opened in the fall of 1977. This facility utilizes groundwater wells as a water supply and has a complex water delivery system that includes a water recycle system allowing for up to 90% of water used in outdoor ponds to be reused.

The FVTH stocks approximately 150 lakes and streams a year, covering most regions in BC. Fish reared at this facility include rainbow trout, anadromous (sea-run) cutthroat trout, coastal (or lake) cutthroat trout and steelhead trout. The hatchery is home to the Fraser Valley domesticated rainbow trout program, and maintains a captive broodstock of these fish. These programmes are responsible for much of the high-use urban lake stocking in the lower mainland and other regions. Such lakes are often stocked repeatedly with catchable-sized fish through the spring and fall periods to provide a consistent high quality fishery in and near urban centres.

The FVTH is involved in several cooperative fish production programmes. They support higher education through facilitating graduate studies work in conjunction with UBC, SFU and other post-secondary institutions by offering fish, facilitates and fish culture practices as students conduct research projects. As well, the FVTH conducts other programmes such as 'Learn to Fish' and public education programmes. The FVTH staff work closely with several DFO hatcheries to produce anadromous cutthroat trout and steelhead trout smolts for some local rivers, as well as to produce catchable rainbow trout. In addition, almost 100% of the adults required to produce eggs for in-house anadromous cutthroat and steelhead trout programs are captured through the efforts of volunteer anglers or are donated by other facilities/agencies. These partnerships have proven to be highly successful

Fish Health Unit

The FFSBC Fish Health Unit (FHU), located in Duncan, BC, plays an integral role in the Society maintaining year round diagnostic assessments on all FFSBC fish. The actions of the FHU ensure that all fish health standards established by federal and provincial regulatory agencies are met or exceeded. This ensures a high-quality hatchery fish, and protects the aquatic ecosystem and wild fish populations from exposure to disease pathogens originating from hatchery fish.

The FHU laboratory is staffed by competent and trained professional fish health technicians. These staff members have experience in both fish culture applications and in the diagnostic analysis of fish health events. The capabilities of the FHU range from fish

health information services, environmental impact analysis on fish health, pathogen identification for environmental, bacterial and viral pathogens, biochemical identification of pathogens and access to other levels of fish health care through contacts and collaboration with other fish health agencies. The FHU is current on all aspects of fish health care and diagnosis and the staff are continually upgrading their skills and knowledge base through courses and seminar/conferences. The FHU has in place a system of information dissemination to the hatcheries which ensures that information on fish health issues is shared among the Society. In addition, the FHU has an established relationship with a licensed veterinarian who provides a veterinarian/client relationship and allows for academic and prescriptive advice. The position of the FHU in the organizational structure is such that it is accessible to all members of the FFSBC and regulatory agencies.

In terms of complex diagnostic capability, the FHU maintains seven cell lines to conduct virology assays. These cell lines are used in monitoring the ongoing health of the salmonids and sturgeon stocks and assist in meeting regulation requests for the Society's conservation culture programs for white sturgeon.

The FHU is capable of performing a number of other disease screening techniques including PCR tests which are genetic-based to confirm the presence or absence of certain pathogens. In addition, the FHU lab can perform bacteriology isolation and basic identification of some common bacterial pathogens. A full histology lab allows for the preservation and processing of tissues in order to look for microscopic changes within the tissue which may be the result of pathogenic infections or environmental changes. This capability underscores the capacity of the FHU to aid in the overall fish health care and stands as testament to the commitment that the FFSBC has undertaken to promote fish health.

1 INTRODUCTION

1.1 Objective

The objective of this Freshwater Fisheries Society of BC (FFSBC) Fish Health Management Plan (FHMP) is to provide the best possible fish health support for fish in the care of the FFSBC. This FHMP provides the best management practices resulting in optimal fish care and culture. The FFSBC has established itself a leader in wild freshwater culture and technology, the result of which is that the anglers of BC have come to rely and depend on the high-quality fish supplied by the FFSBC and recognize the high standard of fish released into the waters of BC.

The FFSBC is unique among other fish culture operations in BC with regard to a FHMP. Commercial salmon aquaculture operations are commonly located in distinct geographical locations with fish transfers limited to the eyed egg, smolt and broodstock stages. And of these transfers, fish are moved within a defined region, usually around or about the waters of Vancouver Island. In contrast, the FFSBC has the mandate to supply and transfer fish over a broad range of geographic locations that may encompass distinct river watersheds and intra-provincial bio-geographical boundaries (Regional Management Units). Commercial salmon aquaculture operations have the mandate to contain their fish throughout the fishes' life from spawn to harvest. In the case of the FFSBC, the mandate is to release the fish they raise into the environment, which is in juxtaposition to the common concepts of finfish aquaculture. Commercial salmon aquaculture operations may rear one or two year classes of a single species; the FFSBC may, at a given time, hold several year classes, species and strains at a given location. In addition, the FFSBC transports and receives fish stocks from wild and domestic strains that originated at distant hatcheries. Further, the FFSBC shares specialised equipment (primarily transport vehicles) between geographically distinct areas. From a perspective of shared mandates to produce fish, there is a considerable difference in the overall production models of the commercial salmon aquaculture operations compared to the FFSBC model. Nevertheless, there are undeniable homologies, not the least of which is maintaining fish health.

The FFSBC maintains its efforts to preserve the environmental integrity of BC waters while supplying a high-quality product to BC anglers. In no small part is this due to the fish health practices of the FFSBC. There remains in place professional, dedicated and highly-trained staff of the FHU who oversee all aspects of fish health management at the FFSBC. Their work and diligence has resulted in the continued operation of the FFSBC mandate to support recreational and conservation efforts in the BC freshwater fishery.

The overall structure of the FFSBC is designed to support sound fish culture practices, preserve fish health and maintain environmental integrity. The five FFSBC hatcheries, the Fraser Valley Trout Hatchery, the Kootenay Trout Hatchery, the Clearwater Trout Hatchery, the Summerland Trout Hatchery and the Vancouver Island Trout Hatchery, in addition to the fish holding/distribution stations in Prince George and the sturgeon conservation facility at Bull River and Vanderhoof are managed as a single integrated

unit and supported by senior management, the FHU and other professional staff. The FHU conducts regular and *ad hoc* fish health services to all the culture facilities and is equipped with state-of-the-art equipment for this purpose. FHU staff receive regular training and education to stay current with trends and discoveries in the fish health sector. They are in direct and constant communication with all of the FFFSBC fish culture facilities by internal electronic intranet and by conventional methods. In addition, all culture sites are linked via the landmark Production and Information Reporting System (PARIS) programme that records and processes all aspects of the FFSBC fish culture practices. In this fashion, the staff members at the FHU of FFSBC are kept up-to-date on all fish culture and health related activities across the FFSBC.

The FHU reports and receives direction from the FFSBC Senior Management. In this way, the FHU is independent to internal or external fish culture demands and provides unpartisan service and support where directed and needed. The mandate of the FHU is to serve the best interests of the FFSBC and preserve the long term goals of the society.

This document provides the detailed operations of the FFSBC as it pertains to fish health and culture practices of the society. It contains the proprietary practices and the information contained herein is the property of FFSBC; it may not be copied or distributed without the express consent of the FFSBC President.

1.2 Definitions

AF3N: All-female gender-manipulated triploid fish obtained by using milt from an XX male and pressure treating the egg at fertilization to induce triploidy; a sterile female fish

FFSBC: Freshwater Fisheries Society of British Columbia; a private non-profit society with a mandate to conserve and enhance the freshwater fish resources of BC for the benefit of the public

FHMP: Fish Health Management Plan

FHU: Fish Health Unit; a FFSBC section dedicated to fish health management

Liberation: The planned release of fish from captivity to a natural environment.

PARIS: FFSBC computer inventory system database for eggs and fish; Production And Reporting Information System

Production Fish: Cultured fish produced at a FFSBC facility for liberation

Rearing Unit: Any containment apparatus used to culture fish e.g.: tank, raceway, net pen, trough, pond etc.

REDS: the Research Evaluation and Development Section of FFSBC

Region: Provincially Ministry of Environment Management Region

SOP: Standard Operating Procedures

Wild: Fish from the native environments that are the progeny of a natural spawning event

XX Male: a genotypic female fish that has been manipulated to be a phenotypic male fish; they only produce sperm with female sex chromosomes

1.3 Document structure

This document includes sections for hatchery operations and broodstock operations. Sections requiring operator specific Standard Operating Procedures (SOP) are noted in the document. In addition, FFSBC facility sites may vary in their practice of activities covered by a general SOP and these variances are noted as options or alternative methods stated within the SOP. For example: The SOP for taking eggs (SOP 3.6.1 Egg Take) may contain variations for different FFSBC fish culture facilities due to the methods used to suit local conditions. Where these deviations exist for specific FFSBC facilities, they will be referred to as an alternative method in that SOP.

All SOPs are located in Appendix 6 of this document. In some instances an SOP may apply to more than one section; in these cases the same SOP is used to address multiple sites and requirements

1.4 Annual review

This document is reviewed annually by the staff of the FHU in conjunction with the Hatchery Managers and staff. Each year the FFSBC conducts Performance Reviews of each facility and office. The FHMP is added to this annual review of operations.

1.5 Living document

All FFSBC SOPs are living documents and subject to constant review and update. As such, changes will be made to this document as required and any changes are reported to the Senior Management and the FHU by the Hatchery Manager. All SOPs bear an update field whereby revisions are noted and signed off.

1.6 Personnel duties and responsibilities

1.6.1 Fish Health Unit

Ms. Sherry Mead, Head Fish Health Section
Ms. Angela Lee, Fish Health Technician
Ms. Kathleen Sherry, Fish Health Technician
Ms. Lauret Prosperi-Porta, Fish Health Lab Assistant
Dr. Nancy Holling, DVM, Veterinarian (contract)
1080 Wharncliffe Rd.
Duncan, BC
250-737-1444

1.6.2 Hatchery Site Staff

Fraser Valley Trout Hatchery
Steve Arnold, Manager

34345 Vye Rd.
Abbotsford, BC
V2S 7P9
604-504-4709

Every member of the hatchery staff has been assigned fish health and biosecurity duties. All personnel have received training in these areas. Manuals for site duties are available for reference in the site office and via intranet. All staff routinely follows approved hygienic measures and fish health procedures.

1.7 Communication to enhance disease prevention and control

The FFSBC has in place a defined system for the collection and dissemination of fish health information. There are four circumstances where established communications systems are used. These are: a) a fish health event, b) fish health records recorded on PARIS, c) literature reviews and current events in fish health, and d) annual corporate-wide meetings.

In the circumstances where there is a fish health event, there is an established procedure to initiate the assistance of the FHU (see SOP 2.9 Fish Health Emergency Procedures). When mortalities of a group of fish spike above a baseline daily percentage or are greater than predicted in response to a stressor (e.g. transport), the FHU is notified immediately by phone and/or by email. The Hatchery Manager or Assistant Manager will speak directly to the FHU and report the event. The Vice-President, Operations will also be contacted if the fish health event is deemed non-routine or is a new discovery. Written information is then relayed by email or less frequently, by facsimile detailing the event and a time course prior to the event. Stock history, if not immediately available, is also reported to the FHU.

Immediately after reporting the fish health event at a facility, the Manager sends fish samples (live or fixed) to the FHU via courier (see SOP 2.7.1.1 Fish Health Sampling). If requested, more complete written records then follow electronically. Within 24h the FHU will have performed a gross necropsy and preliminary screening for pathological agents and identify a suspect causative agent based on these findings and the Manager's report. This screening includes primary bacteriology and identification of suspect pathogens by history, visual signs, microscopy and if indicated, cell culture for bacteriological and viral testing. As indicated, the veterinarian will prescribe therapeutic action or other actions will be initiated as directed by the FHU. Fish health monitoring of this stock will continue. If required further, staff from the FHU will make a site visit, obtain fish tissue samples to be plated on media or cells lines in the case of a suspected viral pathogen, and in-depth analysis then ensues. The monitoring of the situation is continued until the event has passed and a follow up report is prepared after which all parties and the Senior Management will review the results.

Different types of fish health events trigger appropriate actions. For example, an event that is unanticipated consisting of an environmental event such as a rapid increase in water temperature may induce a certain fish health event. Conversely, mortality of non-biological origins such as transportation of fry may induce mortality. However, should post transport mortality be higher than expected, the FHU would be notified. The FFSBC has a good history with regard to fish transport and an established communications system. In addition, the FFSBC hatchery staff are long-term fish culturists within the Society, many with 20 years experience or more.

The FFSBC has established the computer software PARIS that controls inventory, tracks stock movements, tracks feed use, weight gains, mortality rates and environmental data. This network permits all members to view fish culture data on the FFSBC intranet. In this fashion, if a situation of interest to the Hatchery Manager and the FHU are flagged, concerned parties can review recent entries into PARIS collectively, analyse the data and chart a course of action for response. FHU staff can go into the database and view fish health records for any stock on hand at any hatchery. In addition, after being advised of a fish health event, FHU staff can review fish health data prior to the arrival of sampled fish. As a follow-up procedure to gauge effectiveness of the actions undertaken, FHU staff can track improvements to the stock in question.

Part of the FHU mandate is to keep current on fish health literature. In doing so, publications of interest are circulated to hatcheries or in some circumstances, broadcast to all staff via email. Hatchery Managers and Assistant Managers can also request and receive information on a given health management issue. In addition, the FFSBC has a specific folder on the main server dedicated to fish health literature that is accessible and searchable by all members of the Society. Should members of the FHU identify a current advancement in fish health that is of current interest to hatcheries, a notice and copy of the information is sent to each hatchery and placed in the folder on the main server. The Hatchery Manager then posts the information notice and a copy is placed on a 'Current Information' clipboard in the staff break room. In this fashion, current, applicable and historic literature references on fish health issues are available to all staff of FFSBC.

The FFSBC has three types of annual meetings for the exchange and evaluation of activities. In the annual staff meeting to which all personnel attend (tasks permitting), a section of the event is dedicated to Technical Developments. A subset of this section can be devoted to fish health issues and it is here that major initiatives are reviewed or launched with regard to fish health affairs. In the summer of each year the Unit Heads meet with the Mangers of each hatchery and senior management in an Annual Fall Planning Meeting and collectively exchange information on several topics among which are fish health issues. Finally, if recurrent fish health issues are observed, or if new fish health related techniques are available, FHU staff will tour the hatcheries and make seminar presentations to the staff. Therefore it is by these three face to face events, the Annual General Meeting, the Annual Fall Planning Meeting and hatchery seminars, that communication within the FFSBC is kept open and current.

Over and above regulatory reporting requirements to government, FFSBC facilities will communicate incidents of disease that are significant to other industry associations, including: the BC Salmon Farmers Association (BCSFA) the Department of Fisheries and Oceans, the BC Trout Famers Association, Canadian Food Inspection Agency and others. The intent here is that other, clinically unaffected sites in the geographic vicinity can be alerted to the concern. OIE-reportable diseases are as a matter of course and practice, tested for and proper protocols will be observed if these diseases are detected or suspected.

2 HATCHERY SITES

2.1 Biosecurity

FFSBC Management and the FHU Section Head have undertaken biosecurity audits to identify areas of opportunities to improve or upgrade biosecurity systems. This audit was conducted in the Spring of 2007 by the Head of the FHU and Vice-President, Operations of the FFSBC. The goals of the audit were to raise awareness of biosecurity issues for fish culture at all FFSBC facilities and to inventory and record current biosecurity equipment and practices. Improvements to practice and infrastructure were noted and changes implemented. In addition, the hatchery staff received information on improvements to biosecurity practice and the level of awareness to these issues was increased.

As stated above, FFSBC members receive training and information transfer in the form of posted bulletins, intranet access, posted information, transfer at scheduled meetings and in seminar form. In addition, staffs are encouraged to attend outside, formal seminars on hatchery-related issues for the purposes of education and advancing their knowledge in the areas of fish health and fish culture.

Support for biosecurity programmes comes directly from the FHU and the Vice-President, Operations. The lines of communication for information or education on biosecurity matters are well established and used regularly. Throughout routine literature reviews, issues relating to biosecurity are elucidated and transferred to the FFSBC facilities. Biosecurity upgrades are not restricted by budget

An annual biosecurity audit has been implemented to assist hatchery staff in keeping up with the biosecurity programme. In this way, the FFSBC ensures that staff maintains a clean, safe work environment that will reduce the possibility for spread and exposure of fish to infectious or parasitic disease.

2.2 Keeping Fish Healthy

As stated, FFSBC hatcheries and facilities face biosecurity and fish health challenges: they may care for multiple year classes and species; they may capture, spawn and release wild broodstock; they transport fish and eggs between locations and they release hatchery-reared fish into the natural environment. Over the years the FFSBC and its

predecessor the Fish Culture Section of the Ministry of Environment, has developed ways and means of addressing the questions of biosecurity challenges while ensuring continued fish health and environmental integrity.

In the operations of a typical FFSBC hatchery, eggs may be received from three sources: wild source eggs from anadromous fish, those that have been acquired from non-anadromous broodstock reared in designated brood lakes, and captive broodstock eggs. Eggs are also transported irrespective of the source; hatcheries may receive eggs from other facilities in order to fulfill rearing and stocking requirements set by the Ministry of Environment. Eggs that have been subject to triploid treatments that may originate in one area, be treated in another and shipped to a third.

Eggs are obtained from anadromous fish: those reared in brood lakes or taken from captive broodstock held on site. In the case of the former, fish mature under natural conditions, are captured during the spawning season and stripped of gametes. Ova are then disinfected before transfer and disinfected on receipt by the hatchery. In the case of captive eggs, again, double disinfection practices are carried out if eggs are to be transferred.

The growth cycle of 'production' fish, those that are to be released into the wild for stocking, ranges between 2-16 months. In a typical production cycle, eggs are hatched, ponded, first fed and grown to fingerlings before release. Larger fish are stocked that are of a catchable size. For these larger fish, the growth cycle may be up to 18 months, and these fish are kept separate within the facility. In some circumstances there is an overlap of year classes on a given site, but this is minimized and mitigation procedures have been established to limit pathogen transfer.

For juvenile fish transfers, equipment is regularly disinfected before and after use. Before any fish transfers are undertaken, fish health checks may be done on the subject fish if warranted and requested by the FHU or hatchery staff. In addition, proper permits attesting to the stock health and movement are secured. Post transport mortality and fish health is closely monitored for fish transferred between hatcheries.

Broodstock operations have separate sites and locations, but may be located and affiliated with a hatchery. There are also temporary or seasonal broodstock locations that are used during the spawning season to capture and hold wild spawning fish. All equipment used on broodstock fish is designated equipment and in general, broodstock operations have designated personnel. Every measure is taken to limit pathogen transfer from brood sites to hatchery sites. Section 3 Broodstock – Special Considerations deals with the issue of broodstock in greater detail.

This brief overview gives some insight into the operations of the FFSBC with regard to biosecurity threats and the management of those threats. The following sections explicitly address these issues.

2.2.1 Separation of life stages and year classes

Most of the FFSBC hatchery operations have overlapping year classes on site. Rearing conditions have been modified to ensure that there is a reduced risk of pathogen transfer between year classes and stocks. This is done by two methods.

In the first method of separation of life stages and year classes, physical barriers are in place to prevent pathogen transfers between year classes including separation of rearing units. For example, eggs are held in an incubation unit that is separate and distinct from other rearing facilities. Due to the pressures of pathogen transfer risk, the strictest biosecurity measures for staff and material measures are followed. Entry into and out of the incubation facilities is tightly controlled and monitored.

All eggs originating off site are isolated, incubated in separate containers (jars or trays) and labelled accordingly. This length of isolation/quarantine extends to the period of pathogen incubation and they are not released from quarantine until the FHU gives permission. This decision is backed up by broodstock screening results. After isolation/quarantine is lifted, groups remain segregated and are shocked, picked and returned to discrete incubation. The PARIS incubation records chart and report on the mortality of the identified eggs and any abnormal performance of these eggs is observed daily and reported. If poor egg performance of the quarantined eggs is noted, further investigative work is done by the FHU. Further actions may involve destroying the eggs and disinfection of the incubation containers, including eggs and trays below the identified tray containing 'positive' eggs.

For hatchling and first feeding fry, troughs are used and are located in enclosed buildings dedicated for the first-feeding and early rearing purpose. These buildings are restricted access areas and commonly have disinfection stations at or near each entryway and dedicated equipment such as nets, boots, buckets, etc. Troughs are maintained in a separate rearing unit from the incubation area and troughs are commonly covered with steel mesh, fibreglass covers or jump skirts to prevent transfer of fish or water to adjacent troughs. In most circumstances adjacent troughs contain fish from the same stock or species and therefore, pathogen transfer risk is rated minimal. Protocol for escaped fish found outside the rearing unit is to euthanize the fish, place in an approved container, disinfect the contact area and any equipment used (see SOP 2.5.1 Equipment Disinfection; SOP 2.5.4 Site and Staff Disinfection; SOP 2.7.2.6 Euthanasia). The incident is recorded in the hatchery log.

In addition to the trough covers as barriers, troughs are fitted with recessed downstream screens to prevent entry into the drainage vestibule that houses the water exit standpipe. Fry size depending, these standpipes may also fitted with plastic mesh around the top of the standpipe to further impeded escape. Further, all exit pipes may also be screened at some point before hatchery waters enters receiving waters. There are therefore, barriers to passage of any hatchery water before entering the receiving waters. These barriers are checked routinely.

Each trough is routinely cleaned and any mortalities removed, classified and disposed of in an appropriate, designated fashion (see SOP 2.7.1 Mortality Collection, Classification

and Disposal). Each trough has dedicated equipment that is stored on accompanying equipment racks located on each trough. These tools (nets, mortality container, scraper, brush etc.) have identification markers for the corresponding trough and a separate disinfection container (exceptions are area disinfection stations for discrete smaller areas). Use of a designated equipment helps minimize the risk of pathogen transfer.

When fry reach a size that permits their transfer to outdoor raceways or in some cases circular tanks, fish from identical stocks may be combined provided that the action is authorized by the FHU. This decision is based on fish health surveys and fish performance history. Once in the outdoor rearing units, identical actions and procedures are followed as for the indoor rearing troughs. Each rearing unit has designated equipment, an area to store this equipment and disinfection containers. If there are several rearing units of identical stocks, these rearing units can share certain equipment such as feed trolleys and feed storage containers. If fish are from different stocks, each rearing unit has its own equipment.

In the outdoor rearing area, there is common equipment that does not leave the designated area. This includes heavy equipment such as trolleys, pallet jacks, lifting devices etc. Each outdoor area contains its own disinfection station (see SOP 2.5.4 Equipment Disinfection). Feeding, cleaning and mortality reporting in addition to observations of fish health are continued as above. Any change in normal feeding, behaviour or mortality is recorded and reported to the Manager and FHU. Observations are made repeatedly throughout the working day.

In the event that Fraser Valley Trout Hatchery receives fingerlings from another FFSBC hatchery, the fish to be transported are first subject to a health review before transfer and have FHU approval to do so (see SOP 2.5.6 Fish Transport). The receiving hatchery will accept the fish and make the appropriate changes to fish inventory in PARIS. The transferred fish may be put under quarantine if required and treated as a rearing unit for biosecurity purposes, meaning strict disinfection procedures for fish care are observed (see SOP 2.9.2.1 Isolation and Quarantine). Mortalities of the transferred fish are classified as per SOP (SOP 2.6.3 Mortality Collections, Classification and Disposal) and recorded. The FHU and hatchery staff monitors the mortality rate and if abnormal mortality or greater than anticipated mortality should occur (see SOP 2.9 Fish Health Emergency Procedures) fish samples (as per SOP 2.7.1.1 Fish Health Sampling) are sent to the FHU for further diagnosis and the appropriate actions are then taken under the direction of the FHU.

Adult captive broodstock may be cultured under similar bio-secure conditions to production fish. In addition, these fish remain in a distinct and isolated area of the facility.

In the second method of separation of life stages and year classes, fish of different year classes are kept separate by hatchery practice. This practice entails what could be considered an 'all in – all out' strategy. In this method, production fish are transported to their respective receiving lakes, streams or other facilities before the next year class is

moved to the same rearing area. For example: the equipment and rearing units are disinfected (see SOP 2.5.1 Site and Staff Disinfection) before the next group of fish are moved from the indoor troughs to the outdoor facility. The indoor fry troughs are then likewise cleaned and disinfected and ready to receive new fish input.

In this manner, a temporal and operational barrier to pathogen movement is observed in addition to the barriers imposed by containment and the establishment of biosecurity units. Both methods are governed by SOPs and overseen by both the hatchery management and the FHU.

2.2.2 Suitable rearing environment

The FFSBC has invested considerable resources to upgrade facility infrastructure and keep current with the best management practices of the aquaculture industry in both the private and public sectors. Management and staff routinely attend industry, educational and governmental conferences to keep abreast of the latest fish culture technology available. To this end, the FFSBC has added a professional engineer to assist in ensuring that the most up-to-date trends in fish care and culture are incorporated into FFSBC facilities.

The FFSBC also has Fish Culture Development and Research and Stock Development units within the Science Division. These specialized units help ensure all staff keep abreast of the latest in fish culture technology and seek improvements to fish culture practices and fish stock performance. They also maintain a current knowledge base on culture issues.

All FFSBC hatcheries use ground water to supply the rearing units. Hatcheries have all been situated in areas of substantial aquifers and are sited based on extensive geophysical and hydrological knowledge and planning. Fraser Valley is equipped with four production wells. All wells are cable at operating at full capacity however the hatchery will try and only run 3 wells for most times during the year.

In addition, each hatchery has diesel electric backup for water delivery and has in place a reservoir of pressurized water via storage tanks for use as a failsafe supply. Further to emergency water supply, all fish culture units are supplied with compressed oxygen backup in the case of a third level emergency (see section 2.4.1 Water Contingency Plans).

All members of the FFSBC charged with the care and culture of fish receive training in fish health and husbandry. Staff members are instructed on all aspects of fish culture from water requirements, water quality, feeding and nutrition in addition to fish health signs and sampling procedure. This training ensures that trained, capable staffs provide the best care to fish. Managers supervise all aspects of fish care and review staff observations on a daily basis. In all ways, fish care is optimized and monitored.

In terms of feeding and feeding rates, the FFSBC monitors the growth and feeding requirements of all stocks through PARIS. In addition, staffs are educated as to the

effects that changes in environmental factors, predation, handling and disease can have on consumption. If feed consumption does not match the level anticipated, staff alerts the Hatchery Manger or Assistant Manager and the matter is reviewed. Should these observations trigger an alert, the FHU is consulted. The predicted fish food to be consumed, the actual food consumed and fish feeding behaviour observations all serve to ensure fish receive sufficient quantities of food.

Food quality is assured by strict operating procedures regarding delivery; storage and disbursement (see Section 2.5.5 Feed and Nutrition).

2.2.3 Monitoring normal fish behaviour

The monitoring of fish at FFSBC takes the form of daily tasks: security, feeding, cleaning and handling. In order:

1) The security of the facility and fish are monitored on a routine basis for predators, natural occurrences, such as wind or snow damage, or vandalism.
2) The feeding of fish is the most complete involvement of the fish culturist with the fish. This involves complete attention to behaviour and physical appearance.
3) The cleaning of tanks and surrounding environs, the fish culturist views and categorizes mortalities and observes the rearing environment.
4) The handling of fish involves removing the fish from the water and closer visual inspection of fish. Post-handling (transfers, sample counts etc.) observations also allow another level of fish health in the order of stress response to the handling event.

The fish, grounds and physical plant of each of the FFSBC facilities are inspected for security routinely twice each day: morning and night.

1) Inspection of all the fish holding systems is inspected to ensure water flows and other systems are in good order.
2) The grounds of the facility are inspected to insure that there has been no breach in the security of the hatchery and that the physical barriers of the facility are in good order. The grounds and buildings are also monitored by digital intrusion alarms and any breaches in security result in an immediate response by a security agent.
3) The physical plant is reviewed and observed to be in good working order. This action includes wastewater systems, oxygen delivery systems, and backup systems in addition to observing that all mechanical equipment such as pumps is operating normally. All hatcheries utilize modern digital controls systems which help track performance of equipment and alert maintenance staff to potential problems.

Feeding is the best time to observe fish behaviour. Although rearing unit equipment is fitted with automatic feeders in most circumstances, some hand feeding may occur to observe feeding response. This is for two reasons: a) normal feeding behaviour characterized by an aggressive feeding response by all the fish indicates a positive health condition, and b) the staff feeding the fish has a prime viewing position to observe fish feeding behaviour, but also for signs of disease or predation. Any deviation from normal

behaviour or physical condition is reported immediately. Key indicators of good fish feeding behaviour include:

- aggressive response to introduced feed, especially first thing in the morning,
- competition for introduced feed,
- dispersion in the rearing unit,
- schooling behaviour,
- flashing,
- position after feeding and
- continued challenge for feed.

Biological parameters to assess good fish health include:

- operculation rate,
- colouration,
- fin condition,
- presence of exopthalmia,
- missing scales and the presence of external parasites (noted by small red marks or visual identification of the infestation) and
- blebs on the surface of the fish or redness at the base of fins.

All these factors are taken into consideration when the staffs observe fish feeding behaviour.

When cleaning the rearing units, staff have the primary purpose of providing a clean and healthy living space for fish, but also have a secondary purpose of observing fish health. In the latter activity, staff will observe the overall condition of the fish in the rearing unit and look for signs of predation, infection and disease. The act of cleaning a rearing unit by its nature involves introducing a cleaning instrument into the areas where fish abide. The escape response from the equipment is a very good indicator of fish health with a rapid action of evasion being an indicator of good health. If fish make no effort to evade the equipment or have a slow response to the cleaning action, this is taken as a negative response and further observation of the fish is warranted. In addition, position in the tank, trough or raceway is a good indicator of fish health or water quality. If fish are backed up against the exit screen in a raceway it can indicate exhaustion from excessive water flow or a response to a fish health concern. This is similar to fish holding position in a tank. If fish are not evenly dispersed within the water column, water flow may need adjustment or fish should be observed for signs of duress or disease. In this way, the routine cleaning of fish rearing units brings the staff into a good position to observe fish health.

The handling of fish for routine purposes such as sampling, rearing unit transfer or transport is an additional opportunity to observe fish health. The escape response from a net is a good indicator of fish health with slow fish or fish that do not avoid being captured being suspected of fish health concerns. When fish are out of the water during handling, it is an excellent time to view scale, fin and eye conditions which can be helpful in evaluating fish health. In addition, fish colouration, the presence of fungus or suspected predation marks can likewise be evaluated at this time. When fish are immobilized during anaesthesia, it is possible to conduct a visual external examination of a subsample of fish. This examination includes fin condition, slime and scale loss,

cursory evaluation of the gills (red and in fine order) external parasite check (gill and skin), presence of redness at the fin base and vent, exopthalmia, scale condition, jaw condition and any other key indicators. Post-handling recovery should be rapid for healthy fish. A slow return to regular feeding patterns is an indication of a health issue as is overall response to the event. If fish remain slow and lethargic for more than 24h, sub-clinical infection may be the cause and the FHU is notified. Mortality post-handling or transport is to be expected, however, if 24-72h values are above an anticipated baseline, samples of the fish are sent to the FHU for further investigation.

Other than feeding, perhaps the best indicator of fish health status is the biweekly, routine sampling for fish growth and biomass (see SOP 2.3.1 Common Fish Handling Techniques).

Fish rearing densities at the FFSBC are set, monitored and enforced. Best Management Practices dictate that loading densities at all stages of the life cycle are observed. The FFSBC target range for rearing density is not to exceed 36kg/m^3. As an example of the practice, Table 1 displays the loading densities for Rainbow Trout life stages for fish cultured at the Vancouver Island Trout Hatchery. Other FFSBC facilities have similar charts for fish culture, but these may vary according to local conditions and equipment.

Table 1: Loading densities in rearing units for Rainbow trout of progressive lifestages reared at the Vancouver Island Trout Hatchery.

Life Stage	Rearing unit	Volume		Min kg/m^3	Max kg/m^3
Egg	Jar/Tray*			0	6K green
Yolk-Sac Fry	Tray			0 (partitioned)	6
1st Feeding Fry	Small Trough	16 ft^3	0.5 m^3	14 kg/m^3	16 kg/m^3
Fry	Large Trough	88	2.5	7.5	9
Fingerling	Small Raceway	1028	29.0	8	10
Sub-year	Large Raceway	2013	57.0	17	20
Yearling	Raceway	624	17	5	6
Sub-year	Tank	84.8	24	7.2	8.5
Sub-year	Tank	126	36	10.7	12.5
Yearling	Tank	260	74	22	26

* Green eggs are placed in jars (hence 0 min) and eyed eggs are placed in trays.
$kg/m^3 = g/l$
1 cubic foot = 0.0283168466 cubic meters

2.2.4 Predators

Predators include birds, mammals and rodents. The exclusion of predators from fish culture sites is by exclusion (physical barriers). Keen observation limits the loss of fish due to predator attacks and avoids stress on fish due to predatory behaviour. Exclusion of predators also reduces the risk of introducing fish pathogens to the fish culture facility and prevents the spread of pathogens between rearing units or to off-site waterways.

The following practices are observed at all FFSBC fish culture facilities:

- Fish food and dead fish are stored in a responsible manner that prohibits predator exploitation
- Dead fish are managed in a manner that does not attract predators or scavenging animals to the facility because as a complete land-based facility, any mortalities are collected and stored in freezers; mortalities are cleared from rearing units on a daily and an *ad hoc* basis
- Vegetation and structures that provide potential cover for predators is removed on a continual basis from around holding units by contractors or FFSBC staff
- Ground level, fencing or buildings surrounds all fish culture facilities
- Most rearing units are located under cover and within fenced or screened enclosures, many rearing units are within buildings that have limited entry
- Daily facility inspections includes checks for signs for predator attacks
- Predator covers are checked daily for signs of being breached and are reported and fixed immediately upon detection
- Routine examination of dead and live fish includes observations for signs of predator attacks

- Measures taken to protect fish from predators occur in a manner that considers predator welfare and does not endanger the predator population such as live trapping.

In this fashion, the impact of predation is minimized, largely through a preventative (exclusionary and observational) role.

2.2.5 Feed and Nutrition

2.2.5.1 Objectives

There are two objectives to feeding fish: growth and health. Of the former, much consideration has been given to using the best available life-stage appropriate feed to achieve optimal growth and performance of the fish. In addition, seasonal changes in photoperiod are taken into consideration and the diet is adjusted accordingly to match the metabolic and nutritional demands of the fish. The Managers and staff, including the Science Division staff work diligently to assure that each facility evaluates the nutritional merits of commercial feeds to best meet the requirements to assure sustained, healthy growth of FFSBC fish.

Managers and staff work with each other, the FHU and the FFSBC Science Division to keep up-to-date on advancements in fish nutrition. These staff investigate the merits of feed suppliers and evaluate what feed is best for stocks including anadromous and non-anadromous stocks, and fish held under various conditions at the FFSBC hatcheries. Nutritional requirements of different life stages and species vary between the different FFSBC hatcheries and therefore, there is a variety of feeds to be found at each FFSBC hatchery according to need.

Feeding rates of the varied life stages and species of fish held at FFSBC facilities is carefully considered and monitored bimonthly. By using weight and growth data gathered from the routine sampling schedules, feeding rates are calculated and set for the next interim period based on predicted growth, life stage and temperature. These predictions dove-tail with other management practices such as loading densities and survival data.

In regards to fish health, optimal feeding rates are important to the overall well being and fitness of a fish population. Deviation from predicted feed use rate may be an indication of a fish health event. For this reason, feed consumption as a factor of predicted feed use rate is a tool for managers to monitor fish health.

Managers stay abreast of developments and advancements in fish feed and nutrition. This is done by reviewing peer-reviewed literature, conference proceedings and manufacturers' literature.

2.2.5.2 Practices and Procedures

Across all FFSBC facilities, the feeding practices and procedures vary according to individual need and the task at hand. However, feeding practices and procedures all vary around a central theme to optimize fish health and growth. That is, feeding and optimizing feed rates to match consumption with fish health and growth and are not a

'feeding formula'. This stated, there are central themes to fish feeding practices and procedures at the FFSBC.

In general, fish are fed to the ration described in the following Table 2 according to life stage, rearing temperature and percentage body weight. Minimal variation in feeding rate occurs with temperature although all FFSBC hatcheries that use ground water. However, feeding rates are kept to those which produce healthy fry and juvenile fish that are well prepared for release, adaptation and survival into the natural environment.

In terms of feed delivery, fish in the life-stages of fry to yearling receive feed from mechanical feeders and occasionally hand feeding. The frequency of feeding diminishes with the life stage of the fish; smaller fish are fed more frequently by hand throughout the day compared to larger fish. In the case of first-feeding fry, it is essential that feeding be closely observed as feed presentation is as important as nutrition at this critical stage. In addition, feeding activity is a key indicator of fish health. Likewise, as fish grow and progress, observation of feeding, schooling and other behaviour is an important indication of fish health and well-being. The staffs at all FFSBC hatcheries are trained in visual identification of aberrant behaviour of fish with respect to feeding.

Aggressive feeding among Rainbow and Cutthroat trout is considered normal behaviour. Observation of this behaviour is important to fish health monitoring and is done daily. Both species of trout will fin nip if the supply of feed is not sufficient at a given feeding rate. If nipping behaviour is noticed, the feeding rate is adjusted. Similarly, auto feeders are calibrated for changes in feed size, delivery rate and coverage according to need before changes in fish behaviour at feeding occur. Feeders are maintained on a daily basis and cleaned or adjusted as a result of visual inspection or anticipated need.

2.2.5.3 Automated feeders

The type of automated feeder depends on the year of purchase and the supplier. However, general operating protocols call for the activation of feeders according to season (water temperature and daylight hours), fish size and need. The following table is an example of a feeding rate per day relative to feed size (fish size), type of rearing unit, and season again taken from Vancouver Island Trout Hatchery practices. All other FFSBC facilities utilize similar practices.

Table 2: Feeding schedules for Rainbow trout for 10-13°C at the Vancouver Island Trout Hatchery

Fish	Rearing Unit	Fish Size	Feed Type	Feed Size	Ration BW/day
1st Feeders	Trough	0-0.15	Nutra	0	6%
		0.15-0.8	Nutra	1	5
1st Feed Fry		1.5-3.0	Nutra	2	4
Fry	Large Trough	3-5	Nu + Clark	2 + 1.2	3
		5-7	Clark Fry	1.2	3
		7-15	Clark Fry	1.5	2.5
Yearling	Sm. Raceway	15-40	Ewos Vita	#2	2.1
	Lg. Raceway	40-100	Ewos Vita	#3	1.7

		100-180	Ewos Vita	#3	1.5
Brood	Lg. Raceway	40-100	Ewos Vita	#3	1.7
		100-250	Ewos Vita	#3	1.5
		250-500	Sk Vitalis	4.0mm	1.2
	Circular	500-1,300	Sk Vitalis	6.0mm	0.8
	Circular	1,300+	Sk Vitalis	6.0mm	0.8

2.2.5.4 Feed types

Feed type is gauged to the nutritional demands of the fish in question and is often in response to species, seasonal or life stage requirements. Similarly, higher fat diets may be used at different times of the year, or the composition of the fat in diet changes with the time of year. All of these parameters are taken into account when choosing a feed supplier.

Feed size is a choice in consideration of fish size. Charts of fish size are the basis for feed size choice with the modifications of temperature, feed acceptance, soft versus hard feeds and others being considered. Feeds sizes are mixed when transferring between sizes and close attention is paid to the fish with particular attention paid to 'culling' of smaller fish due to unacceptable feed size; the mechanical inability to ingest the new feed size. After transfer to the new feed size is complete, close attention is paid to the fish population to guard against the development of a bimodal population; a population that has distinct groups of large and small fish. This is a clear indicator that a proportion of the population is not getting adequate feed whilst the other proportion of the population is getting the majority of the feed and there is feed build up in effluent water or in waste recovery systems. In the event that a bimodal size distribution occurs, mitigation is to either grade the population or resort to mixed feed sizes.

2.2.5.5 Feed rate

To ensure that fish receive the appropriate ration of feed per day according to biomass, each rearing unit is sampled every two weeks for biomass. In this procedure (see SOP 2.2.5.5 Fish Weight Sampling), a statistically significant amount of fish are removed from the rearing unit, sampled for weight and returned to the rearing unit. Fish are crowded, netted and transferred to a tared container and the weight noted. The fish are returned to the rearing unit and as they are returned, they are counted. Enough fish are weighed in this manner to provide 95% confidence limits. The running inventory is applied to the median weight and standard deviation to determine an accurate population representation of biomass. The appropriate ration of feed for the rearing unit is then calculated and entered into the hatchery log and PARIS. In this way, fish are assured of receiving the proper amount of feed and that fish rearing densities are kept to an appropriate level.

SOP 2.2.5.5 Fish Weight Sampling

2.2.5.6 Storage
Feed is stored in dedicated, cooled and secured rooms to ensure feed integrity (see SOP 2.2.5.6 Feed Storage). These feed storage areas are integrated with the larger storage facility and are always weather and water proof. Feed preparation areas are immediately adjacent to the feed storage area both are accessible by authorized personnel only. Feed preparation areas contain the equipment necessary to weigh or measure, mix or prepare special diets as required. Drug storage is located in the dry lab and feed preparation takes place in the lab; drugs are stored in a secure area.

Feed delivery is by commercial vehicle. Access to the feed storage area is by fork lift or other lifting device. In general, feed is removed from the delivery vehicle by the facility equipment and transferred to the feed storage area. In this manner, the feed delivery vehicle entry into the facility is minimized to preserve biosecurity.

Pest management of rodents and birds is accomplished by either commercial professional organizations or on site monitoring of baited traps for rodents and observation and exclusion in the case of birds. The intensity of pest management actions is driven by need and is at the discretion of the Hatchery Manager. Observation of rodent infestation control is practiced by all FFSBC staff. The facility manager may opt to maintain rodent monitoring devices (traps) to ensure pests do not become a problem and are under control.

In the case of rodents, pest management actions are of three levels: eliminate opportunity, exclusion and extermination. Surplus feed is not stockpiled and inventories of feed are rotated and therefore, no feed remains in a single feeding location for extended period of time. This action includes feed allocated to a rearing unit. In this fashion, rodents do not have the opportunity to establish a pattern of feed source and activity. The feed storage area is swept and cleaned and is clean prior to receiving new feed shipments. In addition, any spilled feed is immediately cleaned up and discarded in rodent-proof waste containers. If the staff find a rodent problem that cannot be immediately addressed, the Hatchery Manager is authorized to contract a commercial pest control company. Under no circumstances are poisons used to control pests.

The feed storage area is constructed of rodent-resistant materials and methods designed to prevent exploitation by pests. All feed containers located outside the feed storage areas (feeders excepted) are fitted with tight lids and of a material that resists entry by any pest. Only the daily feed allotment for a particular rearing unit is to be found in the feed containers at any one time.

Birds are prevented access from stored feed by exclusion (feed storage facility). At the site of open-air rearing units, birds are kept from feed by covers on the automated feeders and by sealed feed containers. Any spilled feed is cleaned up immediately and disposed of in sealed waste containers. Entry of birds into the area is by deterred by roofing above raceways, sideway screens, raceway covers and tank covers. Eradication of birds is not permitted.

SOP 2.2.5.6 Feed Storage

2.3 Proper Fish Handling Techniques

2.3.1 Common Fish Handling Techniques

In general, there are three common fish handling techniques for non-broodstock fish at the FFSBC facilities: biomass sampling, moving fish between rearing units, and occasionally, grading. Small fish need environments where feed is frequently introduced and water movement is minimal; larger fish require more space and increased water flow. To optimize the rearing environment, it is necessary to determine the biomass of the rearing unit, the individual sizes of the fish and relocate them to the optimal environment. This involves biomass sampling, moving the fish and sometimes, grading the fish.

All fish handling is done in a safe and secure manner that respects fish health and welfare. SOP 2.3.1 Common Fish Handling Techniques details the procedures for common fish handling. The Hatchery Manager is responsible for the execution of proper handling techniques conducted by the FFSBC staff in addition to the tracking of the stock through the hatchery log and PARIS.

SOP 2.3.1 Common Fish Handling Techniques

2.3.2 Marking fish

For select groups of fish at the FFSBC facilities it is necessary to mark fish. This is done to distinguish inputs from FFSBC stocks, year class, endemic stocks or other populations. The marking of fish is a tool to help assess the impact that stocking has on the angling effort, the interaction with other fish species and other wildlife. In the case of FFSBC, marking entails (for example) the clipping of the adipose fin or the maxillary palp (fleshy part of the jaw) for rapid identification while being easy on the fish. Adipose and maxillary clipping is a common practice among fish culturists.

The marking of FFSBC fish is carried out either by a contractor or FFSBC staff according to circumstance. Contractors are used when a large number of fish are to be marked. That is, a group of raceways or tanks will be marked *en masse*. For smaller groups of fish where smaller numbers of fish are to be marked, FFSBC staff will conduct the marking.

The procedure of marking fish is detailed in SOP 2.3.2 Marking Fish. The Hatchery Manager is responsible to ensure that fish are treated in a safe and humane manner that does not compromise fish health and welfare. Briefly and irrespective of the volume of fish to be marked, the rearing unit(s) of fish to be marked is taken off food for 24h prior to the event. Fish are crowded and netted quickly into anaesthetic. The fish are moved to netting suspended in water and individually removed by hand, fin clipped and returned to clean flowing water to recover.

All records of the event and subsequent mortalities and other observations are recorded in the hatchery log and PARIS.

SOP 2.3.2 Marking Fish

2.3.3 Fish transports

Fish transport is conducted by the FFSBC for two reasons: to transfer fish between hatcheries and to deliver fish to the stocking lake or stream (liberation). In the first instance, the Ministry of Environment sets stocking values for angling lakes for which the FFSBC grows and delivers the fish. In this action, the Ministry designates what stocks of fish are to be stocked in certain lakes. In order to accommodate the needs of the Ministry, the FFSBC must from time to time transport fish of a specific strain or breeding from one facility to another.

In the second instance, fish are liberated to the environment to complete the work of stocking water bodies for the purposes of recreational angling or conservation. This transport is done from a FFSBC facility to the natural environment and the fish are released to the wild.

Both types of transport are used for many stages of fish and follow the same general protocols for moving fish between sites (see §2.5.6 Moving Fish Between Sites; SOP 2.5.6 Fish Transport). Fish transports are done to the highest quality to ensure that the fish arrive at the intended destination in good health and in a humane fashion. All delivery equipment is checked before fish transport to prevent trauma during the loading, transport and delivery. This includes ensuring all connections, surfaces and fish contact areas are clean and free from abrasive areas. In general, fish are starved for 12 – 72h prior to transport, moved to clean transport containers aboard FFSBC vehicles, or aircraft, receive oxygen while in transport and are transferred to the destination waters.

The equipment used to transport fish is of the highest quality, is tested regularly and is cleaned and disinfected on a prescribed basis (see SOP 2.5.6 Fish Transport).When required, all permits are carried in the transport vehicle (see SOP 2.5.6 Fish Transport).

There are circumstances when air transport of fish is indicated. This may be for delivery into remote water bodies where access route or time precludes using a vehicle. In these circumstances, aircraft may be used and the process is similar to land transport (see SOP 2.3.3 Air Transport). SOP 2.3.3 Air Transport also includes the instruction for liberation of fish on arrival.

SOP 2.3.3 Air Transport

2.4 Monitoring water quality

As noted, all FFSBC hatcheries and facilities were formerly operated by the Ministry of Environment or the Department of Fisheries and Oceans and as such, the resources available to the engineers and planners were of the highest calibre. This included hydrological mapping of the prospective locations. All FFSBC hatcheries are located on large, high-quality aquifers that have supplied water in excess. The FFSBC is dedicated

to the monitoring of water quality in its efforts to be a steward of the environment from which the waters are used.

Water quality is of the utmost importance to fish health and successful culture. There are three divisions of water quality in a fish culture operation: inflow, resident and outflow water. Each has important implications to fish health.

Oxygen is the only parameter to be consistently measured on a regular basis; other parameters are physical characteristics of the aquifer and do not fluctuate. Each hatchery receives water from drilled wells or springs and is pumped to aeration towers to equilibrate oxygen and drive off other gasses. The excurrent water oxygen level is measured regularly in each rearing unit area (incubation, first feeding, fry, raceway, broodstock etc.) and at a greater frequency if conditions dictate, such as: increasing threshold densities, high ambient temperature, handling etc. Oxygen levels are noted in these measurements and recorded in the hatchery log.

Water quality hardness, TGP and metals are measured annually or as needed. This interval was established by the analysis of numerous years worth of water quality data that demonstrated little variance from year to year. The characteristics of water quality parameters are well established and documented for all hatcheries and facilities. Where parameters such as metals cannot be measured *in situ* by FFSBC staff, samples are collected (see SOP 2.4 Water Quality Monitoring) and sent to the appropriate commercial facility or the FHU for analysis. Date of sample, parameter and results are all entered into the hatchery log.

Some FFSBC hatcheries of have state-of-the-art in line oxygen water quality monitoring. As a backup, all facilities have several hand-held oxygen meter for spot checking areas of potential concern.

SOP 2.4 Water Quality Monitoring

2.4.1 Contingency planning

Each hatchery maintains a contingency plan in the event of acute deterioration of water quality. Systems are suitably alarmed to indicate changes in water quality below predetermined set points, e.g. precipitous fall in dissolved oxygen levels. Failure of pumps and/or oxygen delivery is an immediate emergency. The site has backup system(s) for keeping dissolved oxygen levels compatible with short-term life support for the fish while the system failure is being addressed.

Attachment: 2.4.1 Water Contingency Plans

2.5 Keeping Pathogens Out

All necessary precautions are taken to ensure disease is kept out of a facility. This includes the movement of people, equipment and vehicles. Potential pathogens movement is prevented and minimized by an effective biosecurity "barrier" at the

perimeter of each facility and, between rearing units on the facility. All hatcheries are on ground water, which minimizes the risk of pathogen introduction. However, vigilance is key in maintaining a disease-free facility. Biosecurity applies to all personnel (staff, management), to all visitors and all equipment.

2.5.1 Personnel movement

2.5.1.1 Informing employees of protocol

Employees of the fish culture facility are informed of the potential risk of introduction of infectious agents through constant reinforcement of biosecurity procedure. This is done through in-house education, training and self-guided access to information on the FFSBC intranet and hatchery information libraries. Staff members that have been to multiple fish culture sites or watershed areas are not permitted to work in, or travel to, other fish culture sites without thorough disinfection procedures or a change of equipment and clothing (see SOP 2.5.1 Site and Staff Disinfection). At a minimum, staff must follow disinfection procedures before working in or travelling to other fish culture areas (see SOP 2.5.4 Equipment Disinfection). Signage and training reinforce the message that all staff must use dedicated footwear and hand washing facilities where required prior to entry. All persons entering a fish culture facility are instructed not to share facility equipment between multiple sites and/or rearing units. Staff is likewise informed of any pathogen-related fish health incident that may occur in areas they intend to work. It is the responsibility of the person travelling between two fish culture areas to inform the facility manager of their actions prior to entering a new facility. Similarly, it is the responsibility of a facility Manager to ask if a visitor of any affiliation (staff or visitor) has been to another fish culture facility in the near past.

2.5.1.2 Managing employees' personal vehicles

Designated parking areas are provided for employees of the fish culture facility. This area is clearly marked with appropriate signage and is a discrete distance from fish rearing units. Personal vehicles are not permitted past the parking areas or near the fish culture units. If for some reason materials are to be transferred to personal vehicles, facility vehicles or equipment brings the required materials to the staff parking area or outside the facility perimeter.

2.5.1.3 Disinfection of personnel footwear and/or clothing

In critical areas or circumstances (e.g. incubation rooms), personal footwear is exchanged for dedicated facility footwear at strategic entry points. This practice reduces the risk of introducing fish pathogens that may exist outside the facility. Likewise dedicated footwear within the facility reduces the risk of pathogen transfer from one area of the facility to other areas. Any employee wearing clothing suspected of contamination is not permitted to travel between or work in multiple fish culture sites. This includes angling for pleasure or working on wild broodstock capture or spawning sites. Any outdoor clothing (raingear, boots etc.) travelling between sites is disinfected and dried before reuse again. Wherever possible, clothing and boots are designated for use in each department within the facility (ex. Quarantine, Incubation, etc.). Personnel violating these directives can be subject to reprimand as these actions put the entire operations of the facility at risk.

2.5.1.4 Fish Handling Equipment
Each culture facility has sufficient designated equipment to ensure that sharing equipment for multiple uses does not occur. If this situation is unavoidable, equipment is properly disinfected after each use (see SOP 2.5.4 Equipment Disinfection).

SOP 2.5.1 Site and Staff Disinfection

2.5.2 Visitors

There are two types of visitors to FFSBC hatcheries: tourists and professionals. This section will address the biosecurity risks of pathogen transfer from tourists and professional visitors. It will also delineate the risk of pathogen transfer that visitors pose to coastal and interior hatcheries.

Tourist Visitors
It would be inconceivable to prevent tourist visitors from coming to FFSBC hatcheries. The history of British Columbia has always been oriented around salmonid culture and is an integral component of the public education system. The mandate to support public education regarding aquatic ecosystems is at the very heart of the FFSBC as is the responsibility to invoke respect for salmonid populations. Almost every child educated in British Columbia has at one time or another visited a hatchery to learn more about salmonid life history. The FFSBC plays a key role in this cultural and educational process and is equipped to do so while minimizing the biosecurity risk the task imposes.

Tours and tourism is an integral part of the outreach and educational programmes supported by FFSBC; the general public supports the Society through the purchase of fishing licenses, by donation and community support. The Society has fostered a lasting relationship with the general public that endures through educational programmes, guided and self-guided tours. The Society also encourages public awareness in fish culture activities and recreational fishing thorough 'Learn to Fish' programmes and other public outreach.

Tourists are of two types: on- and off-season. The former type of tourist are typically visit a hatchery as part of the summer vacation crowd who want to see hatchery fish and learn more about trout while enjoying a family activity. On-season tourists arrive frequently and in large numbers or groups. Off-season tourists arrive infrequently, and are more destination-oriented visitors with the group numbers being smaller than during the summer.

Coastal versus Interior Hatcheries
To better explain the situations at the different hatcheries, the FFSBC has designated two geographic areas according to risk of pathogen transfer: coastal and interior.

Coastal Hatcheries
Coastal hatcheries are by their nature are located near salmon-bearing waters and industries (wild capture and farmed salmon production) and thus, there is a risk of

pathogen transfer to the hatchery by visitors. In addition, coastal hatcheries are located in urban areas. This mix – proximity to pathogen sources and urban location – increases the risk of pathogen transfer by the presence of tourist visitors. Accordingly, all tourist visitors at the Fraser Valley Trout Hatchery are welcomed at an interpretive centre adjacent to the hatchery where tourists and tour groups can view displays of trout and salmon natural life history, fish ecology, conservation, biology and environmental impact. The contact of on- or off-season visitors with any hatchery production-related activity is severely restricted and no tourist visitor may enter active production areas or handle any fish rearing equipment. Vancouver Island Trout Hatchery does not operate tours unless expressly granted by FFSBC management and/or the Hatchery Manager and then under strict biosecurity measures (see SOP 2.5.2.1 Visitor Biosecurity – Tours) and at a designated time.

Any tour group that passes through the hatchery grounds is guided and supervised by the tour guide or designated hatchery personnel. This tour activity is detailed in SOP 2.5.2.1 Visitor Biosecurity – Tours. In brief, the procedures for tour visitors limit the risk of pathogen transfer by exclusion and limited contact with fish or fish-husbandry procedures. In some circumstances, such as the Fraser Valley Trout Hatchery, educational (school) tours pass through outside areas to view fish and gain access to educational areas (e.g.: Learn to Fish), but the pathway that visitors follow is distinct and foot traffic flow is unidirectional. This limits the risk of pathogen spread by visitors.

Off-season tours continue at the Fraser Valley Trout Hatchery through school educational programmes. These tours are facilitated by a permanent staff tour guide and follow the visitor biosecurity protocol (see SOP 2.5.2.1 Visitor Biosecurity – Tours). In brief, exposure to hatchery operations is very limited with the activities centering on the designated educational areas and ingression to the operations areas limited to observation of designated rearing units.

In sum, at coastal hatcheries, the visitor interpretation centre at the Fraser Valley Trout Hatchery is distinct operation from fish culture facilities as defined by structural and spatial barriers. Tour access to the operations side of the hatchery is severely restricted and monitored. The FFSBC has taken measures to ensure that the educational experience of visiting a hatchery is not diminished and that the biosecurity of the facility is not compromised. This mitigation is through the use of tourist/education centres and guided tours. Again, tours at the Vancouver Island Trout Hatchery are severely restricted.

Professional Visitors

In general, professional visitors are not accepted on site without an appointment. This appointment is made through the facility receptionist or with the Hatchery Manager, Assistant Manager or Maintenance Manager. The Hatchery Manager is the final authority on who may be permitted access to the site. In addition, professional visitors are notified that biosecurity procedures are in effect and their movement around the facility will be restricted. They are also informed that to enter a fish rearing area, they will need to change or disinfect footwear as a minimum precaution.

Professional visitors are categorized into two types: office and service. Office visitors are at the FFSBC facility to most often visit with Management and carry on business that does not involve contact with fish culture operations. Protocol for ingression of office visitors is described in SOP 2.5.2.2 Visitor Biosecurity – Professional. The biosecurity risk of office visitors is minimal and is not considered further.

Service visitors visit the facility with the purpose to perform a required task, for example: install, repair, inspect or maintain equipment. Service visitors are of low risk as they are not primarily involved with fish culture and exposure to outside pathogens is low. The movement of professional visitors is monitored and biosecurity of service visitors is observed (SOP 2.5.2.2 Visitor Biosecurity – Professional).

A third category of visitors are researchers. Researchers come from educational or governmental institutions or from the Science Division of the FFSBC. These visitors may be dealing 'hands on' with fish. There is a small, elevated risk of pathogen transfer from research visitors because the nature of their visit is to work with fish and they have in all probability been exposed to 'outside' fish in recent times. However, by their nature, researchers are only dealing with discrete populations of fish at the facility and on a limited basis. As such, researchers pose a low risk to pathogen transfer and follow normal biosecurity protocols that apply to regular FFSBC staff (see SOP 2.5.1 Site and Staff Disinfection and SOP 2.5.4 Equipment Disinfection).

SOP 2.5.2.1 Visitor Biosecurity – Tours
SOP 2.5.2.2 Visitor Biosecurity – Professional

2.5.3 Equipment

All equipment at the FFSBC facilities is either dedicated to a rearing unit, a rearing area or an individual or group. In each instance, disinfection practices are strictly observed prior to and immediately after equipment use. In the case of a rearing unit, the equipment is dipped or washed in surface disinfectant, rinsed and hung or replaced in the approved storage location. Brushes and cleaning equipment are stored in disinfectant for prolonged contact time in a designated area and are air dried and hung on designated hangers until needed. Any equipment that comes into contact with perceived contaminants, such as a floor or mortality is disinfected before reuse. For equipment within a rearing unit such as an anaesthetic bath, grader or other piece of husbandry equipment, the piece is disinfected after each discrete use and inspected for cleanliness prior to reuse. Shared equipment such as pumps, seine nets and Pescalators are disinfected according to protocol and tagged as 'clean' (see SOP 2.5.4 Equipment Disinfection).

2.5.4 Equipment movement

The nature and mandate of FFSBC fish culture involves the large-scale movement and transfer of fish. Inherent to this function is the use of equipment that is shared between sites. This is of two types, juvenile and broodstock transfers. In the first case, fry, fingerling and fish to be released to the wild are moved from location to location within

the FFSBC framework or released to the wild, while in the second case, broodstock are captured from the wild, spawned and the ova and milt are transported to FFSBC facilities.

Fish transports for transfer or release has been performed by the FFSBC for decades. In the instance of transfer between fish culture facilities, there is a strict biosecurity protocol that is observed (see SOP 2.5.4 Equipment Disinfection). All transfer equipment is disinfected before use and the equipment log documents this act. Before using the equipment on any fish, the equipment is checked to see that the disinfection protocol has been observed.

Dedicated and experienced FFSBC staffs are responsible for obtaining wild ova and milt from the wild broodstock. For broodstock capture in the wild, the spawning team will disinfect all equipment, vehicles and personnel before changing location. Immediately, after broodstock have been stripped and returned to the environment, the SOPs 2.5.1 Site and Staff Disinfection and SOP 2.5.4 Equipment Disinfection are observed. This action limits the risk of pathogen transfer from the point of possible origin.
For captive broodstock, each broodstock rearing unit has dedicated equipment for the purposes of rearing and handling broodstock for culture and spawning purposes. Hatchery staff will follow normal procedures for equipment disinfection (see in SOP 2.5.4 Equipment Disinfection) in addition to a full disinfection of the spawning area (see SOP 2.5.1 Site and Staff Disinfection).

SOP 2.5.4 Equipment disinfection

2.5.5 Suppliers

All visitors including suppliers are informed in advance of site biosecurity procedures. Each supplier is appointed a time or approximate time of arrival on site. The supplier is directed to park their vehicle in a designated parking area and check in with reception and/or the designated person who coordinated the delivery, usually the Hatchery Manager, Assistant Manager or Maintenance Manager. It is prohibited that the supplier wanders unescorted through the facility searching for the contact person. Rather, the designated FFSBC contact meets the supplier in the reception area or the designated parking area in advance of the delivery. In some locations for interior hatcheries, it is permissible to enter the hatchery compound with the delivery vehicle and park in designated, non-fish culture areas prior to delivery. This is because the compound entry is adjacent to common delivery sites (feed storage, garage, maintenance area) and in plain view of hatchery operations.

If the supplier or their vehicle are deemed to pose a biosecurity risk, the supplier is either asked to return at another time or not permitted further into the facility until undergoing personnel and equipment disinfection (as per SOP 2.5.4 Equipment Disinfection). If there is no perceived risk, the supplier proceeds with the delivery.

Given that the FFSBC fish culture facilities are located in geographically distinct areas of the province, it is unlikely that a single supplier will visit two FFSBC hatcheries in succession or another fish hatchery with the exception of the Vancouver Island Trout

Hatchery. In considering the Vancouver Island Trout Hatchery, the facility has a single-entry/exit that is in full view of the office. Feed storage and maintenance areas are adjacent to this entry point. In addition to advising suppliers that the Vancouver Island Trout Hatchery is not to be serviced after delivery to another fish culture facility, the Vancouver Island Trout Hatchery staff follow protocols described in SOP 2.5.5 Supplier Biosecurity to ensure a limited risk of pathogen transfer into the hatchery.

SOP 2.5.5 Supplier Biosecurity

2.5.6 Moving fish between sites

Fish movement between sites will be minimized, however wherever a disease risk is identified, an assessment will be undertaken by a fish health professional prior to moving the fish. If there is a disease of concern fish cannot be moved without Introductions and Transplant Committee approval. Particular care will be paid to handling of the fish to avoid undue stress, transmission of disease or possibility of escape. Where there is a potential fish health problem the risk will be reduced in conjunction with FHU in advance of the fish being moved.

The move will be planned in advance to be as stress-free and as short a duration as possible. The receiving sites will make arrangements for isolating the newly arriving fish. Water quality will be maintained and frequently monitored during transport. All attempts will be made to minimize the amount of transport water delivered to the receiving site, to prevent spread of waterborne pathogens.

SOP 2.5.6 Fish Transport

2.6 Minimizing disease within the site

The importance of keeping FFSBC facilities disease-free is profound. First, there is the impact of a disease outbreak and what that means to fish under the care of the FFSBC. Second, there is the fiduciary responsibility to the anglers of BC who rely on the stocking of high-quality fingerlings into angling waters. Third, there is the potential environmental impact of releasing potentially infected fish and the impact that would have on the native population of fish and the ecology of the aquatic environment. Four, the FFSBC transfers fish between watersheds; the impact of pathogen introduction could be widespread. For these reasons and others, the FFSBC strives to maintain the highest quality standards to minimize pathogen transfers between sites; this task is first addressed by minimizing pathogen transfer on site.

2.6.1 Hygiene and disinfection - personnel

All FFSBC staff is issued clothing for work performed on site. The standard issue clothing identifies FFSBC personnel, serves as a 'team uniform' and is a tool in biosecurity efforts. Standard issue items also include rubber boots and rain jacket and overalls. The latter three items are of a material that can be cleaned and disinfected. In the case of the incubation facilities, there are supplied rubber boots and rain wear that are for wearing inside the incubation facility and do not leave. These too are cleaned and

disinfected on a regular basis. As with the incubation areas, the broodstock areas of FFSBC facilities also have their own apparel and it is treated as single-purpose equipment.

Showers are provided for staff at each facility. In addition, there are cleaning stations for hands and apparel located at certain, specified entry points of a specific rearing unit. The use of these cleaning stations is enforced and observed. In this way, standard issue items are cleaned and disinfected before work continues in different areas of the facility.

2.6.2 Hygiene and disinfection – equipment

As mentioned, each rearing unit has its own common equipment that is cleaned, disinfected and hung on or adjacent to the rearing unit. Nets and brushes are stored either hanging from the rearing unit or are placed in tubes so that the bristles, netting or other functional part of the equipment can air dry and be exposed to light. Equipment shared within a rearing unit is cleaned and disinfected after use (see SOP 2.5.4 Equipment Disinfection).

2.6.3 Mortality collection

Observation of fish is done on a continual basis throughout daylight hours. The first observation is during feeding in the morning and the last during security check in the afternoon. Staff members routinely observe feeding behaviour (2.2.5 Feeding and Nutrition) and fill the feeders for the day and in this action also observe for mortalities. After feeding is complete, the rearing units are cleaned for the first time of the day and mortalities are removed at this time. In addition, observations of fish continue throughout the day and mortalities, if present are retrieved from the rearing unit. In the event that a moribund or dead fish is observed, they are removed and handled according to protocol (SOP 2.6.3 Mortality Collection, Classification and Disposal; SOP 2.7.2.6 Euthanasia). At no time is the mortality transported away from the rearing unit in a net; this is to prevent the spread of potential pathogens from the mortality to the surrounding areas. The capture device, dip net, hand net or sieve, is cleaned and disinfected (see SOP 2.5.4 Equipment Disinfection). The mortality is classified (SOP 2.6.3 Mortality Collection, Classification and Disposal), tagged, bagged and placed in the mortality freezer. The mortality freezer is located in a remote area of non-essential equipment and distant to feed or rearing units.

The routine mortality collection procedure involves the following procedure: each rearing area has a dedicated mortality collection container that contains collected fish. During the morning mortality check, further observations of fish health are made for the general population including flashing, puffing, rubbing on the rearing unit sides, response to human movement and position in the tank (near the out flow, high in the water column, etc.). If slow moving, moribund or dead fish are seen, they are collected from the rearing unit and immediately transferred a mort container. Moribund fish are euthanized immediately (see SOP 2.7.2.6 Euthanasia). Dead fish are examined topically for obvious and overt signs of disease, physical appearance or physical anomaly. Overt signs of disease include: lesions, red fin bases, flared or inflamed gills, blebs, exothalmia, fungus, parasites, 'black tail', fin erosion or scale loss. The overall physical appearance of the

fish is observed generally including shape, size and colour relative to the population. Physical deformities are also observed generally such as scoliosis, starvation and deformity. Any overt signs of disease are noted on the mortality recording chart and the Manager is advised.

The mortality chart at each rearing unit is a record of feeding, behaviour and fish health observations and is affixed to the rearing unit and all husbandry observations are recorded on this chart. Notations on the chart are collected regularly and transferred to the hatchery log and onto PARIS. The mortality chart is an instant snap shot of mortality and fish health trends. If mortality rates increase, it is immediately visible and brought to the attention of the hatchery management.

After any mortality of fish behaviour has been logged, dead fish are placed in the mortality bucket. Any drops of liquid that escaped containment during the process are cleaned and disinfected and the dip net immersed in disinfectant and hung to dry on the designated space of the rearing unit. When all rearing units in the culture area are checked, the contents of the mortality container are moved to the mortality freezer and transferred to biodegradable compost bags or other containers, sealed and placed in the freezer. The mortality container is wiped down, cleaned and disinfected before being placed back in a designated storage area (see SOP 2.5.4 Equipment Disinfection).

SOP 2.6.3 Mortality Collection, Classification and Disposal

2.6.4 Mortality Disposal

Mortalities are removed from the freezer according to need for space. During the period of broodstock collection and spawning, the need to empty the freezer increases. Frozen carcasses in the biodegradable bags are transferred from the freezer to designated buckets and placed in a transport truck and taken to the landfill or if available, organic recycling facility. Some sites landfill mortalities on FFSBC property using a backhoe to dig a landfill site at a remote location on the large properties and cover the mortalities with lime and earth. This action and the other methods of mortality disposal are addressed in SOP 2.6.3 Mortality Collection, Classification and Disposal. According to the site, this service is provided by staff or a contractor. The vehicle and buckets are disinfected according to protocol (see SOP 2.5.4 Equipment Disinfection).

2.7 Monitoring Fish Health

Fish are monitored at least once daily for any unusual behaviours, visible lesions or other signs of disease. Fish biomass sampling (see SOP 2.2.5.5 Fish Weight Sampling) is also an excellent opportunity to visually assess fish condition as the fish are removed from the rearing unit and weighed. Changes in behaviour and physical condition will be reported to hatchery management. Water quality will also be routinely monitored (as per § 2.4 Monitoring Water Quality; above).

2.7.1 Mortality classification

As mortalities are collected, they are examined topically for signs of disease (as per SOP 2.6.3 Mortality Collection, Classification and Disposal; above). Together with behaviour observation, this initial screening serves to alert staff to any increase in the types of mortality and rule out probable causes. Should staff observe an increase in a particular type or pattern of mortality the Hatchery Manager is notified and as required the Manager will contact the FHU. The Manager and the FHU discuss any remedial actions and the FHU may ask for samples if the Manager has not already sent them.

In assessing mortalities, the first rule out is if the fish is physically disfigured; a 'gimped or whimped' fish. Nutrition is ruled out if the fish is not smaller or emaciated ('pin-head'). If the fish appears 'normal' with no untoward signs and mortality numbers are low or if the fish were not handled recently in any way, no further action is warranted. However, if the fish exhibits obvious signs of disease or infection, this too is noted and if there has been an increase in mortality, further action is taken.

The fish culture staff will take note of any trend in the number or type of mortalities in a given rearing unit or area. The mortality card attached to each rearing unit provides the information on recent mortalities. Therefore, there are three catch points for disease emergence: 1) the daily routine of mortality procedures, 2) the recording of daily mortality numbers and resulting trends in the hatchery log and PARIS, and 3) review of PARIS or submitted information to the FHU.

In the event of an increase in mortality rates or of suspicious fish death, qualified personnel who have received training and authorization from the FHU may prepare slides for Gram's staining. Qualified staff may also view these slides under oil-immersion microscope to obtain further evidence of a causative agent for the fish mortality. The preliminary results of these investigations are relayed to the FHU and the slides used are shipped to the FHU for further examination. Some hatcheries use microscopes fitted with optical software and the images are either sent to the FHU by email or viewed in real time. The FHU may elect to use these images to help assess the situation.

2.7.1.1 Fish Health Sampling

In the event that mortality rates are noted to be increasing, the FHU may request, or the hatchery staff may elect to voluntarily submit fish samples. There are generally two instances when samples are shipped to the FHU: 1) slow, steady increase in the mortality rate, and 2) a spike in mortality rate. In these circumstances, live fish are sent via expedited courier and/or air freight from the hatchery to the FHU for processing.

The fish selected for sampling are those fish which exhibit moribund behaviour or that which is not normal; this can be reduced startle reflex, high position in the water column, a position close to the outflow or with overt signs of disease. FHU staff provides direction on the number of samples to submit, often in the range of 30 - 60 fish. These fish are captured and transferred to a plastic bag that is overlaid with oxygen, placed over ice in a Styrofoam box or insulated cooler and shipped. Strict biosecurity measures are followed for any equipment used in the procedure and for staff who conducts the work

(see SOP 2.5.1 Site and Staff Disinfection; SOP 2.5.4 Equipment Disinfection). A sample Fish Health Sampling report appears in Appendix 4.2.

SOP 2.7.1.1 Fish Health Sampling

2.7.1.2 Samples for histology
Histology is the study of body tissues most often by viewing prepared slides. Histological examination of tissues from dead or dying fish can be used to determine the pathogen responsible for the fish health incident. The FFSBC is fortunate to have the capacity to prepare, read and evaluate histology preparations in order to best determine the course of action to pursue on a fish health issue.

Only live fish are suitable for histology. If the FHU directs that fish are to be sampled for histology, the FHU will ask for a Fish Health Sampling (see SOP 2.7.1.1 Fish Health Sampling) and these samples are sent to the FHU.

2.7.2 Common fish health procedures

2.7.2.1 Egg disinfection
Eggs supplied to FFSBC facilities are from two general sources: wild and domestic. As a preventative measure to limit pathogen transfer from source to receiving areas, eggs are surface disinfected with buffered iodophore at the concentration of 125ppm for 10 min after fertilization. As a further measure, eggs are again disinfected by the same procedure at the receiving hatchery. Eggs are passed through a receiving half door to the disinfection area of the hatchery's incubation facility.

For wild eggs, gametes are transferred to new, clean containers after fertilization and after water hardening, disinfected. Disinfected eggs are then transported to the receiving hatchery's incubation facilities as noted above.

For hatchery transfers of domestic eggs, that is, between FFSBC facilities, eggs are disinfected (as described) before transport and on receipt in the second hatchery. This may occur at the fertilized or the eyed stages.

SOP 2.7.2.1 Egg disinfection

2.7.2.2 Egg treatments
Eggs are routinely monitored for the presence of *Saprolegnia spp.* fungus. Although eggs are sensitive to light, hatchery staff check on the development and state of eggs in incubation under low light and red light conditions. There are two methods of incubation involving two types of incubation containers: jars and trays; most FFSBC hatcheries contain both sets of equipment. Incubation jars are often made of clear plastic and the presence of fungus is easily noted when viewed under low or red light conditions. Trays are periodically pulled from racks and the eggs inspected. All the FFSBC facilities use groundwater sources which limits the point source of *Saprolegnia* infection, however the fungus is ubiquitous and spores are in common soil and airborne. Therefore, casual, indirect infection of eggs by *Saprolegnia* is possible and although infection does occur

from time to time, the use of groundwater and low incubation temperatures helps limit the infections. Jar incubators minimize fungal infection through gentle movement of eggs throughout their incubation phase. Routine manual removal of dead eggs occurs from the eyed egg stage onwards. As with all circumstances where eggs are incubated, *Saprolegnia* must be detected early and treated quickly lest an outbreak of greater proportions occur.

On occasion, therapeutic treatments are used to control fungal infection. Treatment of fungal infection for eggs in jars differs from fungal treatment of eggs in trays by the amount of eggs treated: individual jars are treated whereas a stack of trays must be treated. In the case of individual jars, the water flow and jar volume are calculated and the amount of formalin (37% aqueous formaldehyde) needed to achieve a concentration of 1000 to 2000 ppm with a target concentration of 1670 ppm (618 ppm active ingredient) is determined and decanted. This appropriate volume of formalin is evenly and continuously introduced into the affluent water and eggs are treated in this flow-through manner for 15 minutes (see SOP 2.7.2.1 Egg Fungal Treatment). In the treatment of fungus for eggs held in trays, the effective volume of water to be treated is the complete volume of the stack of trays. Flow and volume are calculated as above and the appropriate amount of formalin is decanted and continuously introduced to the header tank. This is continued for 15 minutes. Treatment may be repeated as required.

SOP 2.7.2.2.1 Egg Fungal Treatment

2.7.2.3 Alevin treatments

There are no therapeutic treatments on alevins. Routine husbandry procedures involve picking and cleaning of incubation units. Mortalities and observations of fish health are noted in the hatchery log and PARIS.

2.7.2.4 Anaesthetizing fish

The approved fish anaesthetic TMS (tricaine methanesulphonate; aka: MS-222) is available by prescription from a licensed Veterinarian. As the intended end use of fish raised by FFSBC is for human consumption, TMS is the recommended anaesthetic for anaesthetising fish at the FFSBC facilities. Drug use is under the supervision of the FHU and the FFSBC contract veterinarian.

The exposure of anaesthetics to fish and people is minimized wherever possible. Certain stressful practices to fish are avoided to help minimize the need to anaesthetize fish. This practice aids the FFSBC efforts towards fish welfare, waste management, personal exposure, cost and effort with regard to the use of anaesthetics.

Anaesthesia is used to reduce stress and avoid unnecessary trauma during common culture techniques where immobilization can mitigate circumstances impacting fish health. The handling of fish is a common occurrence in the life cycle of cultured fish and can be for a number of activities including: transfers between life stage-dependant rearing units (e.g. trough to raceway), grading, weight or health sampling and any instance where acute stress may result from common husbandry techniques. Wherever possible and

where indicated, the alleviation of stress-inducing activities is done by the use of anaesthetics.

In all circumstances, anaesthesia is conducted by educated, trained and experienced staff whom are familiar with the use of these drugs on fish. The use and disposal of these drugs are addressed in the SOP 2.7.2.4 Anaesthetizing Fish. The veterinarian and the FHU monitor drug use at FFSBC.

SOP2.7.2.4 Anaesthetizing Fish

2.7.2.5 Vaccinating fish
FFSBC fish are not vaccinated.

2.7.2.6 Euthanasia
Where feasible, the euthanasia of fishes should consist of a two-step process, with initial anaesthesia to the point of loss of equilibrium, followed by a physical or chemical method to cause brain death. For small fish, concussion or continued anaesthesia to medullar collapse (brain death within 1 minute) is acceptable.

Physical techniques such as percussive stunning and gill-cut methods should are used secondary to anaesthesia; the exception is when fish are in extreme distress and the time taken in preparation of anaesthesia would result in prolonged distress. Use of lethal levels of central nervous system depressants, such as buffered TMS, is the preferred method of euthanasia. Alternatively, a stunning blow to the head performed by an experienced person is also acceptable if followed by cutting the gill arch or severing the spinal cord.

The use of carbon dioxide is not an acceptable method of euthanasia, nor is suffocation by draining the tank or removing the fish from water. Use of hypothermia (including putting fish on ice) before euthanasia is avoided because of concerns about the induction of pain during ice crystal formation. Physical euthanasia techniques such as decapitation alone are avoided because many species of fishes continue to have brain activity in the face of advanced cerebral and systemic hypoxia. It is therefore desirable to physically destroy the brain in fishes that have been terminally anaesthetized and then euthanized using a primary physical technique such as blow to the head. Bleeding to death under anaesthesia is also an acceptable method of euthanasia. When large numbers of fish need to be euthanized such as in depopulation, the use of immersion anaesthetic at lethal dose in the holding tank is acceptable. Euthanasia of any cultured animal is a necessary part in the process of production. Euthanasia can be conducted on the grounds of compassion, fish health sampling, culling, biosecurity, and spawning.

SOP 2.7.2.6 Euthanasia

2.8 Fish Health Records

There are two controls over fish health records; one record is site specific and remains on site at the hatchery, the other is through PARIS and if needed, is also filed at the FHU. In

this way, redundancy of fish health records allows staff and technicians to analyse fish health outbreaks from past instances and use this information to better predict and respond to new threats.

Fish health records at the hatchery are located in the hatchery log and include inventory records that give up-to-date information on the species, strain, number, size, location, feeding rate, mortality rate etc. at one source. These records are the most commonly-referred to records to compare fish performance. These records are kept in the hatchery office and are also entered into PARIS.

The hatchery log and PARIS also record fish movements, complete with other information regarding possible health checks done (if required) and results of the transfer. Mortality records and mortality cause are also logged at the hatchery and into PARIS.

Any lab work done as a result of a fish health sampling (see 2.7.1.1 Fish Health Sampling and SOP 2.7.1.1 Fish Health Sampling) is recorded at the FHU and assigned a sequential case file number according to the date and source (see Appendix 2: Diagnostic Fish Health Sample Submission) . In addition, and email is sent to the hatchery and senior management with the results and entered into the hatchery log. Diagnostic sampling for fish transferred across provincial zone boundaries are also recorded in this manner. A full written accounting of any fish health sampling results is also given to the hatchery at a later date and is entered into PARIS. A complete fish health case load summary is presented by FHU staff at the FFSBC Annual General Meeting or Fall Planning Meeting.

The FHU dispenses all prescribed medications and anaesthetics and records all information pertaining to shipping, instructions for use and the Drug Use log. The Veterinarian is responsible for all prescription drugs and is kept up to date on fish health issues. When medication is sent to a hatchery, a record of the draw down is given to the Veterinarian and a copy of this transaction accompanies the medication and is also put on the case file. These records and others as required are compiled and reported to the Provincial and Federal authorities in accordance with existing fish health regulations and copies of the submissions and reports are kept at the FHU and FFSBC headquarters in Victoria. Similarly, backup copies of correspondence, fish health sampling results and reporting are kept at the FHU and FFSBC head office.

As noted above (2.2.5 Feed and Nutrition; 2.6.3 Mortality Collection, Classification and Disposal) feed records are entered daily and mortality records are entered on a regular basis. A paper copy of information that is in the process of being entered into the computer is kept secure and in an identified folder until it is entered into PARIS. Entered data is stored in a binder or other filing system.

2.9 Fish Health Outbreaks

The FFSBC has emergency contingency plans to maintain fish health in the face of natural disaster and a fish health crisis. The primary responses to an environmental natural disaster has been described in section 2.4.1 Water Quality Contingency Plan. This

plan ensures that fish have water and oxygen to survive extended interruptions to normal water delivery. The following is a description of procedures in reaction to a fish health event. In general, fish health events are by their aetiology, gradual in progression and seldom catastrophic. In the case of a hatchery, large, catastrophic events are almost always environmental in origin. Nevertheless, SOP 2.9 Fish Health Emergency Procedures describes the protocol to address such an event.

SOP 2.9 Fish Health Emergency Procedures

2.9.1 First steps

As stated previously (see 2.2.5 Feeding and Nutrition) a statistically significant number of fish from all groups of fish, save adult broodstock are sampled for weight and length every two weeks. At this time the hatchery staff have an excellent first-hand account of fish health signs and indications. If untoward health effects are seen or in any way indicated, this is reported to the Hatchery Manager, the FHU and entered into the hatchery log and PARIS. Further consultation between the parties ensues and if indicated, a fish health sample will confirm the presence of a pathogen. This early detection of a suspected pathogen is a key tool in the fish health model at FFSBC.

Mortalities are collected daily from each rearing unit and these generally are examined for signs of pathogens by the attending hatchery staff. This too is a tool in the early recognition of an outbreak. In addition, feeding and schooling behaviour is monitored throughout the day, but especially in the mornings for all rearing units. However remote, there is the chance that an outbreak could occur undetected that would result in catastrophic loss.

On noticing any untoward increase in mortality, staff immediately contact the Hatchery Manager or Assistant Manager. The details of the emergency are clearly recorded including:

- Rearing unit ID
- Species
- Stock
- Age
- Feeding rate
- Previous mortality rate
- Events (transfer, grading, feed size change etc.)
- Other particular identifiers and any other information.

These details are relayed quickly to the FHU via telephone and the details sent by email immediately and entered in to the log. Senior management is also advised of any serious fish health concerns. The Manager then conifers with the FHU and prepares to send a fish sample to the FHU. If capacity and capability permits, the Manager may direct qualified personnel to examine fish samples in the hatchery lab. The Hatchery Manager then directs the staff to treat the event as an Infectious Disease Emergency. The FHU may also notify other hatcheries of the event and relay information on the stocks of fish affected. This is to warn other facilities who may hold a cohort stock and put that hatchery on notice.

2.9.2 Infectious Disease Emergencies

After samples have been sent to the FHU and before tests results are received at the hatchery in question, a series of events aimed at containment and security are enforced. This is to limit the potential transfer of any pathogen from the affected rearing unit to other areas. The rearing unit in question is also monitored frequently throughout the day for additional mortalities. The Hatchery Manager may assign a staff member to be in charge of observing and reporting any additional information regarding the affected rearing unit. This staff member will observe the strictest personal biosecurity measures (see SOP 2.5.1 Site and Staff Disinfection).

2.9.2.1 Isolation/Quarantine

At the recommendation of the FHU and senior management the site may be officially designated as isolated/quarantined. Isolation/Quarantine remains in effect until such time as the problem has been diagnosed and/or managed through the FHU and hatchery management. Under this dictum, all fish transfers, including eggs, in or out of the facility is stopped. The SOP 2.9.2.1 Isolation/Quarantine details the steps to secure the rearing unit, the rearing area and the facility. In brief, the rearing unit is identified in an unmistakable manner to designate that the particular unit is under Isolation/Quarantine. The rearing unit identification states the contact person and information. Where possible, foot traffic is impeded around the rearing unit and a footbath is placed adjacent to the rearing unit. For a culture area, the area is cordoned off with a rope or plastic tape barrier with signs of 'Do Not Enter: Isolation/Quarantine Restrictions in Effect'. The quarantined/isolated area has a single point of entry where dedicated footwear must be used before entering. Contact information and responsible person's coordinates are posted. For a facility Isolation/Quarantine procedure, the movement of people, fish and equipment is curtailed until directed otherwise by the FHU.

SOP 2.9.2.1 Isolation and Quarantine

2.9.2.2 Stop fish movement and/or handling

The transfer of all fish to and from the facility may be stopped at the discretion of the FHU, senior management and Hatchery Manager. Under certain circumstances fish transfers may resume or occur if the FHU, senior management and the Hatchery Manager surmise that the suspected outbreak is contained, localized and managed well. An example of this would be the localization of a minor outbreak in a defined rearing unit from a different stock and lifestage than the affected group. If the FHU, senior management and the Hatchery Manager determined that the risk of spreading the pathogen was limited and manageable, some fish transfers would occur. Under no circumstances would fish transfers occur during a facility Isolation/Quarantine.

Further handling of non-impacted fish is at the discretion of the FHU and Hatchery Manager. Evaluation of the risk includes facility-specific details, pathogen type and virulence, and specific conditions related to the situation. If the risk of further pathogen spread is minimal, handling of non-affected stocks may be authorized. Any further non-

essential handling would be delayed and if handling does occur, a close watch is kept on the subject fish.

2.9.2.3 Disinfection and Hygiene
During a suspected or present infectious disease fish health event all staff will be instructed regarding proper disinfection procedures and the Hatchery Manger will review SOP 2.5.4 (Site and Staff Disinfection) with all staff. Where needed and as directed by the Hatchery Manager, the regularity of site disinfection may increase. Cleaning and disinfection of all equipment may be ordered by the Hatchery Manager.

2.9.2.4 Suppliers
The review of supplier and visitor protocol (SOP 2.5.2.1 Visitor Biosecurity – Tours; SOP 2.5.2.2 Visitor Biosecurity – Professional; SOP 2.5.5 Supplier Biosecurity) will be instructed by the Hatchery Manager. Vehicle disinfection after site delivery may be required. Suppliers should re-arrange schedules to visit the affected facility last on their routes if there is a risk of pathogen transfer outside the facility.
2.9.2.5 Mortality Collection
During a fish health event the frequency of mortality collection will be increased as will vigilance towards disinfection procedures. Affected tanks will be mort picked last and staff will adhere to disinfection procedures between tanks and rearing units. Where possible, separate equipment will be designated for the affected unit and designated by marking the equipment. All equipment, surfaces and clothing that come in contact with infected fish or infected material will be thoroughly disinfected after use (see SOP 2.5.4 Equipment Disinfection). Mortality collection and disposal procedures will be strictly observed and provisions made for increased mortality collections and disposal.

2.9.2.6 Determining the cause of the outbreak (outbreak investigations)
The Fish Health Unit may require records and appropriate sampling to determine cause of the outbreak and best course of action (see SOP 2.7.1.1 Fish Health Sampling). The Fish Health Unit will give instructions for proper sampling to the Hatchery Manager and may send a Fish Health Technician to the site to assist with the sampling. Water samples, both inflow and outflow in addition to feed sample collection, storage and shipping may be requested for further analysis. Samples will be properly handled, properly stored and promptly shipped as per the FHU staff instructions.

Continued monitoring will be required after the initial investigations to determine the subsequent course of the outbreak and to assess whether treatment and/or management measures are being effective. Frequent observations of the fish are essential and will be recorded in the hatchery log and PARIS. Feeding response and water quality monitoring will also be observed with greater frequencies. All treatments and management changes such as cleaning, or mortality collection, are noted as they occur. The FHU and hatchery management will work together to review fish health records and make further fish health management decisions. Any repeat sampling and current sampling results are recorded in the hatchery log and PARIS.

2.9.2.7 Site depopulation

In the event that a facility has been ordered depopulated, the euthanasia of fish will follow the protocols set out in SOP 2.7.2.6 Euthanasia. The depopulation will occur in an orderly fashion and be limited by the capacity of staff or contractors to safely dispose of carcasses according to protocols set out in 2.6.4 Mortality Collection, Classification and Disposal. It is the Hatchery Manager's discretion to use alternative disposal methods providing they meet with local regulations and the plan has been reviewed and approved by the FHU and senior management.

After depopulation, the site will undergo a complete disinfection procedure and will not be put into production until directed by regulatory agencies, the FHU and senior management.

2.9.2.8 Reporting to authorities
The chain of reporting a fish health incident such as an infectious disease outbreak or OIE-reportable disease is as follows: The Hatchery Manager prepares a report on the timeline of the outbreak and actions taken during the event and submits it to the FHU. The leader of the FHU then augments the report with laboratory test results and other findings which is then submitted to the FFSBC Vice-President Operations who then submits the report to the MAL, MOE, and other authorities. This process will be evaluated once the federal National Aquatic Animal Health Plan is enacted.

2.9.2.9 Communicating with other operators
In the event of a fish health event at a given facility, the Hatchery Manager or Assistant Manager or designate first contacts the FHU and informs them of the incident. The Hatchery Manager will then identify the stock transfers of cohort fish that may have been received at other facilities. If the outbreak is of a minor nature and the number of fish affected minimal, a call to other Hatchery Managers is recommended to inform and warn other operators to increase observation efforts for the type and stock of fish in concern. If the outbreak is severe and affects a significant amount of stock, the Manager will contact immediately the Vice-President Operations and all other FFSBC facilities and disclose the severity of the event. In addition, on advice from the FHU, the Manager may contact any other private fish culture facilities within a 50km radius and inform them of the issue.

2.10 Fish escape

FFSBC hatchery rearing, incubation and broodstock holding facilities effluent are screened in triplicate to prevent escape of fish. For example: fry troughs are fitted with escape prevention covers or skirts that provide shade and prevent escape. Fry troughs also have recessed or sealed screens set in the outflow end of the trough. The outflow standpipe may be screened as may be the outflow end of the standpipe. The communal drainage is screened above and at the terminus of the trough. In this fashion, premature fish escape is severely impeded.

In the unlikely event that fish escape into nearby streams or watersheds, fish health records - including relevant diagnoses and treatments - will be made available to the appropriate regulatory authorities as required.

2.11 Releases

The health and treatment status of fish will be considered when planning intentional fish releases from enhancement/conservation facilities. If there is a health or treatment concern fish shall not be released until risk assessment recommendations are in place. To ensure fish are healthy for release, the Hatchery Manager reviews fish health records in the hatchery log and PARIS to ensure the fish have no untoward signs that would prevent a planned release.

If fish are to cross regional zones that require fish health certification, a fish health assessment is conducted by the FHU or hatchery designate. This collection is done in the same fashion as a SOP 2.7.1.1 Fish Health Sampling, but includes additional testing at the FHU.

SOP 2.11 Health Assessment for Fish Releases

2.12 Handling drugs and chemicals properly

The FHU acts as the central dispensary for all drugs and chemical treatments used on fish at the FFSBC. Drugs are obtained by veterinary prescription through the contract veterinary services provided by Dr. Nancy Holling with whom the FFSBC maintains a veterinarian/client relationship. Under Dr. Holling's instruction and advisement and in consultation with the FHU, drugs and chemotherapeutants are sent to the hatchery of concern together with instructions for the care, use and reporting of the materials sent.

2.12.1 Handling chemotherapeutants and medicated feed: storage and inventory

The FFSBC has need of four drugs:

- TMS (tricaine methanesulphonate; DIN 02168510),
- Parasite-S (37% formalin; DIN 02118114) and
- Oxysol 1000 (100mg/g Oxytetracycline; DIN 00607657)
- Aquaflor (Florfenicol DIN 02231742).

The necessary prescriptions for these drugs are obtained from the veterinarian. The drugs are then ordered from approved suppliers and shipped to the FHU labs in Duncan. For TMS, fish biomass is predicted on the basis of production schedules that are set during FFSBC, user groups and hatchery meetings. On this basis, the FHU will dispense TMS to the hatchery based on historic use rate, predicted and actual need.

For Oxysol and Aquaflor, the disbursement of drug is under the advice of the veterinarian. When a hatchery files a fish health report to the FHU and the diagnosis of the causative agent warrants, the FHU will administer the appropriate amount of Oxysol to treat the affected fish. The Oxysol and Aquaflor are shipped and are accompanied by detailed instructions for use, vehicle (if necessary) and a copy of the prescription.

Parasite-S is disbursed as required. Chloramine-T and deiodized salt are non-prescription chemicals but, are handled and stored as if they were prescription drugs.

Storage of all prescription drugs at the FHU is under lock and key in a designated and labelled cabinet. The storage area is also behind pass-card or key-lock main doors within a restricted entry area of the building. Only authorized persons may access and dispense drugs.

In the hatchery, all drugs are kept in a cabinet that is clearly marked for the storage of restricted chemicals. This is most often a locked chemical cabinet or behind locked laboratory doors.

At both the FHU and all hatcheries, there is a drug log that inventories all drug use and withdrawal. In addition, the hatchery log details the receipt and use of drugs during treatment. Each drug withdrawal is noted in the drug log and is signed by the person responsible for the drug handling and use.

All medicated feed is top-coated and mixed by hand or machine (see 2.12.2 Handling and Administering Chemotherapeutants and Medicated Feed). Only enough feed used for each day is medicated prior to use; on some occasions a second or more days' feed will be prepared in advance, but this practice requires permission from the Hatchery Manager. This may be done to ensure accurate measurement of the drugs when small volumes of medicated feed are used. Once prepared, the medicated feed is stored in a labelled container that is sealed and stored in a cool, dry environment until the automatic feeder is loaded with the feed. Any unused feed is stored in clearly marked containers in a secure, cool, dry environment and away from other feed.

In sum: all drugs and chemicals are stored in secure areas and cabinets. Only authorized personnel have access to drugs and chemicals. Drug and chemical inventories are kept on site and at the FHU.

In the unlikely event there is excess medicated feed after completion of the treatment the Fish Health Unit will be contacted to determine proper handling and disposal.

SOP 2.12.1 Chemotherapeutant and Medicated feed handling and storage

2.12.2 Administering chemotherapeutants & medicated feed

Chemotherapeutants and medication to be mixed into feed are shipped with up-to-date Material Safety Data Sheets (MSDS), which specify handling and safety precautions. A MSDS for all chemotherapeutants and medications used on site is kept in a binder adjacent to the chemical storage locker in which the materials are kept. Additional sets of MSDS information is kept in the FHU main documents sections and another is kept in the hatchery office binder. Each binder is marked 'MSDS' in large bold letters. Articles are arranged in alphabetical order.

Only staff that have received WHMIS training are permitted to handle restricted chemicals of any nature and at some hatcheries, staff are required to sign off that they have read the material before handling the chemicals. This ensures that all chemicals are handled safely by trained staff. In the course of their labours with restricted chemicals, staffs wear appropriate protective gear and take suitable precautions. The appropriate protective gear is listed in the MSDS and in the SOP for the task.

Chemotherapeutants & medicated feed are dispensed in accordance with the FHU instructions. These instructions accompany the drug along with a copy of the prescription when the fish health event case file was opened and a diagnosis/treatment was stated. The instructions detail the necessary information for treatment and the information to be included in the treatment record (see §2.12.3 Treatment records, below). The package will also contain the methods for administering the drug (see SOP 2.12.2 Administering Chemotherapeutants and Medicated Feed; SOP 2.7.2.4 Anaesthetizing Fish). This insures that the appropriate rearing unit and affected fish receive the prescribed dosage for the duration of treatment.

SOP 2.12.2 Administering Chemotherapeutants and Medicated Feed

2.12.3 Treatment records

The hatchery log, FHU case records and PARIS record all drug treatments on a case by cases basis. This information is generated by the facility that receives drugs for treatment and the responsible person is the Hatchery Manager who ensures that these data are recorded and reported properly and that all required persons are informed. The FHU will ensure that the required reporting of drug use to the Provincial authorities has been filed after the treatment is complete. Provincial regulations require that treatment records for therapeutants include:

- Aquaculture license number for the FFSBC
- Location of facility
- Species of fish
- Name of the prescribing Veterinarian,
- A log naming the drugs (therapeutants), including
    - Name of the drug
    - Specifying how they were administered (e.g. top coat)
    - Treatment schedule including the date treatment commenced
    - Date of last treatment
    - Name and signature of the person responsible for administering treatment.

Detailed records are kept during the entire time of treatment. Medicated feed records will be kept for the entire time the fish are on site. The hatchery manager will include this information in the hatchery log, in a report to the FHU and on PARIS. In addition, treatment effectiveness is reported, namely mortality rate and abatement, observations (feeding behaviour etc.) and any other information the Manager sees as necessary.

In combination with inventory records, the rearing unit(s) that was/were treated will be readily identifiable throughout the treatment process by posted notice that the fish are on

treatment. The notice includes signage and a note on the rearing unit mortality card. The notice(s) does not come down until the FHU acknowledges the required withdrawal period. This ensures fish are not released (liberated) before drug depuration has occurred.

A copy of the treatment records will accompany those fish to another site if the fish are subsequently moved. However, it is very doubtful fish on medication would be moved.

2.12.4 Enhanced fish

Enhanced fish are those fish (rainbows and Eastern brook trout) that have been treated with α-Methyl Testosterone (α-MT) as fry to become all-female males: males that when mature, only produce female offspring. All-female milt producing fish are contained in separate and identifiable rearing units throughout their hatchery life. These fish are never released to the environment with the exception of a population of all female milt brood for Eastern brook trout that are kept at Aylmer Lake and stocked from the Kootenay Trout Hatchery. This unique situation of all-female milt males in Aylmer Lake is an arrangement between the Ministry of Environment, the Ministry of Agriculture and Lands and the FFSBC and is a joint, ongoing project that has a 15 year history. Elmer Lake is designated as 'No Fishing' lake and has restricted access through First Nations Reserve land and limited access through crown land. Approximately 22,000 fish are stocked into the lake per annum as a backup population of all-female milt males for the sterile Eastern brook trout programme.

Of fish treated with α-MT, the juvenile and adult fish do not have detectable levels of exogenous α-MT (from earlier treatment as fry) and any steroid hormones present in the carcass of a dead fish is from endogenous, natural production. However, these fish must be disposed of in a proper manner that does not threaten the public confidence. Enhanced fish that have been treated are disposed of according to protocol (see 2.6.3 Mortality Collection, Classification and Disposal). The procedure for producing an all-female milt male using α-MT is detailed in SOP 2.12.4 α-MT Enhanced Fish.

SOP 2.12.4 α-MT Enhanced Fish

2.12.5 Disinfectants, chemicals and biologicals

3.12.5.1 Disinfectants

Disinfectants such as Virkon, hypochlorite, Biosolve, Peroxyguard, Peroxaide and others are stored in original, clearly marked containers and in a standard steel chemical cabinet or in the case of 400 litre drums, in designated storage areas. Note: bleach (hypochlorite) is never kept in proximity or in the same cabinet as commercial ammonia-based or chlorine products such as Windex or Comet cleaner. A MSDS for each disinfectant is kept in an accessible binder in the lab and in the site office. Master copies of all MSDS are kept at the FHU and can be sent to any facility as requested. In addition, all suppliers have the MSDS for their products listed on the web. The label of each product gives instructions where to find safety information for the product. WHMIS regulations stipulate that all personnel who handle chemicals must have received instruction in the

use of the chemical in question. Appropriate protective wear must be worn when working with chemicals.

Disposal of all spent disinfectants is as per manufacturers or suppliers specifications. FFSBC complies with all wastewater regulations; the information on the disposal of disinfectants and must be secured from the chemical supplier prior to use and this disposal must comply with all regulations.

2.12.5.2 Chemicals

Chemicals associated with fish health practices are normally confined to the lab. These chemicals are used in the preparation of tissue samples for microscopy. As such, the use of these chemicals is restricted to qualified personnel who are trained in their use, and disposal. These chemicals are of the type such as: formalin or Davidson's solution used for preserving fish tissues and Gram's stain chemicals. These chemicals are stored behind locked doors and in clearly marked containers. For chemicals safety information, a MSDS for each chemical is located in a binder in the lab and another copy is kept in the MSDS binder located in the site office. As per WHMIS instructions, all chemicals must be handled safely by trained staff that are wearing appropriate protective gear and taking suitable precautions. Disposal of spent chemicals is as directed by the supplier.

2.12.5.3 Biologicals

Biologicals including vaccines or probiotics are not used at FFSBC facilities.

3 BROODSTOCK – SPECIAL CONSIDERATIONS

There are two main areas of broodstock management for the FFSBC: wild and captive stocks. Wild stocks are native fish that are grown to maturity from natural spawn in a natural environment. A portion of a wild stock`s maturing fish are intercepted *en route* to their natal spawning grounds, air- or hand-stripped of their gametes, sampled for milt and ovarian fluid and released. The native strains of rainbow trout are taken from Dragon Lake, Premier Lake, Tunkwa Lake, Pennask Lake and Beaver Lake in the BC Okanagan Valley. Anadromous cutthroat and steelhead are taken from coastal locations on an `on demand` basis. The wild spawning of fish for the acquisition of gametes augments the total production of trout eggs produced under the FFSBC programme.

The FFSBC also has a captive broodstock programme that supplies `production` eggs used to produce fish for various stocking programmes. These broodstock are kept at several FFSBC hatcheries. All captive broodstock are under the same biosecurity conditions and standards (see §2.1 Biosecurity), have the same feed storage as for production fish (see SOP 2.2.5 Feed Storage), and have the same water supply as production fish. In essence, the captive broodstock are a family extension of the production fish reared on site and are treated in the same fashion as all other fish with the same level of fish health care (see §2.2 Health; §2.21 Separation of classes; §2.2.2 Suitable rearing environment) and husbandry (see Table 1; 2.2.3 Monitoring fish behaviour) with the only differences being diet (see Table 2; 2.2.5 Feed and nutrition) and volume of the rearing unit (see Tables 1 & 2; 2.2.3 Monitoring fish behaviour), which are generally larger in volume than rearing units for production use. The most notable difference in the treatment of broodstock is the stripping of gametes during the spawning period.

3.1 Suitable rearing environment

Wild broodstock are captured during the spawning period by using a trap, Fyke-style net or weir in the natal spawning stream. Fish are transferred to 3X3m holding pens that are secured in the stream and fitted with predator deterrent netting. Mature fish remain in the holding portion of the nets or traps no longer than 96h and are not fed. The handling (see SOP 3.4.2 Broodstock Handling) and spawning (see SOP 3.6.1 Egg Take) procedures for these fish are clearly defined. In other circumstances, temporary or semi-permanent structures such as circular rearing units may be in place to temporarily house wild broodstock, each with biosecurity measures enabled. Under these circumstances, the broodstock are cared for under the same level of care or greater than that of captive broodstock. Water supply is of ambient quality and observation of these fish under these conditions is done on a more regular basis than in a hatchery facility. Predator exclusion measures are also observed.

Captive broodstock remain under conditions described (see 2.2.2 Suitable rearing environment) and are treated as any other captive fish, albeit at a lower loading density that does not exceed 3.5kg/m3 (see Table 1; §2.2.3 Monitoring fish behaviour). As with production fish, captive broodstock are given superb care and husbandry.

3.2 Feed and Nutrition

For Fraser River drainage wild anadromous broodstock, fish are often not fed commercial diets if their residency in the hatchery is brief. Wild broodstock are only fed commercial diets and krill if they are captured early in the spawning season (e.g. Vancouver Island) and need be held for periods longer than a few weeks. In some instances, anadromous cutthroat trout will be offered pelletted feed as they recondition after spawning and before being reintroduced to the rivers where they were caught. Reconditioning after spawning is thought to be beneficial to the fish to improve survival after release. The feeding of anadromous broodstock is determined in discussion between staff and the Hatchery Manager.

Captive fish are fed specially formulated broodstock diets that are appropriate for their age and size. In addition, anadromous broodstock receive a higher protein diet during the period of 40-250g mass compared to potadromous (non-seawater migrating) production broodstock. The brood diets are fortified with higher protein levels than production feed and are of a larger size than for smaller, non-broodstock fishes. For example, the feeding rates for broodstock fishes held at the Vancouver Island Trout Hatchery are as detailed in Table 3. Other FFSBC facilities have similar tables for broodstock fish. Broodstock are fed by automatic feeders filled daily.

Table 3: FFSBC broodstock feeding strategy for Vancouver Island Trout Hatchery. Size of fish in the top row in grams. Percentage of numbers indicates a ration of %BW per day.

	40-100g	100-250g	250-500g	500-1,300g	1,300g+
Potadromous	EWOS #3 Vita		Skretting Vitalis 4.0mm	Skretting Vitalis 6.0 mm	
	1.7%	1.5%	1.2%	0.8%	
Anadromous	Skretting Orient 3.0mm		Skretting Vitalis 4.0mm	Skretting Vitalis 6.0 mm	
	1.7%	1.4%	1.2%	1.0%	0.8%

Feed for broodstock fish is stored with feed used for production fish and under the same conditions (see SOP 2.2.5 Feed Storage). The handling of broodstock feed is identical to that of production fish and the automatic feeders are filled daily. Feed consumption is recorded for each rearing unit in the hatchery log and in PARIS.

3.3 Biosecurity

Wild broodstock are kept captive for short periods of time as described (see above). This captivity always occurs at a discrete location some distance from the parent facility. For example, at the Vancouver Island Trout Hatchery, wild brood are held in rearing units in an isolated facility located about 2 road kilometres distant from the parent hatchery. These secondary facilities have a secure water supply, are secure from visitors and have predator control measures in place. These remote broodstock facilities ensure that activities related to the handling of wild fish and the acquisition of wild eggs limits the risk of pathogen transfer to the parent facility. Indeed, any equipment used on wild broodstock is either designated equipment and is not used for any other purpose, and is

cleaned and disinfected according to protocol (SOP 2.5.4 Equipment Disinfection). The only materials that pass from brood sites to the main hatchery are eggs and possibly milt and those are subject to disinfection according to protocol (SOP 2.7.2.1 Egg Disinfection). The receiving of eggs entails another disinfection upon arrival at the hatchery (see SOP 2.7.2.1 Egg Disinfection) and is done through passage of the egg containers through a half door or window into the incubation room; no personnel who have visited a brood site may enter the incubation facility. In this way, separate staff and designated equipment are used to acquire gametes from wild brood fish at remote sites. The risk of pathogen transfer is reduced by only transferring disinfected eggs to the incubation facility.

Broodstock fish cultured at FFSBC facilities have separate rearing units in discrete and marked locations. Rearing units holding brood fish are clearly marked and have their own equipment that is dedicated to the specific rearing unit. In addition, biosecurity measures for equipment cleaning and disinfection and personnel movement are as dictated for production rearing units (see SOP 2.5.1 Site and Staff Disinfection; SOP 2.5.4 Equipment Disinfection).

Statistically significant subsamples of all spawning populations are subjected to ovarian fluid sampling and screening for pathogens of concern (see SOP 3.6 Egg Take; SOP 3.7 Broodstock Screening, below). Appendix 3 displays the Ovarian Fluid Sample submission form that accompanies samples shipped from a spawning location to the FHU. A sample report of results of those screening procedures is presented in Appendix 4. In this fashion, the vertical transmission of pathogens of concern is minimized. Should results come back positive, the eggs are destroyed. Accurate tracking of stocks, ensures that egg lots are in a known locations (see § 3.10 Identifying Progeny).

3.4 Selection and handling

Wild and captive broodstock are handled and anaesthetized in the same manner. That is, other than the rearing unit, the procedure used to remove fish from the rearing unit to the anaesthetic bath, the checking of fish for maturity (ripeness) and the return of the fish to the rearing unit or spawning the fish, is essentially the same for wild and captive brood fish. The same level of training and care are exhibited by the broodstock crews and the process is the same. The SOPs that pertain to these treatments are: SOP 3.4.1 Broodstock Anaesthesia and Recovery SOP 3.4.2 Broodstock Handling, SOP 3.3.2 Broodstock Equipment Disinfection and SOP 3.6.1 Egg Take.

Broodstock are handled at least once to determine maturity and ripeness. In this process, the fish is removed from the rearing unit (see SOP 2.3.1 Common Fish Handling Techniques) and placed in an anaesthetic bath (SOP 3.4.1 Broodstock Anaesthesia and Recovery). Once anaesthetized, the fishes` abdomen is palpated to determine if the gonads have reached an acceptable level of maturation that would provide viable gametes. This practice is only performed by personnel with a higher level of training and experience in fish spawning and in fish handling due to the concern for fish health and welfare in addition to the procurement of high quality gametes. Not only can fish health

be compromised without employing good handling techniques, but the quality of gametes collected can vary appreciably according to the development of the gametes and the handling of the donating fish. Considerable expertise is required to successfully judge fish maturity, obtain optimal gametes and minimize stress and trauma to fish.

Fish that are deemed `green` are returned to the rearing unit and observed until fully recovered. The interval of re-checking for maturity is generally 48 – 96h and sometimes more for 'very green' (not mature) fish. This allows recovery from anaesthetic-induced stress and handling stress and for further maturation to continue. The rearing unit feeding and mortality card will note the times the tank has been sampled. Fish will be observed with increased regularity to determine if fish have died and will be removed according to protocol (SOP 2.6.3 Mortality Collection, Classification and Disposal).

Captive fish are returned to regular feeding as soon after spawning as possible. The return to feeding is gauged by the response of fish to hand feeding. Feed records reflect the return to full feeding behaviour.

The FFSBC has depth and experience in predicting spawning dates for fish stocks of concern. Records on spawning dates and stock have been kept for 40 years. This alone assists in minimizing the handling of fish and the optimization of gamete quality.

SOP 3.4.1 Broodstock Anaesthesia and Recovery

SOP 3.4.2 Broodstock Handling

3.5 Treatments

Under the direction of the Veterinarian and the FHU, captive broodstock are on occasion, treated prophylactically for disease by a dorsal sinus or intraperitoneal injection of oxytetracycline. This is done to treat a suspected low-grade, subclincal infection of pathogens. If a stock is to be treated with a prophylactic injection, instructions, a copy of the prescription, identification of the stocks indicated, equipment and the drug are shipped via courier to the site which has the stock in question (see SOP 2.12.1 Chemotherapeutants and Medicated Feed Storage and Handling; SOP 2.12.2 Administering Chemotherapeutant and Medicated Feed; SOP 3.5 Broodstock Treatments). Only authorized persons will dispense and administer the drug to anaesthetised fish. The treatment regimen is recorded and reported in the hatchery log, PARIS and directly to the FHU. Any unused drug and equipment is returned to the FHU, or under instruction, disposed of in an approved manner.

The treated fish are placed under quarantine (see SOP 2.9.2.1 Isolation and Quarantine). Once spawned, the carcasses are disposed of in the normal manner (see SOP 2.6.3 Mortality Collection, Classification and Disposal). Treated fish not killed are not returned to the wild unless they are held in captivity for the required drug withdrawal period. Release of these fish to the wild is only under direction of the prescribing veterinarian and the FHU.

On occasion, broodstock fish may develop some fungal infections during or prior to the spawning season as a result of confinement and captivity. This occurrence is especially noted in anadromous fish that may be caught by volunteer anglers and transported to a broodstock facility. As well, it is sometimes noted that wild broodstock suffer predation wounds from birds, mammals or other fishes. In these circumstances, over-the-counter (non-prescription) remedies such as 3% peroxide, 35‰ salt baths or Polysporin may be administered by staff, provided the incidence of the affliction is limited to a small number of individuals. If the incidence of infection increases to 5% of the population, the FHU is notified immediately.

SOP 3.5 Broodstock Treatments

3.6 Egg take

There are three main types of egg take done at FFSBC facilities. The first is from captive domestic stock held in captivity throughout their lifecycle. The second group is where fish returned to a hatchery or where anglers have caught wild fish by line or net and transported them to the FFSBC broodstock facility. The third instance is wild fish that move to lakes' feeder streams to spawn and are caught, held and artificially spawned. In all cases, fish can be either terminally spawned (see SOP 2.6.3 Mortality Collection, Classification and Disposal) or fish are spawned artificially by manual stripping or air spawned (see SOP 3.6.1 Egg Take).

Treatment of collected gametes may differ depending on the type of offspring needed, for example: all-female triploid (AF3N), broodstock, production or enhancement. These treatments determine how the broodstock are retained, transported or spawned. The treatment of the fertilized eggs further depends on stocking requirements generated by the Ministry of Environment in their annual stocking requests. Therefore, the type of spawner, the method of spawning, the treatment of the gametes, the location of the spawning event all play a role in the methods used.

Mature fish are sorted according to anticipated spawning date as judged by an experienced fish culturist. The general indications for ripeness for female fish are:

- an enlarged vent,
- complete roundness to the belly that extends from the anterior to the posterior portion of the body cavity,
- spawning colouration, and
- the movement of ova from palpation of the body cavity.

The free-flowing of eggs represents the ultimate state of spawning readiness.

In male fish the indications for ripeness are:

- soft condition of the flesh and body cavity,
- colouration,
- the presence of a kype (hooked jaw), and
- the expression of milt in response to slight pressure on the body cavity.

Spawners are selected according to designated plan for stocks, egg numbers and hatchery demand and spawned (see SOP 3.6.1 Egg Take). In some instances, fish caught in the

wild may be transported (see SOP 2.5.6 Fish Transport) back to a FFSBC broodstock facility for spawning, spawned and culled or for anadromous fish, returned to the wild. This practice is dictated by the demand for certain types of eggs and stocks as specified by the Ministry of the Environment stocking plan.

3.6.1 Captive broodstock

Captive broodstock are those fish which have been grown from eggs in a FFSBC facility and are kept to maturity in the same or another FFSBC facility. These fish are kept in designated rearing units (see §2.2.1 Separation of life stages and year classes) and are not considered production fish. Fish may mature 2, 3 or 4 years after 'ponding', that is, a proportion of the population will become sexually mature in the second, third and/or fourth spawning season after being placed in a rearing unit from incubation. The maturation period may be delayed and extended for the famous 'Gerrard' strain of rainbow trout, which may mature at 7 years of age. Conversely, sexually precocious males (jacks) occur in the second spawning season (referred to as 2 year olds) and are may be culled (see SOP 2.6.3 Mortality Collection, Classification and Disposal; SOP 2.7.2.6 Euthanasia). Female fish do not normally gain sexual maturity until their third year.

A large proportion of male and female fish mature in the third year after ponding as 3 year olds. It is this cohort that provides the majority of captive broodstock eggs. As spawning season approaches depending on the facility location and strain or stock, fish will display physical changes that denote advancing maturation such as:

- reddish colouration along the sides and opercula (gill cover),
- a darkening of the skin in general,
- a pronouncement of the dorsal crest (a ridge down the back of the fish),
- males may develop a kype (hook on the lower or upper jaw) and
- females may become notably swollen and rounded.

At this point fish are sorted for maturation (see §3.4.2 Broodstock handling) and placed in a rearing unit that is to hold obviously-maturing fish. Further sorting will separate males from females until the fish are determined as 'ripe' or ready to spawn, at which time they will be spawned and gametes collected (see SOP 3.6.1 Egg Take).

Fish are spawned according to protocol (see SOP 3.6.1 Egg Take) and the spawned fish can be treated in two ways after removal of gametes: culled or kept to recover and recrudesce ('kelt'). Of the kelted fish, some may be kept while others may be placed (liberated) into local lakes. In the first instance, surplus fish are euthanized according to protocol (see SOP 2.7.2.6 Euthanasia) and the remainder are kept for another year depending on how many fish will be needed to spawn as 4 year olds. If the stock numbers and fish are healthy, the Ministry of Environment may elect to place these fish in designated lakes for an 'instant' fishery. No fish are stocked out if the FHU has indicated a past history of disease concern in the stock and the fish are not liberated until after the anaesthetic withdrawal time. This out placement of fish depends heavily on the health of the fish, a history of stocking the designated water body and the demand for the fishery. If any of these conditions are not favourable, the fish are culled. Fish that are placed in a

rearing unit to recover – kelt – are fed and nurtured back to their non-reproductive state and kept for another year in captivity until the next spawning year.

Four year spawning fish are sorted for maturation in the spawning season. Non-reproductive fish may be culled, or if suggested by the Ministry of Environment, they may be placed in a designated water body. Otherwise, spawning of four year fish is as for three year fish. Spawned four year fish are culled after spawning.

SOP 3.6.1 Egg Take

3.6.2 Anadromous broodstock

In the second type of spawning fish, anadromous wild fish such as anadromous cutthroat or steelhead are caught by anglers and brought to FFSBC broodstock facilities for final maturation and spawning. Fish that are of hatchery origin and caught may be kept together with wild fish, but in general, these fish are not spawned for use in the enhancement efforts of a stock. Demand and priority for eggs may cause deviation from this principle. Once fish are received from the anglers at a FFSBC facility, they are kept in isolated and secure rearing units complete with tight-fitting lids to prevent predation and escape. Fish are checked every (4-6) days for ripeness and if near maturation, they are removed and placed in 'maturity' rearing units until spawning, usually within a further 4-6 days. As the fish are spawned and the crosses needed are achieved (wild male versus wild female), the fish are kept in captivity until they are fit to be returned to the site of capture or at least near to the site of capture. The process of returning the fish follows the protocols for SOP 2.5.6 Fish Transport.

3.6.3 Wild potadromous (freshwater non-migrating) broodstock

The third type of spawning fish is from wild potadromous stocks that are intercepted en route to natural spawning grounds. The species involved here are rainbow trout, Kokanee, and Eastern brook trout. In principle, mature fish are sorted for ripeness from the containment portion of a capture device such as a weir, a Fyke net, a fish trap or modified net pen.

Spawned fish may be treated in three ways: culled, kept, or released. The culling of fish is dependent on recruitment to the lake in question; if recruitment from natural spawn is high, fish will be culled after spawning. Similarly, if surveys report an overall decrease in the size of surveyed adult fish indicating intense competition for food, or if spawner size, hence fecundity is decreasing year to year, spawning fish may be culled. Any fish with overt signs of disease, predator injury or malformation is likewise culled. In some cases, spawned fish will be kept in containment or rearing units until they are feeding again and visually fit whereupon they are released back into the waterway. Fish treated with oxytetracycline in response to a disease threat or treated with anaesthetics are kept for the depuration period for the drug used (see §3.2 Broodstock treatments). In some cases, fish will not been anaesthetized before spawning. If an operations supervisor determines that the need for anaesthetics is outweighed by the stress for using anaesthesia, or the use of anaesthetics poses a threat to human safety because the fish cannot be held for withdrawal times, the fish may be spawned and released directly back

into the waterway after spawning without using anaesthetics. Kokanee are semilparous fish and die after spawning; they are not anaesthetized and are culled after spawning.

In wild fish, how the egg is handled after the spawning varies with the location of the spawning site, the demand for stocking requirements including the type of treatment to be applied to the egg (triploidy, feminization, masculinisation of the fry, outcrossing, etc.) and hatchery requirements for eggs. For example, 100% of the eggs taken from the Beaver Lake spawning station are destined for all-female triploid treatment. Therefore, all eggs remain unfertilized and are transported to the hatchery for fertilization with all-female milt males and then pressure treated to induce triploid offspring. Males are not stripped at the Beaver Lake station and are simply released. Similarly, Eastern brook trout eggs are shipped to the Kootenay Hatchery green and are fertilized with all-female milt. In this fashion, the distribution of eggs from a given facility dictates the method of spawning and the treatment of the eggs thereafter. In all respects, the treatment of eggs follows standard procedures, but the need dictates egg treatment.

After handling for spawning, fish are afforded adequate recovery time to overcome the stress effects of the incident, observe withdrawal times and preserve fish health. As soon as possible fish are returned to routine procedures and if indicated, returned to the wild.

3.6.4 XX Male Gonad Harvest
By their nature, XX male fish do not have intact *vas deferens* to transport mature milt from the gonad to the genital papillae. In order to harvest the milt from XX males, the fish are euthanized (see SOP 2.7.2.6 Euthanasia) and the gonads excised. Milt is then collected from macerated testis under clean conditions and used to fertilize eggs for the production of all-female progeny. The procedures for this action are detailed in SOP 3.6.4 XX Male Gonad Harvest.

SOP 3.6.4 XX Male Gonad Harvest

3.7 Broodstock disease screening

Broodstock are potential vectors of pathogens. Classical thinking is that broodstock may have developed immunity to a broad spectrum of pathogens that may be systemically present in the fish, but at subclinical levels. The thinking continues that naïve and younger fish have not developed the immunity of the older broodstock fish. In this way, older fish become potential reservoirs of pathogens. Precautionary actions to mitigate any possible vertical transmission of pathogens such as disease screening are done while spawning broodstock fish.

It is practice at all FFSBC facilities to sample ovarian fluid for pathogens. Ovarian fluid is most commonly collected from 20-50 females each during the first days of spawning, near the peak of spawning and again at the end of spawning. More or fewer samples may be sampled as directed by the FHU; this is driven by current disease implications of the stock, history and other variables that may indicate a fish health threat. Ovarian samples are collected in a semi-sterile manner, placed in labelled storage vials and shipped to the

FHU (see Appendix 3). In the lab, pathogens of interest are screened for using microscopic and culture techniques which may include bacterial or viral tissue cultures (see Appendix 4). Any infected stocks that have been identified are euthanized (see SOP 2.7.2.6. Euthanasia).

The number of ovarian fluid samples taken from females spawned at lake sites is approximately 150 samples. In addition, 30 males and 30 females are tissue sampled for kidney and spleen and the samples are sent on ice to the FHU. These samples are tested for viral and bacteriological pathogens by cell culture at the FHU.

SOP 3.7 Broodstock Disease Screening details the procedures for collecting, handling and sending ovarian samples to the FHU. If directed, other tissue samples may be sent to the FHU if the situation warrants. In most circumstances, spawning crews may identify individuals with overt signs of disease or infection and elect to involve the FHU who will test for pathogens of concern from swabs, smears, tissue samples or fluid samples.

SOP 3.7 Broodstock Screening

3.8 Egg disinfection

Eggs shipped to a FFSBC facilities may only be transported after disinfection at the site of origin. This process involves a standard apparatus described in SOP 2.7.2.1 Egg Disinfections §2.5.4.5 Egg Disinfection – Upwelling Method. Briefly, green eggs are surface disinfected by placing them in a continuously upwelling unit containing 100-125 ppm iodophore solution for 10 minutes. Eggs are rinsed of the iodophore after 10 minutes and prepared for transport.

3.9 Gamete transport

Gametes from fish are handled and transported in a manner that protects the integrity of the gametes. In general, after the eggs are disinfected and rinsed, they are placed in clean Zip-Loc bags, jars or other containers (packing unit) and overlaid with oxygen that is introduced after air has been expelled. The packing units are identified outside with indelible marker as to the stock, and fish number and a piece of water-proof paper is placed inside the packing unit with the above information. Careful attention is taken to ensure that egg volumes do not accumulate to the point where eggs on the surface of the packing unit or shipping container crush the eggs below. The packing units are placed in Styrofoam boxes or hard-sided coolers in which ice or ice packs have been placed in the bottom and over which paper or an insulation layer is present to prevent direct contact with the packed eggs. Care is taken to ensure that there is no room for the packing units to move or collide. The container is sealed and care is taken to ensure that the container is light tight. The container is then handled carefully and placed in the delivery vehicle and taken to the hatchery. In a similar manner, milt from individual males is placed in Zip-Loc baggies that have been marked with indelible ink with the appropriate identifying information, oxygen is injected to overlay the milt and the bag sealed. As with eggs, the

milt is placed over ice and shipped in an in an appropriate shipping container that is insulated and light tight. Where directed, transplant permits accompany the shipment.

3.10 Identifying progeny

Identifiers from spawning pairs of captive fish or wild anadromous fish spawned at a hatchery is done by the date and stock or origin and the hatchery where the fish were spawned. Spawning events of identical stock and crosses are designated as a 'Stock' of eggs. This 'Stock' of eggs are identified by a Species Code, Species, Strain, Source of the fish, Genotype (diploid or triploid), wild or captive Origin and Brood Year. During a spawning event, Stock identifier data are entered into the hatchery log and into PARIS according to the data entrance criteria. For an example of the Stock Identifier format in Paris, see Appendix 5. From the point of incubation onward, this Stock identifier will follow this group until they reach their final destination as liberated fish or broodstock. This includes transfers from a hatchery of origin to another FFSBC facility onward to liberation. The Stock identifier serves to track stock throughout the fishes' life at FFSBC facilities. The only time a stock changes a Stock identifier is on the rare occasion when the Ministry of Environment stocking request is for a lake stocking of mixed stock. The other circumstance where spawning events may be combined is for anadromous wild fish from a common drainage (e.g. Lower Fraser) spawned from different tributaries or spawned at different times.

Identifiers from spawning pairs of wild fish is done in a similar fashion and includes the location of the field station and the stock of origin. After receipt at a hatchery, the hatchery is added to the Stock identifier. In addition, treatment of the egg post fertilization may be added to the Stock identifier. For example: eggs fertilized with all-female milt and subjected to pressure shocking to induce triploidization would have the suffix 'AF3N' to the identifier. Wild fish have the Stock identifier until placement into the natural environment.

Through the PARIS system, it is possible to track eggs from any spawning event through the production cycle through to liberation.

3.11 Records

Records for each egg take are and disease screening are kept in PARIS and at the FHU. The PARIS system tracks 'lots' of fish from 'cradle to grave'. In this fashion the FHU are able to keep track of any fish health events for individual stocks of fish and hatchery. This method assists greatly in limiting pathogen transfers in and between FFSBC facilities.

4.1 APPENDIX 1: Regulations/Policies Directly Related to Fish Health Management

4.3.1 Federal

1. Fisheries Act, RSC 1985, F-14.
    - Fishery (General) Regulations, SOR/93-53; Section 56
    - Fish Health Protection Regulations, CRC.
    - Regulations Amending the Fish Health Protection Regulations, SOR/97-392.
2. Feeds Act, R.S.C, c. F-7, s.1.
    - Feeds Regulations, 1983 SOR/83-593.
3. Pest Control Act, RSC, 1985.
    - Pest Control Regulations.
4. Health of Animals Act 1990, c21
5. Food and Drugs Act, Revised Statutes 1985 Chapter F27
    - Amended December 2000

4.3.2 Provincial

1. Aquaculture Regulation, B.C. Reg. 364/89.
    - Escape Amendments, B.C. Reg.335/00.
2. B.C. Veterinary Medical Association, By-Laws and Code of Ethics, 1999.
3. Fish Protection Act, SBC 1997.
4. Pesticide Control Act, RSBC 1996.
    - Pesticide Control Act Regulation, B.C. Reg. 319/81.
5. Pharmacists, Pharmacy Operations, and Drug Scheduling Act, RSBC 1996.
    - Veterinary Drug and Medicated Feed Regulation, B.C. Reg. 47/82.
6. Veterinarians Act, RSBC ch.476, 1996.
7. Veterinary Laboratory Act, RSBC ch.477, 1996
8. Waste Management Act, RSBC 1996.
    - Aquaculture Waste Control Regulation, B.C. Reg. 470/88.
    - Land-based Fin Fish Waste Control Regulation, B.C. Reg. 68/94.

4.2 APPENDIX 2: Diagnostic Fish Health Submission Sample

PARIS
Fish Health Case Details

March 12, 2008
Page 1 of 1

Case 2008-1019
Type Diagnostic
Hatchery FRASER VALLEY HATCHERY
Site MAIN - FVH
Stock RB BLACKWATER R/DRAGON 3N H 2007
Related Cases

SUBMISSIONS

Submission Date January 24, 2008
Contact Char
Comments Lesions found on Jan 21 (1 fish) and Jan 24 (1 fish).
- Wanted to send them as early as possible to prevent outbreak.
- Possible trial using aquaflor?

Gross morphologies:
- External : fish dark, worn dorsals, slight exothalmia in some fish, slightly swollen belly in some fish
- Internal: pale livers, swollen spleens, lots of body fat, food in guts

Feed Skretting #2 - good, normal feeding behavior
Fish Culture
Behavior Normal

TESTS

Date	Reason	Disease Tested	Pathogen	Medium / Procedure	Tissue	Sample Qty	% Affected	Result
25-Jan-2008	Increased mortality	Gyro (Gyrodactylus spp.)	Parasitic	Wet Mount - Microscopy	skin	19	68.00	Positive
25-Jan-2008	Increased mortality	Trychophyra (Trychophyra spp.)	Parasitic	Wet Mount - Microscopy	skin	17	89.00	Positive
25-Jan-2008	Increased mortality	Unknown bacterial ()	Bacterial	Tryptic soy broth - Bacterial	kidney	19		Negative
25-Jan-2008	Increased mortality	Flavo (Flavobacterium psychrophilum)	Bacterial	HS (Sheih's media) - Bacterial	kidney	19		Negative

RECOMMENDED TREATMENTS

Treatment	Dosage	Priority	Comments
None		1	no pathogenic bacteria detected therefore no treatment recommended

ACTUAL TREATMENTS

Date	Treatment	Container	Cont Type	Water Supply	Comments

SAMPLES SUBMITTED

Container

Code	Name	Purpose	Temp	Life Stg	Sample Qty	Avg (g)	Qty in Cont	Density	Flow	O2
RPU11	RECYCLE POND #11	Rearing	8.8	Fry	20	6.0	28,628	Modera	500.0	10.9
				Total	20		28,628			

4.3 APPENDIX 3: Ovarian Sample Submission Sheet

OVARIAN FLUID SUBMISSION FORM **Date:**_____

STOCK	TAG#	WILD	HATCHERY	CAPTIVE BROOD	LGB	LGB YEAR CLASS	LGB RECONDITIONED

* NOTE: ALL OVARIAN FLUID SAMPLES WERE COLLECTED AT TIME OF SPAWNING

4.4 APPENDIX 4: Ovarian Fluid Screening Results Sample

PARIS
Fish Health Case Details

March 12, 2008
Page 1 of 2

Case 2008-1001
Type Screening
Location OLD SITE FRASER VALLEY HATCHERY
Stock ACT LITTLE CAMPBELL R 2N
Related Cases

SUBMISSIONS

Submission Date January 31, 2008
Contact Barry and Morley
Comments EPC confluency 100% healthy
CHSE-214 confluency 99% healthy

Submission Date January 24, 2008
Contact Stevie O and Barry
Comments EPC and CHSE-214 100% confluent, very healthy

Submission Date January 17, 2008
Contact Stevie O and Morley
Comments EPC and CHSE-214 100% confluent, very healthy

Submission Date January 10, 2008
Contact Barry and Char
Comments EPC 100% confluent, cells happy and healthy
CHSE-214 95% confluent-happy looking cells, some areas of wells not confluent

Submission Date January 4, 2008
Contact Stevie O
Comments EPC 100% confluent, cells happy and healthy
CHSE-214 100% confluent healthy with a few small clumps

TESTS

Date	Reason	Disease Tested	Pathogen	Medium Procedure	Tissue	Sample Qty	% Affected	Result
04-Jan-2008	Health check	IHN, IPN and VHS	Viral	EPC and CHSE-214 - Virology	ovarian fluid	3		Negative
17-Jan-2008	Health check	IHN, IPN and VHS	Viral	EPC and CHSE-214 - Virology	ovarian fluid	1		Negative
10-Jan-2008	Health check	IHN, IPN and VHS	Viral	EPC and CHSE-214 - Virology	ovarian fluid	2		Negative
24-Jan-2008	Health check	IHN, IPN and VHS	Viral	EPC and CHSE-214 - Virology	ovarian fluid	2		Negative
31-Jan-2008	Health check	IHN, IPN and VHS	Viral	EPC and CHSE-214 - Virology	ovarian fluid	1		Negative

4.5 APPENDIX 5: Stock Identifier Sheet Sample

SPP CODE	SPECIES	STRAIN	SOURCE	GTYPE	GENOTYPE NAME	ORIGIN	ORIGIN NAME	BROOD YEAR	STOCK
ST	Steelhead	SOUTH ALOUETTE R	SOUTH ALOUETTE R	WR	Winter Run	W	Wild	2008	Steelhead SOUTH ALOUETTE R/SOUTH ALOUETTE R WR W 2008
EB	Eastern Brook Trout	AYLMER	AYLMER	2N	Diploid	H	Hatchery	2008	Eastern Brook Trout AYLMER/AYLMER 2N H 2008
ST	Steelhead	KITIMAT RIVER	KITIMAT RIVER	2N	Diploid	W	Wild	2008	Steelhead KITIMAT RIVER/KITIMAT RIVER 2N W 2008
ACT	Coastal Cutthroat (anadromous)	FRASER R	FRASER R	2N	Diploid	H	Hatchery	2008	Coastal Cutthroat (anadromous) FRASER R/FRASER R 2N H 2008
ACT	Coastal Cutthroat (anadromous)	FRASER R	FRASER R	2N	Diploid	W	Wild	2008	Coastal Cutthroat (anadromous) FRASER R/FRASER R 2N W 2008
ACT	Coastal Cutthroat (anadromous)	FRASER R	FRASER R	3N	Triploid	H	Hatchery	2008	Coastal Cutthroat (anadromous) FRASER R/FRASER R 3N H 2008
ACT	Coastal Cutthroat (anadromous)	FRASER R	FRASER R	3N	Triploid	W	Wild	2008	Coastal Cutthroat (anadromous) FRASER R/FRASER R 3N W 2008
RB	Rainbow Trout	FRASER VALLEY	FV BROOD	2N	Diploid	H	Hatchery	2008	Rainbow Trout FRASER VALLEY/FV BROOD 2N H 2008
RB	Rainbow Trout	FRASER VALLEY	FV BROOD	3N	Triploid	H	Hatchery	2008	Rainbow Trout FRASER VALLEY/FV BROOD 3N H 2008
RB	Rainbow Trout	FRASER VALLEY	FV BROOD	AF3N	All Female Triploid	H	Hatchery	2008	Rainbow Trout FRASER VALLEY/FV BROOD AF3N H 2008
RB	Rainbow Trout	FRASER VALLEY	FV BROOD	AFMT	All Female Methyl Testosterone	H	Hatchery	2008	Rainbow Trout FRASER VALLEY/FV BROOD AFMT H 2008
RB	Rainbow Trout	DRAGON	DRAGON	2N	Diploid	W	Wild	2008	Rainbow Trout DRAGON/DRAGON 2N W 2008
RB	Rainbow Trout	BLACKWATER R	DRAGON	2N	Diploid	H	Hatchery	2008	Rainbow Trout BLACKWATER R/DRAGON 2N H 2008
RB	Rainbow Trout	BLACKWATER R	DRAGON	3N	Triploid	H	Hatchery	2008	Rainbow Trout BLACKWATER R/DRAGON 3N H 2008
RB	Rainbow Trout	BLACKWATER R	DRAGON	AF	All Female	H	Hatchery	2008	Rainbow Trout BLACKWATER R/DRAGON AF H 2008
RB	Rainbow Trout	BLACKWATER R	DRAGON	AF3N	All Female Triploid	H	Hatchery	2008	Rainbow Trout BLACKWATER R/DRAGON AF3N H 2008
RB	Rainbow Trout	BLACKWATER R	DRAGON	AFMT	All Female Methyl Testosterone	H	Hatchery	2008	Rainbow Trout BLACKWATER R/DRAGON AFMT H 2008
ST	Steelhead	COWICHAN R	COWICHAN R	WR	Winter Run	W	Wild	2008	Steelhead COWICHAN R/COWICHAN R WR W 2008
ST	Steelhead	CHAPMAN CRK	CHAPMAN CRK	2N	Diploid	W	Wild	2008	Steelhead CHAPMAN CRK/CHAPMAN CRK 2N W 2008
ST	Steelhead	CHEAKAMUS R	CHEAKAMUS R	2N	Diploid	W	Wild	2008	Steelhead CHEAKAMUS R/CHEAKAMUS R 2N W 2008
ST	Steelhead	CHEHALIS R	CHEHALIS R	SR	Summer Run	H	Hatchery	2008	Steelhead CHEHALIS R/CHEHALIS R SR H 2008
ST	Steelhead	CHEHALIS R	CHEHALIS R	SR	Summer Run	W	Wild	2008	Steelhead CHEHALIS R/CHEHALIS R SR W 2008
ST	Steelhead	CHEHALIS R	CHEHALIS R	WR	Winter Run	W	Wild	2008	Steelhead CHEHALIS R/CHEHALIS R WR W 2008

4.6 APPENDIX 6: Standard Operating Procedures (SOP's) for Fish Health Management Plan

SOP	Section of FHMP
Feed Storage	2.2.5
Fish Weight Sampling	2.2.5.5
Common Fish Handling Techniques	2.3.1
Marking Fish	2.3.2
Air Transport	2.3.3
Water Quality Monitoring	2.4
Water Contingency Plan	2.4.1
Site & Staff Disinfection	2.5.1
Visitor Biosecurity - Tours	2.5.2.1
Visitor Biosecurity - Professional	2.5.2.2
Equipment Disinfection	2.5.4
Supplier Biosecurity	2.5.5
Fish Transport	2.5.6
Mortality Collection, Classification and Disposal	2.6.3
Fish Health Sampling Procedures	2.7.1
Egg Treatments	2.7.2
Egg Disinfection	2.7.2.1
Egg Fungal Treatment	2.7.2.2
Anaesthetizing Fish	2.7.2.4
Euthanasia	2.7.2.6
Fish Health Emergency Procedures	2.9
Isolation and Quarantine	2.9.2.1
Fish Health Assessment for Fish Releases	2.11
Chemotherapeutant and Medicated Feed Handling & Storage	2.12.1
Administering Chemotherapeutants and Medicated Feed	2.12.2
α-MT Enhanced Fish	2.12.4
Broodstock Anaesthesia and Recovery	3.4.1
Broodstock Handling	3.4.2
Broodstock Treatments	3.5
Egg Take	3.6
Broodstock Screening	3.7

SOP 2.5.4 Equipment Disinfection

1. Purpose / Background

The objective of the SOP is to ensure that fish handling equipment is properly disinfected to avoid fish pathogen spread or introduction between rearing units or from watershed to culture facility via contaminated equipment.

2. Scope

This SOP is to be observed by all operators of equipment before and after use between rearing units of one facility in addition to between fish rearing facilities. Any equipment shared between biosecurity zones or units is disinfected after use and before the equipment leaves the biosecure zone or unit.

3. Roles & Responsibilities

Fish Health Unit

The FHU instructs what disinfectant is to be used under the existing regulations and appropriate conditions.

Hatchery Manager

The hatchery manager ensures all equipment is disinfected before leaving a facility or before transferred equipment is used at a new facility.

Hatchery Staff

Disinfection of equipment is the responsibility of the site staff. Staff are also responsible for maintaining proper disinfectant concentrations and for replenishing fouled or weak disinfection solutions.

Other

Visitors are responsible to the orders of hatchery staff regarding the disinfection of equipment brought to the facility.

4. Prerequisites

- MOE Discharge permits or other approved disposal method of spent disinfection liquids are required.
- Approved or adequate storage of the products are required.
- MSDS are available for anyone using the disinfection products; Hatchery Managers may insist on 'signing out' for reading the MSDS.
- Safety equipment in accordance with WCB is made available.

5. Procedures

Any equipment to be disinfected must be clean and free of biological materials.

5.1 The goal of equipment disinfection is to:

- Reduce the risk of spreading fish pathogens within a fish culture facility

- Reduce the risk of introducing fish pathogens from watersheds to the fish culture facility
- Reduce the risk of introducing and spreading fish pathogens between watersheds

5.2 Equipment to be disinfected:

- Fish handling equipment: dip nets, Pescalator, buckets, piping, gill nets, trap nets, net pens, sieves, bins, totes, coolers
- Fish culture equipment: dip nets, brushes, sieves, etc.
- Fish rearing units (small) that have a smooth, non-porous surface
- Fish sampling equipment: weight scales, dissecting equipment, cutting & measuring boards
- Field sampling equipment: boats, outboard engines, oars, anchor bags, net bags, floats, Secchi discs, ropes & lines, tarps, etc.
- Work/ transport vehicles
- Transport container/tanks: oxygen system: airstones, oxygen diffusers, oxygen lines
- Water quality equipment: DO meters, pH meters, thermometers, etc.
- Clothing: footwear, rain gear, waders, PDF's, gloves, etc.
- Any piece of equipment that falls on the floor, ground or unsanitary surface.

5.3 Disinfectants

5.3.1 Virkon

- Use for spots and small spills
- Follow manufacturer's instructions for solution preparation according to use:

TASK	DILUTION RATE	APPLICATION RATE
Footdips	1:100 (1%)	Replenish every 2-3 days or when heavily soiled or when the colour fades
Surface sanitiaztion	1:100 (1%)	300 mls per square metre
Vehicles	1:100 (1%)	Wheels of land based vehicles should be sanitized.
Equipment including nets, boots, waders, hoses, brushes	1:100 (1%)	• Soak for 20-30 minutes in Virkon S solution followed by rinsing with water. • No equipment should leave a facility without being sanitized • Equipment which is used at separate sites, tanks or ponds on a facility should be sanitized by placing equipment in a sanitizing bath when not in use and during transport

5.3.2 Hydrogen Peroxide (Peroxiguard, Hyperox)

- Rinse equipment to reduce organic matter (which will reduce efficacy of hydrogen peroxide)
- Submerse or fill used equipment in Peroxiguard (1:16) for 5 minutes
- For equipment too large to submerse, completely spray down and leave for 5 minutes
- Rinsing equipment is optional (breakdown product is water and oxygen)

5.3.3 Iodophore (Argentyne, Ovadine, Wescodyne, etc.)

- Rinse equipment to ensure no organic matter
- Submerse or fill used equipment in 250 ppm concentration for 30 min
- Rinse equipment with clean, freshwater
- Dry equipment thoroughly in sunlight or at 30°C
- Surface disinfect large equipment using 100% solution for 1h

5.3.4 Chlorine (5%, 12% or 66%-hypochlorite- active ingredient)

- Rinse equipment to ensure no organic matter
- Submerse or fill used equipment in 150L water containing 1.7L of household bleach for 15 minutes
- Use 100ppm for up to 12h on equipment, 24h on raceways
- Drain & rinse equipment thoroughly
- Neutralize chlorine solutions using sodium thiosulphate to excess.

5.4 Frequency

- Disinfect shared equipment (e.g. balances) between uses
- Disinfect equipment between use locations.

5.5 Responsibility

- All users of equipment are responsible for disinfection procedures and proper disposal of used disinfectants.

6. Training

Information regarding proper disinfection techniques is available at:

Virkon: http://www.vetoquinol.ca/en/index.asp?page=132
Hyperox: http://www.antecint.co.uk/main/hypox.htm
Peroxigard:
http://www.animalhealth.bayer.ca/display.cfm?Object_ID=303&Article_ID=78&expandMenu_ID=255
Iodophores: http://syndel.com/biosecurity/biosecurity_products.html

Aquatic Animal Health Standards Commission article on disinfection:
http://www.aphis.usda.gov/import_export/animals/oie/downloads/aahc_jan05/aahc_gen-rec-dis-1-05.pdf

7. Monitoring Requirements

- Inspect the treated equipment for visual signs of disinfection
- Dispose of the spent disinfection is an approved manner.

8. Record Management

- Record the use and disposal of disinfectants
- Notify the Hatchery Manager or designate of the completed disinfection and the equipment disinfected.

9. References

9.1. Standards

Internal standards for cleanliness as directed by the FHU and Hatchery Manager.

9.2. Other SOP/ SOGs

SOP 2.5.1 Site and Staff Disinfection.

9.3. Supplementary Documents

The FHU and the hatchery office have information on file regarding disinfectants including the MSDS for each product.

10. Definitions

None.

SOP 2.2.5 Feed Storage

1. Purpose / Background

The purpose of this SOP is to preserve and ensure the nutritious value of fish feed used in fish culture. Fish feed contains proteins, fats, carbohydrates, vitamins and minerals that are essential for continued fish growth, health and well-being; proper storage of feed is important to protect feed integrity. Storage areas must be temperature controlled, ventilated, free from direct sunlight and free from rodents or other pests.

2. Scope

This SOP is relevant to all personnel involved with fish feeding and care. Staff who receive feed supplies and shipments from suppliers and who remove feed from the feed storage area must be familiar with these procedures.

3. Roles & Responsibilities

Hatchery Manager

- Ensure that feed is stored in correct environment and facilities
- Ensure feed is ordered and delivered as needed in the proper amount
- Oversee delivery and storage
- Ensure records are maintained

- Ensure that all storage areas are maintained and clean

Hatchery Personnel

- Ensure clean, correct storage of feed
- Recording of feed inventory is current
- Environmental monitoring

4. Prerequisites

None

5. Procedures

The objective of this SOP is to acquire, maintain and provide the best feed available for fish under FFSBC care.

5.1 Equipment

- Fork lift, pallet jack or other pallet moving device
- Refrigerated storage area
- Containers for open-source supplies of feed (part bags)
- Cleaning and disinfecting equipment

5.2 Methods

- Prepare the feed storage area prior to delivery (clean and disinfect if directed; see SOP 2.5.1 Site and Staff Disinfection)
- Rotate current stock prior to delivery
- Inspect for integrity of the shipment (broken bags, rodent/bird damage etc.)
- Receive feed delivery
- Organize types and sizes according to directions from the Hatchery Manager
- Sign for delivery
- Report delivery

5.3 Regular maintenance

- Record temperature in the feed storage area as required
- Adjust refrigeration as required to maintain a temperature of 2-10°C
- Clean the feed storage area and dispose of spilled feed
- Maintain inventory records
- Visually inspect area for cleanliness and clean/disinfect as required (SOP 2.5.1 Site and Staff Disinfection)
- Inspect for pest control

5.4 Adverse conditions

- If temperatures exceed 35°C and alarm sounds, notify Hatchery Manager
- Record broken bags or spilled feed and notify Hatchery Manager
- Observe and record any pest damage or presence of pests to Hatchery Manager
- Report any deviation in feed use or storage to Hatchery Manager

6. Training

Training is supplied on the job through supervised experience.

7. Monitoring Requirements

- Monitor and record temperature as directed
- Inspect the storage area daily for cleanliness and security
- Record feed usage
- Maintain proper feed inventory to assure continuous supply of high-quality fish feed

8. Record Management

- Record all feed orders and deliveries.
- Record all feed usage.

9. References

See feed manufactures' instructions on storage and care of feed. This can be by asking the feed sales person or the company website.

9.4. Other SOP

SOP 2.5.1 Site and Staff Disinfection

10. Definitions

None.

SOP 2.2.5.5 Fish Weight Sampling

1. Purpose / Background

The maintenance of accurate and optimal feeding rate is important to fish health and growth. Accurate feeding rates are determined by measuring biomass of the rearing unit and feeding the fish to a prescribed daily rate. This SOP defines the methods for fish weight (biomass) measurement in a rearing unit.

2. Scope

This SOP is for use among staff involved in determining the biomass of rearing units.

3. Roles & Responsibilities

Fish Health Unit Manager

Ensure that the data acquired by this method fits the need of data acquisition for the purposed of sound fish health management. The FHU also monitors the safe and humane handling of fish.

Hatchery Manager

Ensure that the procedures are carried out in a safe, humane and accurate manner.
Ensure the data is recorded into the hatchery log and PARIS.
Ensure that feeding rates are adjusted accordingly.

Hatchery Staff
Perform fish biomass sampling diligently and to the level of expertise that ensures fish are treated safely and humanely in a fashion that does not negatively affect fish health.

Other
Visitors and others are not permitted to perform sampling for fish biomass unless under the direct and express authority of the Hatchery Manager.

4. Prerequisites

The equipment used in this SOP must be of a manufacture that permits thorough cleaning and disinfection (see: SOP 2.5.1 Site and Staff Disinfection; SOP 2.5.4 Equipment Disinfections). The scale used must be of a reliable manufacture and condition and tested for accuracy (1litre water at 15°C = 1kg).
Staff conducting fish weight samplings must have experience in the procedure.

5. Procedures

The goal of this SOP is to ensure the safe and accurate measurement of fish biomass. Anaesthesia is not indicated in sampling due to the short time involved for each sample (<20min per rearing unit). It is the considered opinion of the FHU and Managers that anaesthetizing fish prolongs the time of confinement in the crowded section of the rearing unit which creates stress and increases the risk of trauma and scale loss. As well, anaesthetics are a progenitor of the stress response which in the opinion of the FHU and Managers is a greater risk than working quickly.

5.1 Equipment

- Stable platform for balance
- Battery powered balance or if 110V scale:
    - Safe electrical connection with ground-fault interrupt
- Small container to tare water and weigh fish
- Dipnet
- Crowder
- Disinfection materials
- Recording materials.

5.2 Method

1. Starve fish the day of the sampling until the rearing unit is sampled
2. Determine number (from inventory) of fish to be sampled from each rearing unit based on:
    - 1% of fish in a small trough
    - 0.5% of fish in a raceway
    - 0.5% of fish in a circular tank
3. Set up balance adjacent to the rearing unit
4. Tare the container and water
5. Record mass of container and water
6. Crowd the fish using a movable barrier or fence
7. Dipnet approximately 10 fish; drain excess water
8. Transfer fish to the container on the scale
9. Record mass of water, container and fish

10. Transfer fish in container to the unoccupied section of the rearing unit
11. Release fish in a manner that permits counting
12. Record the number of fish released
13. Note any fish health concerns
14. Repeat Methods 4-13 until the target number of fish has been sampled
15. Clean and disinfect equipment between rearing units (see SOP 2.5.4 Equipment Disinfection)
16. Repeat 3-15 for subsequent rearing units
17. Record all information in the hatchery log and PARIS.

5.2.1 Alternative Method

- Observe biosecurity protocols throughout this procedure
- Crowd the fish using a movable barrier or fence, and/or by drawing down the water level
- Place a sample count bucket on the scale, add water and tare
- Remove a random sample of 250 fish (minimum) from the rearing unit using a dipnet
- Drain excess water
- Transfer the fish to the sample count bucket
- Record the weight on a sample count data sheet
- Count fish from the sample count bucket back during transfer to an appropriate recovery container
- Record the number of fish transferred on the sample count data sheet
- Calculate the number of fish per kg of weight
- Repeat 2 more times or until 3 sample weights are obtained that deviate amongst each other by no more that 3% for each rearing unit
- Calculate the average of the 3 sample weights
    - The resultant value is deemed to be the average weight of fish in the container expressed as #fish/kg.
    - The average weight of fish in grams can also be calculated from the #fish/kg value.
- Check the sampled fish to ensure full recovery.

5.3 Frequency

- Conduct the fish biomass sampling every two (2) weeks
- Abstain from sampling fish under quarantine or undergoing medication
- Sample large (>1kg) brood fish as only when directed by the Hatchery Manager.

6. Training

Personnel must receive instruction from experienced staff and obtain the Manager's approval before assisting or conducting fish sampling for biomass. Anyone involved in this procedure must read and understand this SOP.

7. Monitoring Requirements

Fish biomass is conducted on all 'production' rearing units on a bi-weekly basis. This is to ensure that the feeding rate is adjusted to meet the demands of fish growth, health and welfare. All information from fish biomass sampling is to be recorded in the hatchery log and in PARIS. Calculations of rearing unit biomass and feed rate will be supervised by

the Hatchery Manager or designate. Adjusted feeding rates will be posted accordingly and updated as soon as possible, usually within 24h.

8. Record Management

Information from the fish biomass sampling is recorded diligently in the hatchery log and in PARIS. Any fish health concerns are brought to the immediate attention of the Hatchery Manager and as directed, the FHU. Rough data are archived or disposed of on authority of the Hatchery Manager.

9. References

9.5. Standards

Balances should be calibrated by a qualified technician on an annual basis.

9.6. Other SOPs

SOP 2.3.1 Common Fish Handling Techniques
SOP 2.5.1 Site and Staff Disinfection
SOP 2.5.4 Equipment Disinfection

10. Definitions

Tare: set the balance to zero using the 'Tare' function after placing the container plus water on the balance
or
record the mass of the container and water prior to adding fish
Biomass: the collective mass (weight) of all fish in a rearing unit

SOP 2.3.1 Common Fish Handling Techniques

1. Purpose / Background

Sampling, transferring and grading fish – in that order – are the primary fish handling practices conducted commonly at FFSBC hatcheries. The purpose of this SOP is to standardize these practices in order to maximize efficiency and fish health and welfare.

SOP 2.2.5.5 Fish Weight Sampling addresses the procedures for routine sampling of fish for the purpose of obtaining fish weights and biomass. Other sampling procedures include fish health sampling that is undertaken in the event of a fish health emergency (see SOP 2.9 Fish Health Emergency Procedures), a fish health assessment prior to transport and release of fish (see SOP 2.11 Fish Health Assessment for Fish Release) or for a fish health assessment for a fish health incident report (see SOP 2.7.2 Fish Health Sampling). Likewise, handling fish may be done during euthanasia and depopulation (see SOP 2.7.2.6 Euthanasia). In each of the cases, as indicated, there are specific SOPs that define the proper procedures.

In a similar fashion, the mass transport of fish for stocking purposes (aka liberation) or transfer between facilities is detailed in SOP 2.5.6 Fish Transport.

In this SOP 2.3.1 Common Fish Handling Techniques, the procedures for small-scale sampling are detailed in addition to transfers between rearing units.

The grading of fish is a seldom-performed technique that is used when a bi-modal distribution of size exists and persists within a population of fish in a particular rearing unit. This task is undertaken to ensure that fish health and feeding are optimized for larger and smaller size distributions of fish. The grading of fish is not done using anesthetics (SOP 2.7.2.4 Anesthetizing Fish) because the cumulative stress induced by the anesthetic (TMS) in addition to handling is greater than that of the quick and skilled capture and transfer of fish from the rearing unit to the grader to the new rearing unit. In the opinion of the FHU and the hatchery managers, it is in the best interest of the fish to conduct fish grading without the use of fish anesthesia.

2. Scope

This SOP applies to all personnel who will handle fish.

3. Roles & Responsibilities

Fish Health Unit Manager
The FHU oversees the health and welfare issues of FFSBC hatcheries and as such has a vested interest in the common techniques of handling fish.

Hatchery Manager
The Hatchery Manager ensures that the FFSBC staff are competent in the execution of common fish handling techniques to maximize fish health and welfare.

Hatchery Staff
The staff are responsible to handle fish in a safe manner that respects fish health and welfare.

Other
Non-FFSBC staff may be permitted to handle fish when authorized by the Hatchery Manager.

4. Prerequisites

4.1 Equipment

4.1.1Sampling

- For biomass sampling see SOP 2.2.5.5 Fish Weight Sampling
- For fish health sampling see SOP 2.7.2 Fish Health Sampling
- For all other `quick view` or instantaneous inspections, the following equipment is useful:
    - Sieve or dipnet
    - Clear container to view fish
    - Disinfectant
    - Recording equipment (notebook etc)

4.1.1.1`Button-up`

- Sieve, clear container or dipnet

- Clear container to view fish
- Disinfectant
- Recording equipment (notebook etc)

4.1.1.2 Inspection
- Sieve or dipnet
- Clear container to view fish or bucket to view from above
- Gloves if fish are to be manually handled
- Euthanasia equipment if fish are to be killed (see SOP 2.7.2.6 Euthanasia)
- Anaesthetic equipment if fish are to be immobilized (see SOP 2.7.2.4 Anesthetizing Fish)
- Disinfectant
- Recording equipment (notebook etc)

4.1.2 Transfers
4.1.2.1 Transfers from incubation to first-feeding troughs (small troughs)
- Sieve or dipnet
- Container to catch dripping water
- Gloves
- Recording equipment (notebook etc.)

4.1.2.2 Transfers from small to large troughs
- Dipnet
- Bucket or small container
- Gloves
- Disinfectant
- Recording equipment (notebook etc)

4.1.2.3 Transfers from trough to raceway or tank
- Dipnets
- Buckets or large tote
- Forklift or trolley
- Gloves
- Disinfectant
- Recording equipment (notebook etc)

4.1.2.4 Transfers between larger rearing units
- See SOP 2.5.6 Fish Transport

4.1.3 Grading
- Dipnet
- Grader
- Bucket or small container
- Gloves
- Disinfectant
- Recording equipment (notebook etc)

4.2 Permits
- Transport and Fish Health certificates as required and directed by the FHU

4.3 Fish Health Sampling
- See SOP 2.7.2 Fish Health Sampling

5. Procedures

5.1 Sampling

5.1.1 `Button-up`
- Pull tray from stack
- Open tray lid slowly
  or
- Decrease water flow to incubation unit (jar or basket)
- Dip alevins from the tray using sieve, clear container or dipnet
- Place alevins in container
- Fill clear container with incubation water
  - View status of yolk sac absorption
  - Rate percent of absorption
  - Prepare to transfer to troughs if 95% absorption achieved
- Replace alevins in incubation container
- Ensure water flow to incubation container
- Record observations

5.1.2 Inspection
- Fill container with appropriate amount of water from rearing unit inflow
- Crowd fish if necessary or feed fish to attract
- Target moribund fish or fish that are visibly not alert
- Transfer fish to observation container
  or
- View fish in dipnet for less than 15 seconds
- Return fish
  or
- Euthanize fish (see SOP 2.7.2.6 Euthanasia) and view
  - Classify mortality (see SOP 2.7.1Mortality Classification)
  - Dispose of mortality (see SOP 2.6.4 Mortality Disposal)
- Record observations

5.2 Transfers

5.2.1Transfers from incubation to first-feeding troughs (small troughs)
- Prepare receiving trough
- Ensure trough water flow is correct, screens are in place and drains are secure
- Pull tray from stack
- Drain excess water
- Transfer complete Heath tray unit to trough
- Remove lid
- Release alevins underwater
- Ensure disinfection procedures are followed (see SOP 2.5.1 Site and Staff Disinfection; 2.5.4 Equipment Disinfection)
- Record activities and observations when complete

5.2.2 Transfers from small to large troughs

- Prepare receiving trough
- Ensure trough water flow is correct, screens are in place and drains are secure
- Reduce water flow to small trough
- Drain to reduce water level
- Crowd the fish using the mobile crowder or trough partition
- Fill transfer container with trough inflow water
- Transfer crowded fish from small trough to transfer container
- Minimize time in the transport container
- Transfer to new large trough
- Lower transfer container as close as possible to the large trough water level to limit the drop height
- Release fish
- Repeat as required
- Ensure disinfection procedures are followed (see SOP 2.5.1 Site and Staff Disinfection; 2.5.4 Equipment Disinfection)
- Record activities and observations

5.2.3 Transfers from trough to raceway or tank

- Prepare receiving rearing unit
- Ensure new rearing unit water flow is correct, screens are in place and drains are secure
- Reduce water flow to current rearing unit
- Drain to reduce water level
- Crowd the fish using the mobile crowder or trough partition
- Fill transfer container with trough inflow water
- Transfer crowded fish from small trough to transfer container
- Minimize time in the transport container
    - If fish are to be in the transfer container for more than 5 min, supply supplemental air or oxygen
- Transfer to new rearing unit
- Lower transfer container as close as possible to the large trough water level to limit the drop height
    - If using a container on a fork lift raise the container over the new rearing unit
    - If transfer container is equipped with a drain hose, position hose under water in the new rearing unit
    - Release valve to transfer fish
- Release fish
- Repeat as required
- Ensure disinfection procedures are followed (see SOP 2.5.1 Site and Staff Disinfection; 2.5.4 Equipment Disinfection)
- Record activities and observations

5.2.4 Transfers between larger rearing units

- Follow procedures for 5.2.3 Transfers from trough to raceway or tank (above)
- Ensure disinfection procedures are followed (see SOP 2.5.1 Site and Staff Disinfection; 2.5.4 Equipment Disinfection)

5.2.5 Transfers for liberation or between facilities

- See SOP 2.5.6 Fish Transport

6. Training

Staff must receive training in the form of supervised experience and approval of the Hatchery Manager prior to committing these duties.

7. Monitoring Requirements

The frequency of performing duties detailed here are under the direction of the FHU and the Hatchery Manager.

Post handling mortality and fish health observations are to be reported in the hatchery log and PARIS. Any rapid increase in daily mortality rate is reported to the Hatchery Manager.

8. Record Management

All activities for any fish stock handling is recorded in the hatchery log and PARIS.

9. References

9.7. Standards

Ensure all relevant permits and health information is correct before transporting fish.

9.8. Other SOPs

SOP 2.2.5.5 Fish Weight Sampling
SOP 2.5.1 Site and Staff Disinfection
SOP 2.5.4 Equipment Disinfection
SOP 2.5.6 Fish Transport
SOP 2.6.4 Mortality Disposal
SOP 2.7.1Mortality Classification
SOP 2.7.2 Fish Health Sampling
SOP 2.7.2.6 Euthanasia
SOP 2.7.2.4 Anesthetizing Fish

9.9. Supplementary Documents

See hatchery specific information in hatchery manuals or on the FFSBC intraweb.

10. Definitions

Button-Up: absorption of the yolk sac
95% Button-Up: only a small sliver of yellow yolk sac remains on the belly of the fry

SOP 2.3.2 Marking Fish

1. Purpose / Background

The marking of fish is by removing or clipping the fins and on occasion, part of the fleshy maxillary (jaw) of the fish. These procedures are done on anaesthetized fish by qualified individuals. The objective of the SOP is to ensure that fish marking methods cause a minimal amount of stress to the fish, minimize direct and indirect trauma and ensure that long-term survival and productivity is not adversely affected by marking methods. There

are two instances of marking fish: small and large groups. Small groups of fish meaning one or two rearing units or a rearing unit of a particular strain of fish are marked by FFSBC staff. Larger groups of fish where numbers are in the thousands or tens of thousands, fish are marked by qualified professional contractors.

2. Scope

This SOP is relevant to all staff involved in the preparation for and the assistance in, marking fish. Only experienced and trained staff may mark fish.

3. Roles & Responsibilities

Fish Health Unit Manager

The FHU will conduct follow-up investigations on the health of fish post-marking if requested by the Hatchery Manager. The FHU will ensure that necessary anaesthetics are available and provided.

Hatchery Manager

The Hatchery Manager ensures that fish to be marked are in a healthy state and are marked safely and effectively. The Hatchery Managers ensures that drugs are handled and used according to established procedures and that safety equipment is available and in good working order (see SOP 2.12.1 Chemotherapeutant and Medicated Feed Storage and Handling; 2.7.2.4 Anaesthetizing Fish). In addition, the Hatchery Manager must be satisfied that the Contractor is of sufficient experience to mark fish and has observed biosecurity procedures (see SOP 2.5.1 Site and Staff Disinfection; SOP 2.5.2 Visitor Biosecurity; SOP 2.5.4 Equipment Disinfection).

Hatchery Staff

Only experienced and trained staff may mark fish. Other staff may participate. All staff must adhere to safety precautions when using anaesthetics and sharp tools on fish.

Other

Contractors operate under the guidance of the Hatchery Manager.

4. Prerequisites

Fish health of the stocks to be marked must be confirmed with the FHU.
Drug prescriptions must be verified.
Staff must have read and understand MSDS for chemicals used.

5. Procedures

5.1 Equipment

All equipment must be clean and disinfected before use (see SOP 2.5.4 Equipment Disinfection)

- Anaesthetic bath containers (buckets, garbage pails, etc)
- Latex or nitrile gloves
- Dip nets, sieves, trough nets (small containment nets to fit in the trough)
- Anaesthetic
- Oxygen tanks, tubing, DO meter, stones
- Surgical equipment: scissors

- Disinfection dip for scissors
- Recording equipment

5.2 Small groups marked by FFSBC staff

- Follow preparation procedures to crowd fish as detailed in SOP 2.2.5.5 Fish Weight sample
- Prepare rearing unit to accept fish
    - If fish are crowded to one area of a rearing unit, it is permissible to mark fish and return them across a barrier of the same rearing unit
    - Ensure marked and unmarked fish are not mixed
- Anaesthetize fish in a container (see SOP 2.7.2.4 Anaesthetizing fish)
    - Anaesthetize fish in amounts that will be handled in a timely fashion
    - Use two anaesthetic baths to minimize delays if desired
- Remove fish from anaesthetic bath with a gloved hand or dip net
- Orient fish in hand with head pointing away and belly to the palm of the hand
    - Ensure adipose fin is exposed or
    - Ensure mouth is open to expose left or right maxillary palp (fleshy part of the upper lip)
- Slide scissors along anteriorly (tail to head) on the dorsal aspect of the fish (back ridge) to capture the adipose fin in the 'V' of the scissors

  or
- Slide scissors along the operculum of the fish (cheek or gill cover) and catch the maxillary palp (fleshy part) in the 'V' of the scissors
- Snip the dorsal fin
    - Apply forward pressure to insure the scissors cut
    - Fins are wet and may slide out of the scissors

  or
- Snip the maxillary palp (fleshy part) along the margin of the maxillary (lip) of the fish
- Replace fish in clean water to recover (rearing unit)
    - Place fish in water; do not drop
- Repeat as needed
- Disinfect all equipment and surfaces on completion (see SOP 2.5.1 Site and Staff Disinfection; SOP 2.5.4 Equipment Disinfection)
- Dispose of spent anaesthetic and disinfectants in approved manner
- Record results.

5.3 Contractor

- Follow procedures as details above ***5.2 Small groups marked by FFSBC staff***
- Assist in equipment set up for Contractor
- Assure fish and personnel safety
- Marking is done by contractor
- Assist contractor as directed
- Follow clean up and disinfection as for ***5.2 Small groups marked by FFSBC staff***
- Dispose of spent anaesthetic and disinfectants in approved manner
- Record results

6. Training

Training is done by observation that progresses to hands-on instruction.

7. Monitoring Requirements

Monitor recovery of marked fish; record any observations.

8. Record Management

The following information is entered into the hatchery log and PARIS:

- Date fish are marked
- Number of fish marked
- Concentration of anaesthetic used
- Rearing container number/type
- Fish health concerns
- Date of fish liberation
- Other pertinent observations

9. References

9.10. Standards

Observe regulations regarding anaesthetic use and waste disposal of anaesthetics and disinfectants.
Observe MSDS precautions.

9.11. Other SOPs

SOP 2.2.5.5 Fish Weight Sampling
SOP 2.5.1 Site and Staff Disinfection
SOP 2.5.2 Visitor Biosecurity
SOP 2.5.4 Equipment Disinfection
SOP 2.7.2.4 Anaesthetizing Fish
SOP 2.12.1 Chemotherapeutant and Medicated Feed Storage and Handling

9.12. Supplementary Documents

See anaesthetic and disinfectant manufacturers' website for product details.

10. Definitions

Adipose fin: literally 'fat fin' the most tailward fin on the back of a salmonid (tail excepted); it has no fin rays, hence a 'fat fin'
Dorsal: back (as opposed to belly)
Anteriorly: to move from the tail to the head.

SOP 2.3.3 Air Transport

1. Purpose / Background

This SOP covers general procedures for the liberation of fish transported with the use of aircraft. It augments the information in SOP 2.5.6 Fish Transport.

Special Note: Hatcheries may have different procedures and equipment for loading and releasing fish involving aircraft. This is because the equipment is specialized for specific applications and all the hatcheries do not use the same equipment type or aircraft provider. For this reason, each hatchery involved with air transport of fish for liberation will provide staff with a detailed procedures document that are available from the Hatchery Manager as required. This document is kept in the Hatchery Manager's office and is accessed by permission.

2. Scope

All staff involved in the transport of fish using aircraft for delivery must read and understand this SOP.

3. Roles & Responsibilities

Fish Health Unit Manager

As required, the FHU oversees the pre-transport fish health evaluation and reviews results if a concern is indicated from prior fish health history.

Production Manager

Ensures that the:

- FHU has signed off on the fish to be transported (as required).
- Introductions and Transplant Committee has approved the fish transport if required.
- Transporting hatchery has followed fish health monitoring procedure prior to transport if required.

Hatchery Manager

- Conducts the pre-transport fish health inspection if required (SOP 3.7.1 Fish Health Sampling) and communicates with the FHU.
- Obtains the necessary permits for transport as required.
- Oversees the loading and transport operations.

Hatchery Staff

- Conducts the pre-transport Fish Health Monitoring procedure (if required).
- Conducts or assists with the transport.
- Ensures all equipment is prepared and in good working order.
- Observes all fish culture protocols relating to transport.

4. Prerequisites

A transfer permit may be needed before fish can be moved. See SOP 2.5.6 Fish Transport for procedures.

5. Procedures

5.1 Preparation

- Starve fish for 1 – 2 days prior to transport
- Prepare fry cans with oxygen rings, carrying handles and name tags (i.e. lake name and number/species/stock of fish
- Set up shuttle truck with:

  - oxygen rack,
  - oxygen bottles (size Q),
  - regulator,
  - wrench,
  - gang valves (for oxygen delivery to containers)
  - lids (for fry cans) and
  - straps (for securing fry cans)
- Prepare an aircraft kit:
  - Spare regulator
  - Wrench
  - Spare Tygon rack
  - Plastic T's
  - Copper connectors
  - Pliers
  - Sieves
  - Small graduated bucket (for weigh outs)
  - Large plastic beaker (to tare weight out of bucket)
  - Bungee cords, straps (for securing oxygen bottle)
- Performed sample counts on the stock of fish to be transported
- Determine fish size and the number of fish to be transported (see SOP 2.3.1 Common Fish Handling Techniques).
  - Perform sample counts on day of release or afternoon before
  - Handle fish carefully to reduce skin or scale damage and stress.
- Locate release sites (lakes) on maps and record latitude and longitudes on the liberation sheet
- Input this information into either the helicopter GPS or handheld GPS (available at the hatchery)
- Arrange a meeting time with helicopter
  - Inform pilot of type of work to be done and location of release sites
  - Inform pilot that buckets of fish will be loaded and water may be spilled in the process
  - Inform pilot that back seats and one back door of the helicopter may need to be removed
  - Inform pilot that oxygen bottle will be installed in aircraft

5.2 Loading transport containers (fry cans)

- Arrange fry cans in order to be loaded with name tags and information attached to buckets
- Have truck equipment ready for loading by feeding tygon lines from the gang valve through the fry can lids and connecting them to the oxygen ring (one per bucket)
- Place fry can on scale and tare with water
- Transfer fish into the fry cans using a dipnet
  - Keep fish handling equipment wet to minimize abrasions and loss of scales or mucus
  - Avoid excessive loads of fish in nets or other loading equipment