Department of Fisheries and Oceans Salmon Enhancement Program

Chilliwack River Salmon Hatchery

Fish Health Management Plan

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1 Introduction

1.1 Objective

In 2005, the National Aquatic Animal Health Program (NAAHP) was implemented. The purpose of the NAAHP is to reduce incidence and transmission of infectious agents at all levels of fish culture to meet international aquatic animal health management standards that are required to protect Canadian aquatic resources (wild and farmed).

With the NAAHP requirements in place, this Fish Health Management Plan provides best management practice guidelines for maintaining optimal health conditions for cultured fish to meet the current NAAHP requirements. All Salmonid Enhancement Program (SEP) facilities and those facilities partially funded or associated with DFO must maintain an up-to-date Fish Health Management Plan (FHMP) specific to their facility

This document should be reviewed annually by staff to ensure that it is current and changes should be made as necessary.

1.2 Target Audience

This document is intended for use by the fish culture staff at each SEP (or DFO associated facility) site for managing fish health and enabling an informed fish health decision making process. This document also serves as a valuable staff training tool.

1.3 Document Structure

Sections 1 and 2 contain general statements applicable to the operation of all Fisheries and Oceans Canada hatcheries involved in the enhancement of Pacific salmon in British Columbia.

Section 2 outlines the general principles of fish health management:

- Keeping the fish healthy and maintaining an optimal environment
- Keeping pathogens out
- Keeping disease from spreading
- Maintaining good records of appropriate information
- Minimizing impacts on natural populations
- Minimizing impacts on the receiving environment

Section 3 provides a brief overview of this particular facility.

Section 4 details the Standard Operating Procedures (SOPs) for fish health management practices for Pacific salmon culture that are specific to this facility.

Note: The focus of our work is the production of juvenile Pacific salmon for stock enhancement purposes. Netpen holding is limited to a handful of our facilities, which have the infrastructure and historical evidence of improved survival following a brief period of acclimation to a semi-natural environment. Additionally, this production strategy allows imprinting to a watershed for the eventual return in support

of recreational fisheries in the areas whose natural spawning and rearing habitats are compromised. Specific netpen practices should be included in the Section 4 SOPs where appropriate. Where indicated, Appendixes are included containing ancillary documents pertinent to the operation of the specific facility.

A glossary is provided in the Appendices to assist in defining terms that may not be familiar to staff.

Revisions to this document should be recorded to ensure the ability to track modifications to procedures.

1.4 Fish Health Management Team

Personnel duties and responsibilities: The Fish Health Management Team is comprised of the entities as defined below. The authority to alter the Standard Operating Procedures contained within this document lies with the Fish Health Management Team and should occur in a consultative process. The responsibility for carrying out the procedures defined within this document correctly and according to the individual protocol lies with the staff who have been trained in the individual procedures.

1.4.1 Hatchery Management

The hatchery managers are responsible for identifying and managing disease-related risk factors to minimize their impacts on fish health. The hatchery managers consult with the Veterinarian and DFO biologists on the management of fish health issues and is responsible for reporting outbreaks of significant diseases to other sites in the geographic vicinity and to the proper authorities.

1.4.2 Hatchery Staff

On-site staff is responsible for day-to-day fish health management, according to this Plan and the hatchery manager's directions.

1.4.3 Support Biologists/Community Advisors

Fisheries and Oceans biological support staff is available for consultation and to serve as a liaison between hatchery facility staff and the Enhancement Support and Assessment Unit. Community Advisors liaison between hatchery facility staff and their Community groups.

1.4.4 Veterinarian

A licensed Veterinarian, in conjunction with facility and biological support staff, oversees fish health management for the SEP facilities. The Veterinarian, supported by the Pacific Biological Station Fish Pathology Laboratory, is expected to exercise good professional judgment in fish health matters. Specific duties include site visits, diagnostic workups for fish, treatment advice, and disease prevention and control recommendations. Where applicable, the Veterinarian will report disease findings to relevant authorities.

1.4.5 Contact names and numbers

Contact names and numbers for all key fish health personnel, including emergency numbers, are posted in an easily identifiable location at each site.

Contacts for this site:

Hatchery phone	604-858-7227
Hatchery pager	604-702-7318
Standby phone:	604-819-0963

Hatchery staff list:

Bob Stanton	604-858-0175
Ron Valer	604-858-6534
George McElwee	604-824-4652
Peter Buck	604-858-2278
Jim Donaldson	604-823-6745
Kelly Dover	604-792-6757
Lorayne Tritschler	604-792-1336
Lynn Harper	604-795-9848
Clay Thornton	604-858-7310

Alarm Monitoring company	
Praetorian Security	604-795- 5510/ 604-859-0701

Emergency Police, Fire Department and Ambulance	911
Non Emergency Police	604-792-4611
Non Emergency Fire	604-858- 9986/604-792-8713
Ambulance Service	604-792- 4621

D.F.O. CONTACT PHONE NUMBERS

D.F.O. Community Advisor (Mark Johnson)	604-824-4715/ 604-619-3625
D.F.O. Veterinarian (Dr. Christine MacWilliams)	250-729-8377
Fisheries Officer (Doug Clift)	604-824-3315
Observe, Record & Report Fishing/Habitat Violations	800-465-4336
Conservation Officer Service (Provincial Violations)	800-663-9453
Pacific Biological Station	250-756-7057
	250-756-7069

1.5 Definitions

Adipose fin: the small fin on the back of a salmonid, located between the dorsal fin and the tail. Excision of this fin provides a visual means to differentiate between wild and hatchery-produced fish.

Anaesthesia: A state of unconsciousness produced by anaesthetic agents, characterized by absence of pain sensation and varying degrees of muscle relaxation. This state is suitable for painful procedures like

surgery, but requires greater monitoring as over-anaesthesia may be life-threatening if fish are unable to adequately respire.

Aneurysm: Weakness or injury to the wall of a blood vessel causing dilatation or ballooning and, in severe cases, threatening the integrity of the circulatory system resulting in haemorrhage or stroke. A weakened point of an artery, vein or the heart.

Aquacalm™: Metomidate hydrochloride is a useful sedative for broodstock transport and handling. This product is not intended for use in fish intended for human consumption; no withdrawal period has been established.

Biosecurity: Biosecurity refers to an integrated strategy to assess and manage the risks that threaten animal health, human health, food safety, and the environment.

Broodstock: a male or female breeding animal

CFIA – Canadian Food Inspection Agency

Clove Oil: This is a Generally Regarded As Safe (GRAS) human food additive containing the anaesthetics eugenol and isoeugenol, but whose pharmacology and metabolites are not well understood in fish. Neither clove oil nor its active ingredients are licensed for use in fish in Canada and its use is not recommended

CO_2: Carbon dioxide is a common anaesthetic in harvesting operations. As it naturally occurs in all animals, CO_2 is safe for the operator, the consumer and the environment and is not subject to a withdrawal time. However, hyperactivity is common with this chemical and it is difficult to reach deeper anaesthetic planes suitable for invasive procedures.

Coded wire tag: a wire tag imprinted with a binary code. From the year 2000 onwards coded wire tags are etched in numbers. I.e. decimal coded wire tags.

Euthanasia: The deliberate ending of the life of an animal in an easy or painless manner.

Gametes: Male or female reproductive cells - the sperm or the egg

Hyperox™ : Trade name of a disinfectant chemical containing per acetic acid, acetic acid, hydrogen peroxide and a surfactant.

Immunocompetent: Immunocompetence is the ability of the body to produce a normal immune response (i.e., antibody production and/or cell-mediated immunity) following exposure to an antigen. Opposite of immunodeficiency.

Isolation: Isolation refers to the separation of animals which have a specific infectious illness from those which are healthy and the restriction of their movement to stop the spread of that illness.

ITC: Introduction and Transfers Committee – an intergovernmental committee that regulates the movement of live aquatic animals throughout British Columbia

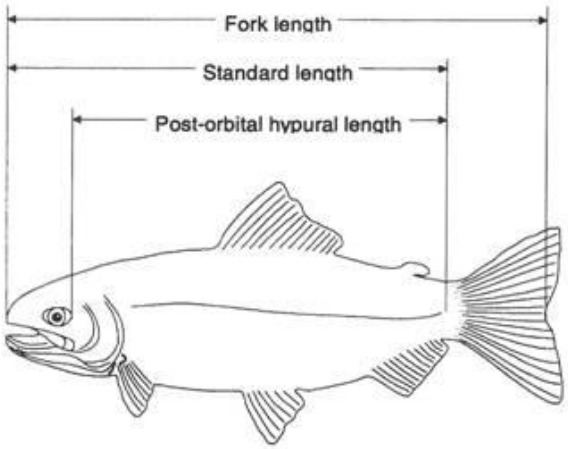
Length:

Fork Length: The distance from the anterior aspect of the snout (or upper lip) to the tip of the medial caudal fin ray

Post-orbital length: The length of the fish from the posterior aspect of the eye to the end of the caudal base. The caudal base is found by moving the caudal fin laterally against the fish's body; a crease will appear at the junction of the hypural bones and the fin rays.

Standard Length: The distance from the anterior aspect of the snout (or upper lip) to the end of the caudal peduncle (the caudal base).

Total Length: The length from the anterior aspect of the snout (or upper lip) to the posterior tip of the longest caudal fin ray when the caudal fin is spread in a 'natural' position.



Margin of Safety: A measure of safety of a drug representing the range between the effective dose and the dose producing toxic effects. A low margin of safety indicates an increased risk of adverse side effects.

Micropyle: The specialized channel on an egg which enables a single sperm to swim down through the egg's surface and fertilize it

Moribund: fish in a dying state

Mort: a dead fish

Otolith: the bones of the inner ear of a fish. Controlled temperature manipulation during incubation of eggs or alevins will result in a distinguishable banding pattern on the otoliths. This technique is valuable for return stock assessments.

Outbreak: an unexpected occurrence of mortality or disease

Ovadine™: Trade name of a disinfectant chemical containing a buffered10% polylvinylpyrrolidone iodine (PVPI) solution in water. It may be used to disinfect equipment or fish eggs. Use on fish eggs is currently being monitored by Health Canada.

Parasite-S™: Trade name for an anti parasitic, formalin-based solution that is commonly used against parasitic and bacterial gill disease including those caused by the protozoans *Ichthyobodo* (Costia) and *Trichodina*. It is also a standard disinfectant used in hatcheries for the prevention and treatment of egg fungal infections.

Perivitelline fluid: The perivitelline space is the area roughly between the yolk/embryo and the egg membrane. The perivitelline fluid fills this space.

ppm: parts per million, equivalent measurement to mg/L (milligrams per liter) or µl/L (microliters per liter)
Prevalence: the total number of cases of a specific disease in existence in a given population at a certain time

Quarantine: Quarantine refers to the separation and restriction of movement of animals which, while not yet ill, have been exposed to an infectious agent and therefore may become infectious. Strict separation of infected or potentially infected fish from healthy populations, including their products or items they might have contaminated, their effluent, feed and handling equipment, must occur for a period no longer than the longest incubation period for the infectious agent(s) of concern. Staff access is strictly controlled and requires heightened biosecurity measures. Release from quarantine requires veterinary approval.

Ripeness: having arrived at such a stage of development as to be ready to spawn

Rostral: the nasal/snout region

Saprophyte: An organism that commonly feeds on dead organic material, usually by decomposing and absorbing it, and assisting in its decay. Saphrophytes, in certain circumstances, may attack living hosts (eg, those weakened by primary pathogens or stress) and become pathogens. Most fungi are saprophytes.

Sedation: Chemical suppression of the central nervous system to allay irritability or excitement. Sedation is appropriate for minimally distressing events like transport, vaccination, marking, etc. and as a pre-treatment prior to an anaesthetic agent. A drug that acts as a sedative at low doses may induce unconsciousness at higher doses.

Suppliers: any person or company that brings products to a site or removes something from the site. E.g. feed suppliers, mortality picks ups.

TMS: Tricaine methane sulphonate, an ester of benzocaine, is used as a fish anaesthetic. TMS is also commonly known as MS-222. A withdrawal period is mandatory if fish are to be released or used for human consumption.

Vertical transmission: spread of a pathogen from the parent to the offspring during gamete development.

*Virkon™***:** Trade name of a disinfectant chemical containing peroxygen compounds, a surfactant, organic acids and an inorganic buffer system.

Withdrawal Time: The time interval after cessation of treatment before the animal or any of its products can be used as human food. Withdrawal times are based on the time interval required for tissue levels of the substance to fall below critical levels as decreed by legislation.

2 General Principles of Fish Health Management

2.1 Keeping Fish Healthy

Keeping fish as healthy as possible is critical to keeping pathogens from coming on site, reducing incidence of disease attributable to those pathogens already present, and/or minimizing spread of pathogens within or between sites.

Fish must be routinely monitored for signs of health and disease and for this reason all staff should be familiar with normal fish appearance and behaviour. Observations which may indicate a problem with the population included (but are not limited to):

- Physical changes – skin darkening, scale loss, fungal or ulcerative external lesions, increased opercular movements (respiration), protruding eyes
- Behavioural changes - loss of normal swimming and schooling behaviour, flashing, failure to elude capture, diminished response to feeding, gasping at the surface, clustering near water inflows or near airstones

Fish should be kept at reasonable densities as determined by species, size, number, type of rearing unit and water quality/availability. Changes in behaviour and physical condition should be reported to site management as early detection is the key to good disease management.

2.1.1 Maintaining an Optimum Environment

2.1.1.1 Suitable Rearing Environment

The fish culture staff is responsible for ensuring a suitable rearing environment for the fish at each life stage.

2.1.1.2 Monitoring Water Quality

Maintaining good water quality is vital to good fish health. The operator should maintain a regular program for monitoring and recording water quality at hatchery sites. Monitoring will vary between sites depending on location and the specifics of the aquatic environment and the frequency of monitoring will depend on available equipment and type of facility water use (i.e., flow through or recirculation). In-line monitoring may be applicable.

SOP: *Water quality monitoring*

2.1.1.3 Water Quality Contingency Planning

The facility should maintain a contingency plan in the event of acute deterioration of water quality (for example due to loss of flow or contamination of supply). Failure of pumps requires an immediate response. Systems should be suitably alarmed to indicate a water supply failure. The site should have back-up systems to ensure water supply is not interrupted and quality is maintained.

SOP: *Water quality contingency plan*

2.1.2 Feed and Nutrition

Feeding is both an art and a science. A site-specific, customized feeding program coupled with appropriately sized, high quality feed will fulfill the nutritional requirements needed for the growth and health maintenance of the fish. The amount fed will be influenced by many factors including: water temperature, species, body size, age, type of feed and different feed delivery methods.

Proper storage of feed is essential to maintain its nutritional value. Feed stored under improper conditions will result in rancidity and degradation of essential nutrients. Feed should be stored in secure buildings such that wildlife is excluded and spillage is prevented.

SOP: *Feed, Feed Storage, & Feeding Practices*

2.1.3 Common Fish Culture Procedures

2.1.3.1 Anaesthetizing Fish

A number of fish health procedures require that fish be anaesthetized. Acquiring chemical anaesthetics requires a veterinary prescription. Netting of fish prior to anaesthesia should be done in as stress-free a manner as possible. Exposure to anaesthetic should be minimized while ensuring the anaesthetic level is adequate for the procedure. Anaesthetized fish should be carefully monitored at all times and the water quality of the anaesthetic bath – in particular, oxygen level – should be monitored.

SOP: *Anaesthesia*

2.1.3.2 Marking Fish

Marking fish is a valuable tool for accurate stock assessment. The species, number of fish to be marked and method of marking should be reviewed annually during this facility's production planning meetings. Marking should be done in a manner designed to result in minimal injury and stress to the fish. Appropriate anaesthesia and monitoring for adverse effects, both during the procedure and for several days following, are standard, as the stress of the procedure and resulting wound can compromise the immune response of the fish.

SOP: *Marking Fish*

2.1.3.3 Fish Transports

Fry, smolts and other life stages should be handled in as stress-free a manner as possible in preparation for transport. Equipment should be checked to prevent significant injury that could predispose fish to damage and/or disease. Proper hygiene and disinfection are adhered to. Appropriate transfer permits are obtained from DFO.

SOP: *Transporting Fish*

2.1.3.4 Vaccination

Vaccines are used to boost immunity to specific infectious diseases (e.g. Vibriosis) and are part of an integrated fish health management program. Vaccines are biological substances that must be stored (refrigerated) and handled as per manufacturer's instructions so as to maintain their safety and effectiveness. A product insert for each vaccine that is on site is kept in a safe, readily accessible place. Staff should be appropriately trained prior to undertaking the vaccination procedure to ensure that biologicals are used safely (i.e., wearing appropriate personal protective gear and taking suitable precautions).

Vaccination must be done in accordance with manufacturer's guidelines to ensure proper results. Since stress reduces the response of fish to a given vaccine, fish should be handled in as stress-free a manner as possible.

2.1.3.5 Euthanasia

In the uncommon situation where fish need to be euthanized, euthanasia should be done in as humane a manner as possible. The method used should result in rapid and irreversible loss of consciousness.

SOP: *Euthanasia*

2.1.3.6 Gamete Collection (Egg Take and Milt Collection)

At the Veterinarian's discretion, broodstock may be treated preventatively for specific infectious diseases prior to maturation to reduce the risk of vertical transmission of disease. Egg take and milt collection should be performed in as hygienic a manner as possible to prevent transmission of diseases to other broodstock and/or progeny. Adult fish should be anaesthetized prior to gamete harvest and spawned adults should be euthanized as humanely as practicable. Carcasses are disposed of in a manner to prevent spread of disease. Males, if used multiple times, should be monitored for recovery from anaesthesia after each procedure.

SOP: *Gamete Collection (Egg Take and Milt Collection)*

2.1.3.7 Egg Disinfection

Eggs can be safely disinfected following fertilization and during water hardening.

SOP: *Egg Disinfection*

2.1.3.8 Egg Treatments

Developing eggs are sensitive to light and shock as well as fungal infections. Eggs are periodically checked for mortality, and presence of infectious diseases or fungus. Affected eggs should be treated as necessary.

SOP's: *Egg Shocking, Picking & Egg Enumeration*
Egg Disinfection

2.1.3.9 Juvenile release

The health and treatment status of fish is considered when planning intentional fish releases. The planned release of enhancement/conservation fish from our facilities will undergo a risk assessment to attempt to prevent undue harm to wild fish populations or public health. Fish are to be released in good health to minimize the transfer of pathogens to wild fish. The timing of release is also important to reduce stress and maximize survival of released fish.

SOP: *Pre-Release or Transfer Disease Risk Assessment*
Juvenile Release

2.1.3.10 Juvenile Treatments

There is a great deal of physiological stress associated with juvenile growth and smoltification. At the same time, the juvenile salmonid immune system is still developing. Because of this, juveniles represent a particularly susceptible life stage and judicious use of antimicrobial agents may help minimize losses due to infectious agents.

SOP: *Juvenile Treatments*

2.2 Keeping Pathogens Out

Biosecurity refers to an integrated strategy to assess and manage the risks that threaten animal health, human health, food safety, and the environment. The key components of a biosecurity program involve the exclusion of pathogens from a site and the containment of pathogens within a site if a disease situation does occur. The nature of enhancing wild populations using gametes collected from mature salmon returning from the oceans means that it is impossible to prevent the introduction of pathogens in all cases. Nevertheless, measures are in place to minimize the introduction of pathogens at key fish culture junctions and to minimize the impacts related to the presence of pathogens.

2.2.1 Site Physical Barriers

Management is responsible for providing a suitable, secure rearing environment. Additionally, physical barriers to prevent uncontrolled or undesirable human and animal entry, the risks involved with movement of all personnel (staff, management, volunteers,*Fish Health Management Team*), visitors and equipment are assessed and managed.

SOP : Site and staff disinfection and biosecurity

2.2.2 Personnel Movement

Staff will adhere to biosecurity procedures for the site. Where possible, personnel will not travel between hatcheries. If such travel is unavoidable, personnel will not return to a clean facility after visiting a disease-suspect one, or will adhere to all biosecurity procedures at each facility to minimize the risk of inadvertently spreading disease between sites.

SOP : Site and staff disinfection and biosecurity

2.2.3 Visitors

Each site shall have posted procedures for all visitors, and visitors are expected to follow these procedures. Visitor access will exclude any areas containing sensitive life stages, i.e. incubation rooms, unless suitably supervised.

SOP : Site and staff disinfection and biosecurity

2.2.4 Predator Exclusion

Every attempt should be made to exclude predators from the site. Predators should be excluded from the site. Predators include birds, rodents and occasionally mammals such as mink, river otters and bears.

SOP: Predator exclusion

2.2.5 Suppliers

Suppliers should be advised of operator and site procedures in advance. Suppliers who visit multiple sites shall be subject to strict biosecurity measures and may be requested not to come on site.

SOP : Site and staff disinfection and biosecurity

2.2.6 Equipment Movement

Where possible, equipment will not be shared between sites. This includes pumps, vehicles and fish handling equipment. Where this is not possible, equipment that must be used at multiple sites should be subject to strict biosecurity and disinfection measures between uses as per 2.2.5.

2.2.7 Equipment Maintenance

To reduce the possible spread of pathogens by fish, personnel or via a waterborne route, equipment should be kept clean at all times. Equipment should be properly disinfected after each use and put away in its proper location.

SOP: Equipment disinfection

2.2.8 Moving Fish Between Sites

Fish movement between sites is kept to a minimum. A disease risk assessment should be performed in conjunction with the *Fish Health Management Team* prior to moving fish and necessary transfer permits should be obtained. Clinically ill fish will not be moved between sites. The move should be planned in advance to be as stress-free and short as possible. Fish should be transported as per 2.1.3.3 Particular care should be paid to the fish during transportation to avoid undue stress or possibility of escape. Water quality should be maintained and frequently monitored during transport.

The receiving sites will make arrangements for isolating the newly arriving fish. Once on site, measures should be used to limit the potential transmission of any previously undetected pathogens to the facility's original population.

SOP's: Pre-Release or Transfer Disease Risk Assessment
Egg and Milt Transport
Quarantine/Isolation Procedures for Suspected Disease Outbreaks
Outbreak Response

2.2.9 Broodstock Management

The Veterinarian and/or *Fish Health Management Team* will develop specific disease screening procedures to minimize the risk of vertical transmission of pathogens from broodstock to eggs. Samples for disease screening must be collected in a sterile manner to minimize risk of contamination which can result in improper diagnosis.

Location of progeny from sampled fish should be tracked until such time as screening results have been received and reviewed by the Veterinarian and/or Fish Health Management.

For DFO enhanced fish, determining the causes of fish mortality prior to spawning can provide important information on disease incidence in the population and indicate the presence of vertically transmitted diseases.

SOP's: Broodstock Selection
Broodstock Handling
Broodstock Biosecurity
Adult Carcass Disposal
Broodstock Treatments

2.3 **Keeping disease from spreading**

2.3.1 **Separation of Fish Groups**

Different species or stocks are kept separated while on site. Rearing units are kept separate to prevent transmission of disease between groups.

2.3.2 Minimizing Disease Within the Site

All efforts should be made to minimize disease on a site. All personnel will adhere to the facility hygiene and disinfection procedures as per 2.2.2. Tank cleaning and moribund/mortality collection is carried out on a routine and frequent basis. This serves to reduce the potential exposure to pathogens and minimize predator attraction.

2.3.3 Monitoring Fish Health

Fish are monitored at least once daily for any unusual behaviour, visible lesions or other sign of disease. Changes in behaviour and physical condition should be reported to site management. Additionally, routine scheduled length/weight sampling during rearing allows a more detailed examination of the fish, as well as comparisons of actual versus expected gains and tracking of biomass per tank for appropriate density management.

SOP's: *Juveniles-Health Observations*
Individual Length/Weight and Bulk Weight Sampling Protocols

2.3.3.1 Mortality Classification

Mortalities are examined for external signs of disease, as per the operator procedure, suspect mortalities may be examined internally. Suspected causes of mortality must be recorded and fish health management should be notified of any unusual numbers or types of mortalities.

SOP: Mortality Classification

2.3.3.2 Mortality Collection and Disposal

Mortalities are collected on a routine and frequent basis to minimize the potential spread of disease, to minimize attractiveness to predators and to allow rapid identification of a health issue. The mortality storage area should be an appropriate distance away from any rearing units and outside usual travel corridors to minimize inadvertent spread of disease. Proper disinfection procedures should be adhered to after each mortality collection.

SOP: Mortality Collection and Disposal

The goal of good fish health management is to have healthy and productive fish. However if fish do become sick, they may require treatment with a therapeutant.

The Veterinarian maintains a Veterinarian-client-patient relationship with the operator that is the basis for disease diagnoses and prescribing treatments.

2.3.3.3 Medicated Feed: Handling, Storage and Inventory

Medicated feed is to be stored in clearly marked bags separately from non-medicated feed. The storage area should be clean, dry and free of predators. The label on the medicated feedbag

provides details about the feed, medication included, feed rate, name of the Veterinarian, prescription number and date it was milled.

Medicated feed is inventoried separately from regular feed. Daily inventory records should be kept as the feed is fed to the fish according to prescription.

In the unlikely event that there is excess medicated feed after completion of the treatment, the Veterinarian should be contacted to determine proper handling and disposal.

SOP: Medicated Feed: Storage, Handling, and Feeding

2.3.3.4 Handling and Administering Medicated Feed

Medication mixed into feed has a Material Data Safety Sheet (MSDS) which specifies handling and safety precautions. An MSDS for all medications used on site must be on site in a readily accessible binder. All staff at this facility has undergone Workplace Hazardous Materials Information System (WHMIS) training and all chemicals must be handled safely; i.e., wearing appropriate personal protective equipment and taking suitable precautions for handling and disposal.

Medicated feed must be administered in accordance with the Veterinarian's instructions. The appropriate rearing unit(s) must receive the prescribed amount of medicated feed for the duration of treatment.

The Veterinarian must be informed if there is a lack of expected response within 5 days of the initiation of treatment.

SOP: Top-Coating Medicated Feed

2.3.3.5 Treatment Records

Provincial regulations require that treatment records for therapeutants include:

- Location of fish culture facility
- Species and stock identification
- Name of the prescribing Veterinarian
- A log naming the drugs (therapeutants), including
  - How they were administered
  - Treatment schedule including the date treatment commenced
  - Date of last treatment
  - Name and signature of the person responsible for administering each treatment

Detailed records of medicated feed administration are kept for the duration of treatment. Staff is responsible for monitoring for any adverse response to treatment (i.e., lack of appetite, lack of anticipated decline in morbidity and/or mortality levels) and reporting this information to the hatchery manager and the prescribing Veterinarian. Medicated feed records should be entered into ENPRO and a hard copy should be kept on site until the fish are released. In combination with inventory records, the fish receiving medication are readily identifiable during treatment and until the completion of the prescribed withdrawal time.

A copy of the treatment records will accompany those fish to another site if the fish are moved.

2.3.4 Fish Health Emergencies

A fish health emergency is any situation where the health of the fish population is suddenly at risk. This may be due to a sudden, severe decrease in water quality or availability, or due to significant pathogens such as the IHN virus. Vigilant monitoring and early detection are the cornerstones of fish health emergency management.

2.3.4.1 System Failure/ Water Quality Event

If there is a system failure, all efforts should be directed to restoring sufficient water quality for the fish. Sufficient oxygen levels must be restored to support the fish. The site will immediately activate the Operator's Water Quality Contingency Plan, as per 2.1.1.3. In the event of life-threatening poor water quality events, the fish should be taken off feed in order to decrease the oxygen demand and stress.

If an infectious disease problem is suspected, the operator Veterinarian and/or Fish Health Management must be ***immediately*** notified. If the problem is not easily discerned, event management and diagnosis will need to be done hand-in-hand.

2.3.4.2 Infectious Disease Emergencies

An outbreak is defined as an unexpected occurrence of mortality or disease. Not all outbreaks are fish health emergencies. Pathogens differ in many respects including ease of transmission, time until clinical signs of disease are apparent, severity of disease, and range of treatment options.

Accurate husbandry records and diligent monitoring of fish population health are central to the early identification of a disease situation. Rapid response is essential but should be determined on a case-by-case basis in conjunction with the Veterinarian and/or Fish Health Management.

Once an emergency has been recognized, certain steps are followed. The objective is to keep the pathogen "load" as low as possible and to prevent spread of the pathogen both within and off the site.

2.3.4.3 Emergency Response Steps

2.3.4.3.1 Quarantine

Quarantine is the enforced physical separation of the healthy population from a (potentially) infected population, their products or items they may have contaminated. At the Veterinarian's recommendation the site may be officially quarantined. Quarantine remains in effect until such time as the problem has been diagnosed and/or managed.

SOP: Quarantine/Isolation Procedures for Suspected Disease Outbreaks

2.3.4.3.2 Stop Fish Movement and/or Handling

The movement of all fish on/off and within the site may cease and fish will not be handled further. No visitors or non-essential staff is allowed on site unless previously authorized by Management.

2.3.4.3.3 Disinfection and Hygiene

Hygiene and disinfection on site, including procedures for personnel and equipment are strictly enforced.

SOP: Outbreak – Disinfection Protocols

2.3.4.3.4 Suppliers

In the case of an outbreak, suppliers (e.g., feed or oxygen delivery) are to be instructed to visit the site last or to make special arrangements.

2.3.4.3.5 Mortality Collection

The frequency of mortality collection is to be increased during an outbreak. Affected tanks are mort picked last and staff adheres to disinfection procedures between tanks and rearing units. If possible, separate gear is designated for the affected unit. All equipment, surfaces and clothing that come in contact with infected fish or potentially infectious material are thoroughly disinfected after use. Mortality collection and disposal procedures, as per 2.3.3.2, are strictly adhered to and provisions made for increased mortality pick-ups and disposal.

2.3.4.4 Determining the Cause of the Outbreak (Outbreak Investigation)

The Veterinarian may require records and appropriate sampling to determine the cause of the outbreak and best course of action. The Veterinarian and/or Fish Health Management will provide instructions for proper sampling. Water and feed samples may be requested. Samples must be properly handled, properly stored and promptly shipped as per the Veterinarian's or Fish Health Management's instructions to ensure prompt and effective analysis

Continued monitoring is required after the initial workup to determine the course of the outbreak and to assess whether treatment and/or management measures are effective. Frequent observations of fish are essential. Feeding response and water quality is monitored. All treatments and management changes are noted as they occur. The Veterinarian, Fish Health Management and site management will work together to review fish health records and make further management decisions. Any repeat sampling, including results, are duly noted.

SOP's: *Outbreak Response*
Diagnostic Sampling protocols
Sample Shipment to a Diagnostic Laboratory

2.3.4.4.1 Site Depopulation

Site depopulation is the total destruction of all animals on site in the event of a catastrophic outbreak. If site depopulation has been agreed upon, the procedure should be conducted as humanely as possible and in a manner consistent with principles of hygiene and biosecurity.

2.3.4.4.2 Reporting to Authorities

Where appropriate and/or in accordance with existing regulations, operator management will report the outbreak to Provincial or Federal authorities.

2.3.4.4.3 Communicating With Other Operators

The site management office will notify other operators in the geographic area of the outbreak.

2.3.5 Handling Drugs and Chemicals Properly

2.3.5.1 Disinfectants

Disinfectants are stored in clearly marked containers. An MSDS for each disinfectant present on site is kept in a safe, readily accessible place, e.g., binder in the site office. As per WHMIS, all chemicals must be handled safely by trained staff e.g., wearing appropriate protective gear and taking suitable precautions.

SOP: Chemicals & Disinfectants: Supplies and Storage

2.3.5.2 Chemicals

Chemicals include, but are not limited to, fixatives such as formalin or Davidson's solution used for preserving fish tissues. These chemicals are stored in clearly marked containers. An MSDS for each chemical that is on site is kept in a safe, readily accessible place, e.g. binder in the site office. As per WHMIS, all chemicals must be handled safely trained staff e.g., by wearing appropriate protective gear and taking suitable precautions.

SOP: Chemicals & Disinfectants: Supplies and Storage

2.3.5.3 Biologicals

Biologicals are substances derived from animals or microorganisms that are used in the treatment, prevention or diagnosis of disease. Biologicals include vaccines, bacterins and antibody-based diagnostic tests. Enhancement hatcheries may use vaccines to boast the immune response to commonly encountered pathogens. Where applicable, these products are kept refrigerated and handled as per manufacturer's instructions. A product insert for each on-site vaccine is kept in a safe, readily accessible place. Trained staff must handle all biologicals safely e.g., by wearing appropriate protective gear as dictated by the MSDS and taking suitable precautions.

2.4 Keeping Good Records

2.4.1 Fish Health Records

Fish health records include, but are not limited to:

- Inventory records
    - Includes source, number, location and lot of fish at the site
- Fish movement records
- Mortality records including clinical signs and mortality cause if known
- Diagnostic sampling records
- Diagnostic results
- Water quality records
- Therapeutics and medicated feed records
- Records of actions (other than therapeutics) taken to prevent or mitigate disease, e.g. refused shipment of potentially infected eggs
- Records of reporting to Provincial or Federal authorities, in accordance with existing regulation

Many of these records are computerized and form part of the integrated operator record keeping system. The operator will provide adequate system training and documentation to authorized site personnel including data entry and reports, e.g. ENPRO for DFO. Backups should be maintained.

Paper records not entered into a computerized system should be well organized, easily accessible and protected from damage, e.g. kept in binders.

Records should be kept for the duration of time the fish are on site. The operator will keep archived records at a suitable location in head office or securely stored off site. Records should be available for inspection upon request by BC MAFF.

Records should be reviewed on a routine basis by the operator Veterinarian and/or *Fish Health Management Team* to look for patterns in fish health and disease.

2.4.2 Reporting to BC Fish Health Database

The operator reports required fish health data, e.g. mortality cause and fish health event information to the BCSFA Fish Health Database on a monthly basis. Aquaculture companies keep records of data submission for audit by BC MAFF. Reporting to the BC Fish Health Database is also required of enhancement hatcheries and this data is also subject to audit by the BC MAFF. There is a shared responsibility to report what is occurring in fish culture regardless of the nature or purpose of culture. Wild and cultured fish share similar resources and compliance with the reporting requirements ensures that the maximum information is available to lead to informed and appropriate aquatic environmental and health management decisions.

2.4.3 Egg Take Records

Records should be kept for egg takes and broodstock disease screening. Records must accompany each shipment of eggs from the Broodstock location to the hatchery receiving the eggs, whether destined for onsite or off site incubation

2.5 Impacts on Non-Enhanced Stocks

2.5.1 Fish Escape

The Salmonid Enhancement Program intentionally releases cultured fish. Escapes in this context are less of a concern than for commercial producers using non-native or selectively bred stocks. However, infrastructure is in place to ensure fish escapes are discouraged. In the unlikely event that fish escape into nearby streams or watersheds, fish health records, including relevant diagnoses and treatments, must be made available to the appropriate regulatory authorities as required.

3 A Brief Overview of this Facility

The Chilliwack River Hatchery was built on an old side channel of the Chilliwack River under the Salmonid Enhancement Program (SEP). It was completed in 1981 and, in keeping with the wishes expressed by local residents, the hatchery site has been kept in its natural state as much as possible. The site is approximately two kilometres long and 0.5 kilometres at its widest point.

There is year round public access weather permitting. Hatchery brochures are located at a kiosk at the bottom of the fish ladder to help with a self-guided tour. Guided tours for school groups are available on request.

Up to 6 million salmon smolts, including two Chinook stocks, Coho, Chum, and Steelhead are produced annually for the commercial, sport and First Nations fresh-water and marine fisheries. Adult salmon are received into our fish ladder and trap or are angled or netted and transported from the river to the hatchery for brood stock. Eggs are fertilized and incubated on site. They hatch and emerge as fry which can either be directly released into the river or are held for rearing and feeding which can be for one month and up to a year to the smolt stage (smolts are the stage of sea water readiness). Steelhead are transported by truck at this stage to be released in the lower river.

Between late summer and early December large numbers of adult salmon of various species return to the hatchery. During this period collection, handling, sorting and spawning occurs. During the spring the fry of the year are emerging. The feeding program is heaviest in the spring of the year, but rearing and feeding occurs year round. Fry and smolt releases, when the juvenile salmon go to the ocean, take place from late April to early June.

The site is a wildlife viewing area for predator birds such as Great Blue Herons, Kingfishers and Water Ouzel, which are attracted to the juvenile fish rearing in the channels. Bald Eagles are frequently seen in the late Fall and early winter months. Along with gulls, they feed on the spawned out salmon carcasses that wash up on the river bank. There are also frequent sitings of black bears, otters, skunks, mink and raccoons on-site throughout the year.

In recent years, there has been a recovery in the natural spawning population of Pink salmon in the Chilliwack River. They return to the river to spawn in every odd-numbered year e.g. 2001, 2003, 2005. Migration timing is from August to early October, peaking in September. The Chilliwack River also supports a significant number of Sockeye salmon migrants returning to Chilliwack Lake between June and August.

TABLE OF SALMON MIGRATION TIMING AND DEVELOPMENT EVENTS FOR CHILLIWACK RIVER HATCHERY

Species	Adult Migration	Spawning	Incubation	Ponding & Rearing	Spring Releases
Red Chinook	Jul 7 - Aug 20	Aug 20 - Sep 7	Aug 20 - Nov 15	Nov 15 - Apr 20	Apr 20 & on
Coho	Aug 20 - Dec 20	Oct 15 - Dec 20	Oct 15 - May 10	Feb 15 - May 15	May 10 & on
Fall Chinook	Oct 1 - Dec 7	Oct 15 - Dec 7	Oct 15 - Mar 10	Feb 15 - May 20	May 20 & on

Chum	Oct 10 - Dec 15	Oct 15 - Dec 15	Oct 15 - Mar 30	Feb 20 - May 31	Feb 20 - May 31
Winter Steelhead	Dec 15 - Mar 20	Mar 1 - Apr 20	Mar1 - May 31	Apr 20 - May 7	May 1 - May 7 truck

*NOTE: These are approximate times. Peak adult salmon migration is normally in the middle of the adult migration timing. These are yearly events . All releases of juvenile salmon smolts are done at the hatchery site with exception of steelhead which are transported off-site to the lower Chilliwack/Vedder River.

4 Standard Operating Procedures for the Chilliwack River Salmon Hatchery

The following list of Standard Operating Procedures outlines fish culture practices that are used at SEP hatcheries and DFO affiliated facilities to promote fish health. These are all "acceptable practices" but may not all be used under all conditions or for all species. SEP encourages innovation and flexibility in fish culture operations to ensure the best possible treatment for the fish while at the same time considering operational constraints.

The following SOP's should be modified to reflect site specific practices that are for procedural reference and may be used for training purposes, while at the same time providing a framework to build "best practices" on.

Broodstock & Spawning

Broodstock represent an important and sensitive life stage. Fish are channeling their energy stores into the maturation of gametes while simultaneously undergoing the physical stresses related to migration, changing temperatures and re-entry into freshwater. The cumulative effects of these multiple stressors can result in a compromised immune system which can lead to ingress or reactivation of infectious agents. Failure to adequately address these concerns through proper husbandry techniques and appropriate biosecurity may lead to the introduction of pathogens into progeny or other fish on a facility and may potentially result in epidemics.

A female trout, heavily laden with eggs, cannot withstand the rough handling sometimes associated with poor hatchery practices. Great care should be taken during the sorting and spawning operation to dip up only two or three fish at a time. Never make a pass through a pen of nearly mature females and fill the bag of the dip net with fish. This can result in broken eggs, poor fertilization, and possibly permanent injury to the fish's reproductive system which is of concern with repeat spawners such as steelhead. It may safely be said that the less the fish are handled the better, and streamlining spawn-taking operations to reduce handling is certainly a step in the right direction.

The interval at which brood females should be sorted during the spawning season depends to a large extent on water temperature and season. To produce eggs of the best quality, it is necessary to watch the brood stock closely. The correct degree of ripeness must be attained in the females. Taking eggs before they are fully mature is as bad as not sorting frequently enough, which may allow some of the females to over ripen. If they are not sorted often enough, overripe eggs are sure to be found.

Research has shown that the ripening of trout eggs can be represented graphically as a curve with a sharp apex. The peak of this curve represents the time of optimum fertility of a particular lot of eggs, which must be stripped at that time. If taken prior to this date, lower fertility results, due to the eggs not being completely ripe. If taken later, on the down side of the curve, overripe eggs are encountered. Correct timing, through proper and frequent sorting, is one of the greatest secrets of successful egg taking.

In general, the size of the egg depends upon the size and age of the parent fish, the larger specimens producing more and larger eggs. Egg size also varies among different strains and stocks of broodstock. It is reasonable to assume that competition among fry gives the larger fry a better chance for survival and faster growth. Size, however, can be attained only at the expense of number. There is, therefore, some point at which, on the average, the forces favoring size are balanced by those favoring number. The number of eggs produced by females of the same age and strain varies considerably.

The amount of sperm extruded from a male varies from a few drops to a teaspoonful. It has been stated that one drop of sperm will contain enough spermatozoa to fertilize 10,000 eggs. It is, of course, necessary for contact between sperm and eggs to occur; hence, the necessity of stirring the eggs and sperm together.

Since there is a limit in the time that both the eggs and the sperm remain viable, correct timing in the spawn taking operation is important. The length of time either eggs or sperm remain viable varies considerably and depends, perhaps, on several factors. Certainly, variety of fish and temperature are contributing factors. It is generally accepted that exposure of eggs or sperm to water for three minutes or more prior to fertilization will result in virtually a complete loss of viability. When eggs are broken in the spawn-taking operation, the process of fertilization is greatly hampered and at times completely stopped. Broken eggs in the spawning pan will appear as a white, creamy substance somewhat resembling sperm. This is actually the albumen from the broken eggs and, unless it is washed off immediately, some of it will

lodge over the micropyle and present the spermatozoa from entering. Broken eggs probably contribute as much to poor fertilization as does any other factor. When albumen appears in the spawning pan, it should be washed off immediately, the sperm added, and the pan emptied of eggs before more are added.

4.1 Broodstock Selection

Rationale: Broodstock are selected to ensure that enhanced fish maintain the fitness characteristics of the native stock. This SOP addresses section 2.2.9 of the General Principles of Fish Health Management. The goal of this SOP is to ensure the selection of broodstock that maintain the fitness characteristics of the native stock.

Authority: The information contained within this SOP will only be revised by the *Fish Health Management Team*. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

A percentage of 10% Jacks relative to the number of broodstock selected throughout the span of the run is targeted.

Under normal circumstances the trap is sorted on a weekly basis. When the fish are returning in greater numbers, the trap will be sorted more frequently.

Severely injured fish are not selected for broodstock as they will not survive the holding period

Wild fish (no clip) are preferentially selected and supplemented with hatchery (clipped) fish.

4.1.1 Coho

A proportion of each stage (early, mid late) of the run will be selected as broodstock in an attempt to represent the duration natural run coming into the river to mimic the natural run over the year.

1. Coho are allowed to swim directly through the fishway into the adult trap.
2. Trap is sorted at least once a week, or more as needed
3. Fish are sorted into males and females and surplus for ESSR and held until spawning
4. Fish are checked for ripeness on weekly basis so that groups for egg takes (and therefore ponding) are large enough
5. Water is lowered
6. Fish are crowded using a crowder
7. Staff enters the water
8. Fish are netted into a net holding pen in the raceway.
9. Fish are checked for ripeness out of this net. Green fish are placed over the crowder back into the raceway, ripe fish are passed up to staff for egg take (see *Gamete Collection (Egg Take and Milt Collection)*)

4.1.1.1 Early run coho

A proportion of 26.6 % of the target production is selected between September 1st and to October 15th. The number of females required to meet the target egg number will be determined and this number of required females will be divided over the duration of the period (~ 6 weeks)

4.1.1.2 Mid run coho

A proportion of 46.8 % of the target production is selected between October 15th and November 30th. The number of females required to meet the target egg number will be determined and this number of required females will be divided over the duration of the period (~ 6 weeks)

Mid run fish are differentiated from early-run fish by physical characteristics. Darker fish are classified as early run and are not selected. Mid-run fish are silver in colour and appear fresher. The cleanest and greenest (less mature) fish are selected as broodstock.

4.1.1.3 Late run coho

A proportion of 26.6 % of the target production is selected between December 1st and January 15th. The number of females required to meet the target egg number will be determined and this number of required females will be divided over the duration of the period (~ 6 weeks)

Late-run fish are differentiated from mid-run fish by physical characteristics. Darker fish are classified as mid-run and are not selected. Late-run fish are silver in colour and appear fresher. The cleanest and greenest (less mature) fish are selected as broodstock.

4.1.2 Chum

The basic strategy is similar to that used for coho (above). However, fish may need to be seined to meet the fish numbers required for the production plan.

Chum generally enter the system in a fully ripe state and are spawned directly off of the sorting table. Therefore fish are not held for ripening, only ripe fish are selected

Every attempt is made to represent the duration of the run which generally lasts from October 1st until approximately the second week of November.

4.1.3 Chinook

4.1.3.1 Summer Chinook

Summer Chinook are collected between late June/early July and mid-August. These fish naturally spawn between late August and early September. The fish enter below the diversion channel but do not come up the fish-way until mid August when it is opened.

1. A finger weir is placed into the diversion channel to keep fish in the channel and prevent them from moving back out into natural the system.
2. Approximately one week prior to the peak natural spawning period, the fish-way is opened and fish are allowed to enter the trap.
3. The trap is sorted twice weekly (or more if needed, this will depend on the number of fish entering.
4. The numbers are broken down into three or four egg takes to meet the production goal. A portion of unused fish will be released up river.

5. The fish-way will be closed when the target production goal is attained. The finger weir will be removed from the diversion channel at this point and fish will be allowed to move into the river to spawn naturally.

4.1.3.2 Fall (Harrison) Chinook

Fall Chinook enter the facility between late September and early October and generally peak around thanksgiving (early November). Numbers of fish collected at the hatchery vary as these fish are susceptible to natural conditions (floods, low water etc). Thus, they may be collected from the river under poor river conditions.

Under normal circumstances, these fish will enter the hatchery via the fish ladder and enter the trap. The trap is sorted 2-3 times per week or more if necessary. The fall Chinook usually enter the hatchery in a very mature state and are therefore, sorted quickly. If an egg take happens to be underway, these fish may be sorted and spawned directly off of the sorting table.

Fish that are being held will be sorted for ripeness 1-2 times per week during an egg take period.

1. Lower the water in the enclosure by approximately 2 - 3 feet
2. Crowd the fish using a crowder
3. Once broodstock to be checked are crowded, enter into the enclosure with short handled deep nets and wearing non-abrasive gloves
4. Capture coho into the nets and then place them into a shallow holding net bag enclosure where they may be immediately checked for ripeness
5. Return green fish over the crowder
6. Kill ripe fish by a sharp blow to the head
7. Place a tailer on the killed fish and hand the fish to staff on the edge of the enclosure to hang and bleed on the rack in a head down position.
8. Ripe females as a rule are killed first and then a corresponding number of ripe males are killed last.
    - Note: Chinook are checked one by one and every attempt is made to achieve a 1 to 1 male female ratio.

If fish are collected from the river the fish are captured by seine net, transported to the hatchery by transport truck/trailer (See *Transporting Fish*) and placed into raceway (R4) where they are held until ripe. These fish are not sorted and separated by sex but are held for weekly ripeness and gender checks as above.

4.1.3.3 Indigenous (summer) Chinook

The indigenous summer Chinook are a small stock natural to the valley that the hatchery is attempting to rebuild. These fish do not enter the hatchery volitionally. Rather, snorkel dives are used to locate them and check for ripeness. Fish are assessed for ripeness by physical appearance and behaviour. For

example, if fish are observed on specific spawning grounds, if redds are found to be present, if fish are displaying spawning colouration they are deemed to be ready for spawning.

When fish are found to be present and mature, regular checks will be performed and if they are seen moving from a pool to a spawning area, they are assumed to be close to spawning.

A tangle net is allowed to drift downstream to capture fish. The net is pulled in to the beach and fish are collected and sorted. If fish are found to be mature, and both a male and a female are collected, the fish are removed and killed for gamete removal at the site. Gametes are returned to the facility for fertilization

Tailers may be utilised to capture individual fish

If a female is observed to be in the process of preparing a redd and darts away, she may be gaffed for retrieval as a last resort if she is unable to be captured by any other method

Any ripe fish that is found is collected and only fish showing obvious disease signs will be rejected for broodstock purposes.

4.1.3.4 Steelhead

Broodstock collection generally begins in mid-January and continues until approximately the end of February. The goal is to collect 75% of the broodstock during this period (Based on FFSBC dictate) and the remaining 25% by the end of March.

Fish are collected by staff and volunteers (both on and off site) by angling. When captured, they are held in collection tubes in the river until they are transported back to the hatchery for holding. Transport is in a small transport tank.
Sorting of brood will proceed through until the end of March

Fish are rejected as brood if seal bites are present, if there is severe damage from capture or any other condition indicates that survival during holding would be reduced

Fish are held in same sex pairs in fish condos until ready to be spawned. Females are checked for ripeness on a weekly basis. Males are checked as required when ripe females are encountered.

Spawning is on a 1:1 basis and males are only spawned once (See *Gamete Collection (Egg Take and Milt Collection)*)

At the end of the spawning period if there have been insufficient numbers to meet the desired quota, fish may be taken by seine net in the attraction channel.

4.1.3.5 Pink salmon

Pink salmon are only taken as brood for spawning on request from other facilities or programs. Pinks are generally collected by seine net at off site locations. Some fish may be acquired by the hatchery trap on site. Fish will not be held as they do not do well in holding. Generally, the facility will take whatever fish are required for immediate spawning. Only obviously diseased fish are rejected.

Forms & Records:

Adult holding sheet
Adult holding/spawning record (Kept in species specific brood year binders)
Steelhead holding sheet
Fish supplied to other agencies sheet


Steelhead Holding form.pdf


Adult Holding Sheet.pdf


Adult Holding/ Spawning Record.pdf

4.2 Broodstock Handling

Rationale: Broodstock will need to be handled at least once to assess gender and degree of 'ripeness'. Fish must be handled with care to protect the brood fish and subsequent gamete quality. This SOP addresses section 2.2.9 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that fish are handled with care and subjected to minimal stress.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

Fish are crowded to make brailing or dip netting easier. The duration of crowding and the density is kept to the minimum amount of time possible. Nets used for crowding and netting are knotless. Numbers of fish in the nets are kept low to prevent fish on the bottom of the load from being crushed and every attempt is made to keep the fish in water at all times.

When using the brailer, anaesthetic is used for handling. The fish are transferred into an anaesthetic bath (see *Anaesthesia*) and monitored until they are ready to be handled. Water quality is monitored and changed as per *Anaesthesia*. Fish are lifted out of the anaesthetic bath and are assessed for 'ripeness' .

Fish are handled with care to minimize scale and mucus loss and are not held solely by the tail if expected to survive post-handling. After any anaesthesia and handling event, fish are monitored closely for signs of injury, morbidity and mortality.

4.2.1 Ripeness determination

- Female fish are considered ripe when the body wall feels soft and thin and loose eggs are palpable within the coelomic cavity. Eggs can easily be expressed by slight hand squeeze/pressure to the ventral mid-section or when tipping of the female head up and tail down.

- Male fish are considered ripe when milt is easily expressed and the milt is white and opaque. If the fluid is clear or watery the fish is not ripe.

- Green females may be released into a pre-designated holding location

4.2.2 Females

1. Crowd the fish and lower the water level in the enclosure by approximately 0.75 m
2. Grasp fish by the tail (gloves are not used for Chinook, coho, and steelhead) at the caudal region and direct the vent outwards. Hold and apply a small amount of pressure below the pectoral fins while gently arching the fish's back and exposing the ovipositor. If the pressure applied results in eggs being extruded from the vent the female is ready to be spawned.

3. If the fish is green, place it back into holding or sort it into an empty container. (if excess fish are available they may be put into the ESSR)
4. A tailer will be placed on Chinook females that are mature to enable a more firm grip so fish do not wriggle free and potentially damage eggs inside the body wall.
5. If the fish is ripe, it is killed by a blow to the head. Usually one or two strong blows to the back of the head will be enough to kill small fish. Larger Chinooks may require more blows to the head.
6. Make sure that when a female is killed that eggs are not influenced directly or indirectly by the killing. E.g. Do not put the belly of the fish on the ground and strike the head. The resulting pressure is then put on the belly which is on the ground, potentially breaking and killing eggs
7. In the case of Chinook, once the fish is dead, hang it by a tailer on a hanging rack. Always make certain the hanging rack is in the shade or under the shelter of the shed. Use the double braided tailers when handling or carrying fish out of the water, this will help prevent dropping of adults and reduce the possibility of broken eggs.
    - In all other cases, fish are placed into bleeding racks following gill cutting
8. Cut the gill arches with a knife to bleed the fish and let hang until the sort is complete or until the rack is full
9. Once the fish have been bled, they are hosed down with water to clear away blood and allowed approximately 5 minutes for excess water to drain away
10. Fish are removed individually for egg taking after they have been rinsed down. Never drop the ovipositor vent lower than the head, eggs will run out the vent
11. Once eggs are cut from the female the carcass may be disposed of to the river or to off channels within the watershed. (See *Guidelines for in-Stream Placement of Salmon Carcasses for Nutrient Enrichment*) or may be sent to ESSR if of good quality.

4.2.3 Males

1. Males are netted (or anaesthetized and brailed) and handled as above for females, but to extract milt (sperm) the belly is squeezed by hand from the pectoral fins down the belly to the pelvic fins.
2. Green fish may be put back to a recovery container or sorted to ESSR.
3. Ripe fish are spawned, killed and put to adult carcass placement (in the river or the side channel) or to ESSR
4. Sperm should never be exposed to weather elements or water as this may result in activation of the sperm and quickly kill it.

References:
Fish Handling Procedures
Broodstock Treatments
Anaesthesia

4.3 Broodstock Biosecurity

Rationale: Broodstock represent a sensitive life stage. They are more susceptible to pathogens that they may be carrying or to which they are exposed due to physiological changes associated with maturation. It is important to protect broodstock and their gametes from infectious disease-causing agents. This SOP addresses section 2.2.9 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that broodstock are protected from pathogens and that other fish groups are protected from pathogens that broodstock may be carrying.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

Broodstock are maintained in a separate holding area from other fish (i.e. juveniles). All broodstock holding areas are pressure washed and scrubbed and disinfected with bleach, or other suitable disinfectant (Ovadine), prior to being used for other life stages.

All equipment used on broodstock will be designated for brood use only. Separate equipment is used for different species. Bleeding equipment is segregated (Chinook – bleeding rack, other species, - bleeding tubes)

Staff separation should occur whenever possible. Ex. Feeders do not work with any adult sorting.

Disinfectant foot bath (Virkon) stations will be regularly maintained between the incubation and fertilization areas. Spray bottles of Ovadine™, or other topical disinfectant solution, will be available for surface disinfection of hands and rain gear.

Staff must adhere closely to site and staff biosecurity procedures (see *Site and staff disinfection and biosecurity*).

Proper loadings during brailer sorts are ensured, fish are not overloaded into elevator and appropriate CO_2 Anaesthesia use ensures stress on broodstock is minimized (see *Broodstock Selection*) (see *Anaesthesia*).

Mortalities are removed and recorded daily.

Mortalities are placed into a tote and placed according to *Guidelines for in-Stream Placement of Salmon Carcasses for Nutrient Enrichment*

Spawning equipment is washed and disinfected prior to use.

References:
Site and staff disinfection and biosecurity

4.4 Adult Carcass Disposal

Rationale: Carcasses should be disposed of in a manner that minimizes the potential for spread of disease. This SOP addresses section 2.3.3.2 of the General Principles of Fish Health Management. The goal of this SOP is to ensure disposal of carcasses consistent with a manner to lower the possible spread of disease agents.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

- Some carcasses are kept for feeding birds
- Bulk mortalities from sampling or spawning are disposed of into the river and channels and ponds, creeks, lake etc in the watershed for nutrient enrichment
- Fish that are surplus to brood requirements may be harvested for commercial sale, providing they have no potential drug residues in their tissues (i.e. no anaesthetics have been used during their harvest).
- Carcasses may be placed into their natal streams to provide nutrient enrichment according to the *Guidelines for in-Stream Placement of Salmon Carcasses for Nutrient Enrichment*. This use is permitted under the authority of the intergovernmental Introductions and Transfers Committee and is not suitable for all facilities
- Because of drug clearance times, and the length of holding, fish previously treated with an antibiotic or anaesthetic must not be used for carcass placement. However, fish treated with external chemicals that do not require a withdrawal period (e.g. Parasite S or Chloramine T) are considered safe for placement. If in doubt, contact the Fish Pathology Program at PBS.

Forms & Records:
Records of dates, areas of placement, numbers and species of carcasses placed are kept. (excel spreadsheet)

References:
Guidelines for in-Stream Placement of Salmon Carcasses for Nutrient Enrichment

4.5 Gamete Collection (Egg Take and Milt Collection)

Rationale: Attention to hygiene at egg take will decrease the risk of horizontal pathogen transfer to other brood fish or progeny. This SOP addresses section 2.1.3.6 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that gamete collection is performed in as hygienic a manner as possible.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

Prior to gamete collection

All necessary equipment is cleaned, disinfected and dried before and after use.

In the event of disease screening, Lab personnel are contacted to ensure they know of the workload on the way and to avoid conflicts and shortage of assistance.

Egg Take Equipment Checklist

- □ clubs
- □ spawning knives
- □ buckets
- □ tailers
- □ spawning bench (s)
- □ insulated tote with lid (for steelhead spawn)
- □ ice (for steelhead spawn if warm)
- □ dip net(s)
- □ wool gloves
- □ bleeding knife
- □ paper towels
- □ spawning basins
- □ hanging rack or bleeding tubes
- □ whirl-paks bags or plastic sperm containers with lids
- □ cooler (48 quart ice chest) (for steelhead spawn)

4.5.1 Salmon

4.5.1.1 Female fish:

1. Ripe females are euthanized by a sharp blow to the head. The gill arches are cut and the fish is either hung by the tail or placed in a bleeding tube to bleed for 5 – 10 minutes.
2. Make sure that when a female is killed that eggs are not influenced directly or indirectly by the killing. E.g. Do not put the belly of the fish on the ground and strike the head. The resulting pressure is then put on the belly which is on the ground, potentially breaking and killing eggs
3. In the case of Chinook, once the fish is dead, hang it by a tailer on a hanging rack. Always make certain the hanging rack is in the shade or under the shelter of the shed. Use the double braided tailers when handling or carrying fish out of the water, this will help prevent dropping of adults and reduce the possibility of broken eggs.

- In all other cases, fish are placed into bleeding racks following gill cutting

4. Cut the gill arches with a knife to bleed the fish and let hang until the sort is complete or until the rack is full
5. Once the fish have been bled, they are hosed down with water to clear away blood and allowed approximately 5 minutes for excess water to drain away
6. Fish are removed individually for egg taking after they have been rinsed down. The fish is handled in an inverted position until it is ready to be incised for egg removal.
7. After bleeding, the ventral surface of the fish is wiped down with paper towel to minimize blood, water or mucus dropping into the eggs.
8. Never drop the ovipositor vent lower than the head, eggs will run out the vent
9. The fish is turned into a head up position by the handler and the person cutting the fish cuts from the vent towards the head, cutting to the side of the pelvic girdle.
10. The eggs are collected into a labeled, clean, disinfected and dried bucket.
11. Any eggs with abnormal appearance, cloudy ovarian fluid or from a female with obvious signs of disease are immediately discarded.
12. Once eggs are cut from the female the carcass may be disposed of to the river or to off channels within the watershed. (See *Guidelines for in-Stream Placement of Salmon Carcasses for Nutrient Enrichment*) or may be sent to ESSR if of good quality.
13. The person responsible for stripping the eggs from the female cleans his/her hands on paper towel prior to handling another female.

4.5.1.2 Male Fish:

Ripe males are euthanized by a sharp blow to the head.

The ventral body wall is wiped down with a clean paper towel to minimize water or mucus dripping into the milt being collected.

Milt is collected from the male fish by cradling the fish, extending the tail while applying firm but gentle pressure on both sides of the body wall at the level of the testes. Milt should be collected into a sterile Whirl-pak™ bag or plastic sperm cup.

Any milt with abnormal appearance, or containing blood or feces, is immediately discarded.

The surface area of milt exposed to oxygen should be maximized.

4.5.2 Air Spawning of Adult Steelhead

Equipment:

- ☐ 2-3 people (preferably 3)
- ☐ Paper towels
- ☐ Air stone
- ☐ Air tubing
- ☐ J-cloths, or clean rags
- ☐ Milt bags (Whirl-paks) or plastic sperm jars
- ☐ Steelhead spawning tote
- ☐ Empty condo cells for recovery

- ☐ Regulator
- ☐ Oxygen cylinder
- ☐ 18 gauge needle
- ☐ Clove oil
- ☐ Portable shelter
- ☐ Basins and/or spawning buckets
- ☐ recovery containers

Procedure:

4.5.2.1 Air Spawning – Female Steelhead

1. Set-up the steelhead spawning tote near the condos.
2. Attached to the spawning tote is an oxygen cylinder. A compressed gas regulator, oxygen flow meter and several feet of tygon tubing (1/4" ID) are attached.
3. At the other end of the tygon tubing insert an air stone attachment and a needle attachment and then a G18 1.5 inch long needle.
4. Turn on the air at the main valve. The air pressure is manipulated through the use of a hand trigger (or a foot trigger)
5. Adjust the flow meter to deliver approximately 1 L/min oxygen flow
6. Anaesthetize fish using clove oil (see *Anaesthesia*). Steelhead generally succumb to anaesthesia in 5 minutes, and will turn onto their side.
7. For the safety of the fish and the staff, the fish should be under full anaesthesia prior to the needle being inserted.
8. Once the fish is under anaesthesia, it is grasped by the tail (and supported by the belly if large), dipped in freshwater to remove any clove oil.
9. Dry off the vent area of the fish as well as possible (using a J-cloth or a clean rag) to prevent any possibility of water being added to the unfertilized eggs.
10. One person holds the fish with the head up and the vent down over a disinfected, clean, dry basin
11. An attempt to manually express eggs is done first. (air expression may not be necessary)
12. Following attempted manual expression, a second person inserts the needle into the fish at the base of the pelvic fins. The needle is inserted at an angle towards the head where the chance of hitting any organs is minimal.
13. Turn on the flow of oxygen by pushing the air trigger

    It is very important that the needle be inserted in such a manner that the oxygen is not delivered into the body wall and that the oxygen flow is turned off while the needle is being inserted and removed.

    NOTE: It is also important that the needle tip is inserted under scales and not through them. Punctured scales have resulted in higher mortalities after air spawning.
14. The eggs should start to slide out. In addition to the air, they may need a gentle, but firm and steady pressure on the main part of the belly to help eject them.

15. When approximately 50% of the eggs are assumed to have been ejected, turn off the oxygen and remove the needle. Ensure that the belly is still pliable and not **rock hard.**
16. Continue manual stripping to remove as many eggs as possible without damaging the fish
17. The containers of eggs are kept at a cool temperature by placing them into a cooler containing ice packs. Gametes are moved immediately to the wet lab following collection (coolers are kept in a cold room prior to use to ensure that they are pre-cooled). Coolers are kept in the shade during gamete collection.
18. Transfer fish to recovery container and gently stroke out remaining air. Hold the fish head down with the belly facing upwards in the recovery tank as this forces any trapped air to the vent area where it is most easily expelled.
19. Return spawned steelhead to recovery condos for recuperation (separate from other fish that have not yet been spawned). Spawned females are kept in recovery condos for several days (3-5 days). After this recovery period, fish are released into the main river near the intake area.

    Recommendation: Rinse the needle in alcohol (95% ethanol or isopropyl alcohol) between uses to avoid introducing any potential pathogens between adult fish.

4.5.2.2 Spawning – Male Steelhead

1. Males are anaesthetized with clove oil (see *Anaesthesia*) for the spawning process
2. When suitably anaesthetized, gently remove fish from the anaesthetic bath
3. Once the fish is under anaesthesia, it is grasped by the tail (and supported by the belly if large), dipped in freshwater to remove any clove oil.
4. Dry off the vent area of the fish as well as possible (using a J-cloth or a clean rag) to prevent any possibility of water being added to the milt.
5. Collect 1-5 mL of milt from each male if possible. Milt is expressed into a sterile Whirl-pak™ bag or a plastic sperm jar.
6. Milt is collected from the male fish by cradling the fish, extending the tail while applying firm but gentle pressure on both sides of the body wall at the level of the testes.
7. Any milt with abnormal appearance, or containing blood or feces, will be discarded.
8. The containers of milt are kept at a cool temperature by placing them into a cooler containing ice packs. Gametes are moved immediately to the wet lab following collection. (coolers are kept in a cold room prior to use to ensure that they are pre-cooled). Coolers are kept in the shade during gamete collection.
9. Males are used only once at Chilliwack River Hatchery. Males are kept in recovery condos for a longer period than females in case they are required by other facilities for spawning or sampling purposes.
10. When the fish is ready for release, it is placed in the river near the river water intake

4.5.3 Broodstock conditions to be aware of

If fish display open sores or lesions or deformities they are generally discarded and not used for broodstock.

When taking eggs, inspect the kidney and should it appear unusual, display lesions, smell, or be necrotic or liquefied, discard the fish and the eggs taken from it.

Any fish with an open body wall wound that allows water into the body cavity is not used for gamete collection

If the eggs have water hardened they will be discarded depending on the numbers. Conditions that may lead to water hardening are extracting under water or fish being over ripe

Ovarian fluid will be visually assessed for opaqueness, which may lead to discarding of the eggs

If the eggs appear bloody this may be due to over handling or an improper killing and bleeding technique. These eggs will be discarded

If eggs are foul smelling they will be discarded

If milt is bloody milt it is disposed of

If fecal matter is present in the milt, discard the sample and attempt to extract more from same male

Forms & Records:

Salmon spawning records (Kept in species specific brood year binders)
Steelhead spawning records (Kept in species specific brood year binders)
Egg incubation record (2 pages) (Kept in species specific brood year binders)
Egg take record (specific egg lots) (Kept in species specific brood year binders)
EnPro
Egg Acquisition form (Kept in the fertilization wet lab, multi species) Place into the daily records at the end of the season
Adult holding forms (salmon/steelhead)(See *Broodstock Selection*) (Kept in species specific brood year binders)
ATU sheets (Kept in species specific brood year binders)

Egg Acquisition form.pdf
Egg Take Record.pdf
Egg incubation record.pdf
ATU sheet.xls

References:

Egg Disinfection
Broodstock Handling
Anaesthesia
Egg and Milt Transport
Diagnostic Sampling protocols

4.6 Egg and Milt Transport

Rationale: Gametes must be transported properly to maintain their viability. Strict biosecurity protocols must be in place to minimize pathogen transfer from the broodstock location to the hatchery. The goal of this SOP is to ensure that gametes are transported safely to the hatchery and pathogen spread is minimized between the spawning site and the hatchery site.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

It is ensured that all necessary transfer permits for eggs being moved offsite by other parties are in place and the paperwork carried with the shipment during transit.

No eggs are brought to this facility from outside the watershed, therefore no permits are currently required for moving gametes onto the site.

Eggs are contained in clean sealed ice cream buckets and milt are contained in sealed plastic sperm jars or whirl paks.

The containers containing the gametes are handled in a hygienic manner.

Gametes are placed into insulated containers and their temperature is maintained as close to the originating temperature as possible using blocks of ice or ice contained in ziplock bags. The containers must be clean and have secure lids.

Forms & Records:
http://www-heb.pac.dfo-mpo.gc.ca/intro_trans/form_b_e.pdf

References:
Egg Disinfection
Equipment disinfection
Gamete Collection (Egg Take and Milt Collection)
Federal-Provincial Introductions and Transfers Committee web page

Incubation

A basic understanding of egg development can be of great use in understanding the incubation requirements of those eggs. Salmon and trout eggs become progressively more fragile during a period from roughly 48 hours after water hardening until they reached the eyed stage. The eggs should not be handled during this extremely sensitive life stage.

Once the eggs reach the eyed stage, they are quite resilient and can withstand handling. This is the point at which egg shocking and egg picking generally should take place. Regardless of their less delicate nature at this stage, eggs should still be treated with care to avoid undue stress or damage.

Eggs are a delicate life stage and there are a number of factors that affect their health and development. Light, temperature, and oxygen are the three primary considerations in incubation. In nature, salmonid eggs are buried safely in redds, in cool, flowing, oxygen rich waters. In culture, we must attempt to mimic these conditions as best we are able to ensure high quality fry and good survival rates. In nature, the water in which eggs rear is exposed to many different pathogens and mortality rates to hatch are often high. In culture, we can protect the eggs during incubation from this early mortality through simple protective methods and appropriate disinfection procedures to prevent the introduction and/or spread of disease.

Predicted embryonic development times for five species of Pacific salmon and steelhead trout, using the models listed in Table 3 from Billard and Jensen (1996). Taken from Clarke 1997.

Species	Temperature ° C	Yolk plug closure		Eyed stage		50% hatch	
		Days	ATUs (°C-days)	Days	ATUs (°C-days)	Days	ATUs (°C-days)
Chinook	5.0	26.7	133.5	51.5	257.5	102.4	511.8
(O. tshawytscha)	7.5	17.9	134.5	34.2	256.6	70.3	527.5
	10.0	13.4	133.5	24.9	249.2	52.6	526.4
	12.5	10.6	132.1	19.2	240.5	42.1	525.7
Chum	5.0	31.9	159.6	50.1	250.3	99.6	498.2
(O. keta)	7.5	19.3	145.1	32.4	243.3	72.3	542.3
	10.0	13.3	133.0	22.9	229.0	54.4	544.5
	12.5	9.9	123.2	17.1	214.1	42.7	533.2
Coho	5.0	22.8	114.1	46.1	230.6	93.6	467.8
(O. kisutch)	7.5	16.3	122.1	31.5	236.6	63.1	473.6
	10.0	12.0	119.7	22.8	227.8	45.9	459.5
	12.5	9.0	112.9	17.1	214.4	35.6	444.8
Pink	5.0	36.7	183.4	51.4	257.2	109.0	545.0
(O. gorbuscha)	7.5	22.2	166.2	32.3	242.5	80.9	606.4
	10.0	15.1	151.5	23.1	231.4	63.0	629.6
	12.5	11.2	139.4	17.8	222.7	54.0	674.9
Sockeye	5.0	27.3	136.4	48.2	240.9	122.8	613.8
(O. nerka)	7.5	18.3	137.0	34.3	257.2	90.5	679.0
	10.0	12.6	126.0	25.0	249.6	69.3	693.2
	12.5	8.9	111.4	18.5	231.7	55.4	692.5
Steelhead	5.0	17.6	88.0	34.3	171.4	70.7	353.4
(O. mykiss)	7.5	11.7	87.5	23.9	179.5	47.2	354.0

	10.0	8.5	84.6	17.1	171.0	32.9	328.6
	12.5	6.5	81.1	12.5	155.9	24.8	309.8

Billard, R., and J.O.T. Jensen. 1996. Gamete removal, fertilization and incubation. Pages 291- 363 *In:* W. Pennell and B.A. Barton, Editors. Developments in Aquaculture and Fisheries Science V. 29: Principles of Salmonid Culture. Elsevier, Amsterdam.

Clarke, C. 1997. Predictions for salmonid egg development. Aquaculture Update No. 80. Fisheries and Oceans Canada. http://www.pac.dfo-mpo.gc.ca/sci/aqua/AQ/aq80.pdf


Predictions for egg development.pdf

Clarke, C. 2000. IncubWin: A New Windows 95/98/NT Computer Program for Predicting Embryonic Stages in Pacific Salmon and Steelhead Trout. Aquaculture Update No. 87. http://www.pac.dfo-mpo.gc.ca/sci/aqua/AQ/aqupdate_e.htm#y1996 http://www.pac.dfo-mpo.gc.ca/sci/aqua/sirp/incubwin_e.htm http://www.pac.dfo-mpo.gc.ca/sci/aqua/sirp/sirp_e.htm


IncubWin:Predicting Embryonic Stages

4.7 Fertilization & Incubation

Rationale: The micropyle is in its greatest open position at the time the egg is taken from the fish. This small appendage commences to move to one side as soon as water entering through the pores starts mixing with the perivitelline fluid and fills the void between the outer shell and the yolk membrane. As soon as this occurs, the opening decreases in size and continues to do so until the micropyle has moved into a position which completely seals off the opening to the outer shell. Therefore the possibility of fertilizing the egg gets progressively poorer as the micropyle opening get smaller, and since the spermatozoon enters only through the micropyle, fertilization is impossible after sufficient time has elapsed to allow the micropyle to close. Therefore, dry fertilization is recommended to ensure the greatest degree of fertilization prior to the addition of water. The goal of this SOP is to ensure hygienic and effective fertilization of eggs.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Eggs should be dry fertilized to increase fertilization success and reduce the introduction of potential water borne pathogens into the egg.

Details of the Procedure:

Well water is used for fertilizing steelhead eggs. River water is used during fertilization of all other salmon species

Spawnings are performed on a 1:1 basis.

1. Eggs and milt are taken in separate, clean, dry containers
2. Gametes are mixed in a dry environment out of direct sunlight in the wet lab
3. Add milt from one male to eggs from one female in a clean bucket
    - Steelhead may produce a very small amount of sperm making it difficult to get the milt out of the container therefore a small amount of water may be added to the milt and this mixture is added when water is added for hardening
4. Mix the eggs and milt gently by hand
5. Allow the gametes to rest undisturbed for 10-30**s** for fertilization to occur
6. Add enough water to the bucket to cover the eggs and stir the mixture by hand
7. Allow to sit for approximately one minute
8. Add additional water to rinse the eggs
9. Decant the water off to wash the eggs

10. Repeat steps 8-9 until the water is clear and all broken eggs, blood and any other contaminants are removed (visually clean)
11. Other than steelhead, groups of eggs will be pooled into large perforated containers (large sieves)
12. Following fertilization and washing, eggs are disinfected to reduce the possibility of external pathogens entering the incubation system. (See *Egg Disinfection*)

Forms and Records:

Egg take records (See *Gamete Collection (Egg Take and Milt Collection)*)

References:

Egg Disinfection

4.8 Egg Disinfection

Rationale: Eggs can be safely disinfected following fertilization, during or after water hardening. The purpose of egg disinfection is to minimize the pathogen load which may have come from the broodstock and decrease subsequent spread of pathogens between eggs or egg batches. This SOP addresses section 2.1.3.7 of the General Principles of Fish Health Management. The goal of this SOP is to ensure safe disinfection of eggs following fertilization.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Ovadine™ is commonly used at fish hatcheries for equipment disinfection. It has also been safely used for over two decades as an egg surface disinfectant during water hardening.

Ovadine™ is under review by the Veterinary Drug Directorate for approval as a fish egg disinfectant. Until approval is received, it is available only by prescription from a licensed Veterinarian, through Health Canada's Emergency Drug Release (EDR) program (see Appendix for Ovadine™ Emergency Drug Release (EDR) – Hatchery Reporting Requirements information sheet)

Eggs may be disinfected at water hardening after fertilization, after egg picking, and after eyed eggs are transferred to a new site.

Disinfection should not been done within 5 days of hatch, as it can stimulate premature hatching with increased mortalities.

Eggs are treated with a 100 ppm iodine solution for 10-15 minutes. A 100 ppm concentration of Ovadine™ is made by adding 10 mLs of Ovadine™ to each litre of water.

Details of the Operating Procedure:

4.8.1 Heath Trays:

An average heath stack tray will hold 10-11 litres of Ovadine™ solution; the actual volume will be predetermined before starting.

4.8.1.1 Steelhead and offsite coho eggs in Heath Trays:

1. Following fertilization and rinsing (See Fertilization SOP) eggs are gently transferred to a Heath tray preloaded with 100 ppm Ovadine™ solution buffered with baking soda, and allowed to sit without disturbance.
    - A suitable ratio is 1 volume of eggs to 10 volumes of disinfectant solution.
    - The Heath tray is pulled out of the stack
    - Water is drained from the tray

- A solution of 80 mL Ovadine and 1.3 g baking soda (16 mg/mL) is prepared directly in the tray
- 8 L of water is added to the tray
- The solution is mixed well
- Eggs are added to the tray and allowed to sit, undisturbed, for ten minutes

2. After ten minutes the tray is gently pushed all the way back in the stack to start fresh water flowing over the eggs.
3. Fresh disinfectant solution is used for each batch of eggs.

4.8.2 Other incubators

All other batches of eggs are disinfected prior to placement in incubators i.e. Atkins and Zengers (No Pad Incubators)

1. The portable tub bath is set up
2. Mix 2.1 L Ovadine, 34 g baking soda (16 mg/mL)
3. Add 210 L water and mix well
4. Pooled sieves of eggs are placed in the bath for ten minutes
    - Tray baskets can be placed into racks and the racks can be submerged in the tub bath
5. After ten minutes, the sieves/racks are removed and drained and placed into the appropriate egg container
6. The disinfectant solution will be a rusty brown colour when it is fresh, but as the iodine degrades, the solution will start to lighten in colour to yellow indicating a loss of activity and effectiveness.
7. Solution will be changed when the colour changes to yellow

Local waste management regulations regarding safe disposal are followed. Diluting spent Ovadine™ bath solutions with the rest of the effluent from a facility will be sufficient before discharging to a stream; however, if dilution is not possible, it can be safely disposed to ground.

Forms & Records:
Ovadine™ Usage Form
Chemical use inventory sheets (Kept in the dry lab for the season, once filled out kept on file)

References:
Ovadine™ data sheet: http://www.syndel.com/d_p_f_s/ovadine_info_sheet.html
Veterinary chemicals: http://www.dfo-mpo.gc.ca/science/aquaculture/aah/veterinary_chemicals_e.htm

4.9 Egg Fungal Treatments

Rationale: Dead eggs serve as growth media for saprophytic fungal infections. Once a fungal infection has started, it rapidly spreads to adjacent eggs and can result in poor survival to hatch. Egg disinfection and picking (see *Egg Disinfection* and *Egg Shocking, Picking & Egg Enumeration*) are the first steps in preventing fungal infections. However, depending on water source, temperature and hardness, preventing and controlling fungal infections of eggs may be best accomplished by administering chemotherapeutants. The goal of this SOP is to safely manage fungal infections of eggs.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

A site-specific fungal treatment program is determined by the Fish Health Management Team. Management will vary according to historical egg fungus infection rates and egg survival data.

Egg batches are observed on a routine and frequent basis to assess and track the development of mortalities and fungal infection.

Approved chemotherapeutants for egg disinfection include: Parasite-S™ (a formalin-based solution) and Perox-Aid™ (hydrogen peroxide).

4.9.1.1 Parasite-S MSDS information:

Formalin must be handled with care. It is harmful if inhaled, and can seriously irritate eyes and skin after contact. Formalin should only be handled in well ventilated areas, preferably while wearing a respirator and safety glasses. Staff should review WHMIS information prior to handling this product and employ appropriate personal protective equipment.

Parasite-S contains methanol which inhibits the formation of paraformaldehyde, a white precipitate that is extremely toxic to fish. Even so, formalin should be stored in the dark above 10^{o}C and not allowed to freeze. If Parasite-S is allowed to freeze, it should be discarded due to the rapid formation of paraformaldehyde.

The toxicity of formalin increases as temperature increases. In very soft water, concentrations of formalin should not exceed 25 ppm. Concentrations greater than 250 ppm may cause severe gill damage and should not be used on salmonids.

Formalin is a gill irritant and thereby reduces gas exchange. This is especially of concern as formalin is commonly used when fish gill function may already be compromised. Additionally, formalin is a reducing agent that absorbs oxygen from the water. Therefore, the safest course is to treat with formalin at the time of day when the water temperature is at its lowest, and to provide supplemental oxygenation via airstones. The fish should be closely monitored during treatment for

signs of respiratory distress (increased opercular movements or gasping at the surface) and the treatment terminated if needed.

Details of the Operating Procedure:

A calculation sheet is on the cupboard door in the wet lab

4.9.2 Parasite-S treatment on pre-eyed eggs

When handling Parasite-S rubber gloves, respirator mask, eye protection and rain gear are worn.

Parasite-S is used to control fungus from fertilization on pre-eyed eggs three times per week (M,W,F) and continued through until eggs are shocked.

1. The cart holding the peristaltic pump (Masterflex pump) is set up next to the container being treated
2. Check and calibrate the pump
3. Calculate the flow by pumping a volume of water into a beaker and time for one minute.
4. Ensure that incubator flows are set to the standard i.e. Atkins cell at 25lpm; Heath trays at 16 L/min; Zenger/Nopad at 53 L/min.
5. Adjust the flow on the peristaltic pump to 140 mL/min for Atkin's cells (set the time on the pump for 20 minutes or 1200 second) 90 mL/min for Heath trays (set the time on the pump for 16 minutes or 1020 seconds) and 295 mL/min for Zengers
6. Mark the treatment for the container being treated as it is completed
7. A stock solution is prepared as follows: 300 mL/L Parasite-S is mixed (3 L parasite S plus 7.0 L water) This is equivalent to 300,000 ppm or µl/L of stock solution.
8. The stock solution is placed into a labeled container
9. The pickup line is placed into the stock solution and the outflow tube is placed into the container to be treated
10. Turn on the pump
11. Treat for time as above in point 4
12. After the time is up the pump will turn off automatically
13. Turn off the pump, put the delivery end into a bucket on the side of the cart to keep drips contained
14. Store the cart with the pump in the incubation room until the next use

4.9.3 Metering Pump for Flow through Parasite-S Formalin Treatment for Eggs (pre-eyed)

The stock solution for treatment of eggs is made up using the following mix:

3.0 L of Parasite-S (Formalin)

7.0 L of fresh Well Water

The resultant stock concentration is 300,000 ppm (micro liters Parasite-S /Liter of solution). e.g. 3,000,000 microliters/10.L

All standard egg treatments are for 15 minutes at a peak target concentration of 1670 ppm.

Set the metering pump to the specified flows rate for type of incubator with the standard flow rates to achieve effective treatment at 1670 ppm of Parasite S. are as follows:

Incubator Type	*Duration	Incubator Flow	Pump Speed
HEATH/FAL	16 minutes	16 L/min	90 mls/min
ATKINS	20 minutes	25 L/min	140 mls/min
ZENGER/NOPAD	20 minutes	53 L/min	295 mls/min

***Note 1.** That the standard treatment (Syndel recommended treatment) for eggs is 1670 ppm for 15 minutes. To adjust for turnover time or the time it takes to fill a Heath tray/Atkins cell/Zenger tray we have added on to the 15 minutes. This assumes all other parameters stay the same. If any of the basic parameters change i.e. stock concentration, target concentration, incubator flow, incubators etcetera, you will have to recalculate.

***Note 2.** Re-check flows, recalibrate/service metering pump and hoses and check stock concentration solution to ensure appropriate delivery of target concentration to incubators.

***Notes**:

- Make sure the hose is below the surface of the water to eliminate fumes as much as possible
- Open doors and turn on exhaust fan to remove the fumes for human safety

Forms & Records:

Treatment sheet

References:

Parasiticides and Fungicides: http://www.syndel.com/d_p_f_s/parasiticides_fungicides.html
Parasite-S™ data sheet: http://www.syndel.com/d_p_f_s/parasite-s_info_sheet.html

4.10 Egg Shocking, Picking & Egg Enumeration

Rationale: Dead eggs are removed to reduce fungal growth and disease transfer. This SOP addresses section 2.3.2 of the General Principles of Fish Health Management. The goal of this SOP is to ensure effective removal of dead eggs, which can serve as growth media for saprophytic fungal infections.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Following egg planting in the incubation containers, eggs are not disturbed until they reach the appropriate ATU (species dependent). See Incubation ATU chart.

After eggs have reached the eyed stage, they can be physically shocked to allow the discrimination between viable and unviable eggs. Shocking will rupture the yolk (vitelline) membrane of eggs which are undeveloped or infertile and result in an influx of water turning the egg white. Dead eggs may be removed, or picked, as required to keep the proportion of dead eggs in the incubators to a low level.

Eggs may be picked by hand using modified tweezers or through the use of mechanical pickers . Mechanical egg pickers are operated according to the manufacturer's specifications. Regardless of the method, tweezers or mechanical pickers should be sterilized between egg batches (see *Equipment disinfection*).

Details of the Operating Procedure:

4.10.1 Egg Shocking

4.10.1.1 Atkins Cells

Eggs which have been incubated from the beginning of incubation in Atkin's cells are shocked as follows.

1. Using a large diameter (~ 1") clear siphon tube the eggs are siphoned into a large perforated sieve bucket that is placed into a large garbage bucket that has a drain that is lower than the top of the sieve bucket
2. The eggs are siphoned out of the Atkin's cell into this sieve bucket
3. Eggs are then poured back into an empty Atkin's cell such that they drop approximately 12-16"
4. The empty Atkin's cell is cleaned of silt and debris to below the screen
5. Eggs are allowed to sit for overnight to allow the dead eggs to turn white.
6. The following day dead (white) eggs are removed using an automatic egg picker or manual tweezers depending on numbers of dead eggs.

4.10.1.2 Heath trays

1. Heath trays are pulled out from the stack
2. The screen basket is removed from the tray
3. A square basin is set up with several inches of water
4. The eggs are poured from the basket into the basin
5. Eggs and water are poured from the basin into the water filled basin pouring from a height of approximately 16”
6. Clean the tray and basket and replace the tray in the stack to refill with water.
7. Eggs are poured into the clean basket which is replaced in the tray and the tray is returned to the stack for 24 hours.
8. After 24 hours the dead eggs are hand picked with modified tweezers
    - If groups are large, the automatic egg picker may be used.
    - If eggs are extremely fungused, a salt solution may be employed to float the dead eggs
    - Note that live eggs attached to fungus balls more than likely will be infected and should be removed with the fungus mass.

4.10.2 Egg Picking:

Equipment

Picking

- Jen Sorter Egg picker and accessories
- Dip nets
- Empty heath tray baskets to sort through eggs over the Atkins cells eggs are to be returned to
- Buckets
- modified tweezers

Enumeration

- Scale
- Pencil and water proof paper
- Colander
- 100 egg paddle
- Calculator
- Bucket

Procedure:

1. Small groups with only a few dead can be picked by hand with tweezers (~1000 eggs);
2. Large groups are to be picked using the Jensorter Egg Picker (please read manual write up of operation before using this machine)

4.10.2.1 Use of the Automatic Egg Picker

Note: For the automatic egg picker to work effectively, the shocked eggs must be clean and free from fungus. The integrity of the individual eggs must also be able to withstand the handling, e.g.

Frequently through the season you may run into a group of eggs that are 'soft shelled'. Eggs in this condition break easily when handled individually and particularly when subject to automatic picking. Broken eggs will foul the automatic picker and sensors, which will reduce the effectiveness of automatic picking. In this case refer to instructions on cleaning the machine and in particular the sensors, before resuming picking. In general discard groups with soft shell eggs it is severe. (i.e. greater than 50% of the total group).

1. Select the appropriate sized wheel for the Jensorter according to the size of the eggs
2. Two buckets with drain holes are placed below the ejector nets
3. Ensure the water that is ejecting the live eggs is of a pressure that is not too high when ejecting. It is undesirable to have them hit the sidewall of the ejector ramp as this will further shock them
4. Put 1 – 2 trays of eggs into the hopper
5. Turn on the egg picker
6. Monitor both exits to ensure selection of live and dead eggs is correct (i.e. that eggs going into the dead egg sieve are not actually live eggs)
7. Fine tune effectiveness of the photo-cell so live and dead eggs are being differentiated properly.
8. Check the hopper occasionally to make sure all the eggs have gone through
9. After the eggs have been picked a live and dead egg enumeration is performed

4.10.3 Egg Enumeration:

1. Take a pooled sample of the eggs from several containers representing the entire group
2. Drain the eggs
3. Tare a small plastic beaker
4. Place the eggs in the beaker until 100 g is achieved
5. Repeat this several times
6. Eggs are counted to determine number of eggs/kg

Dead egg counts are performed similar to the procedure above. One 100g sample is performed on small groups. On larger groups, the maximum number of groups enumerated is three. Drain them as well as possible using a strainer or colander.

Forms & Records:

Cumulative mortalities for each incubation container are recorded in ENPRO.
Egg incubation records
Waterproof green egg data and egg shocking and picking sheets
Egg take records


ATU sheet.xls

References:

Clarke, C. 1997. Mechanical Shock sensitivity in salmonid eggs. Aquaculture Update No. 78. Fisheries and Oceans Canada. http://www.pac.dfo-mpo.gc.ca/sci/aqua/AQ/aq77.pdf


Shock sensitivity in eggs.pdf

Jensen, J.O.T. and D.F. Alderdice. 1983. Changes in mechanical shock sensitivity of coho salmon (*Oncorhynchus kisutch*) eggs during incubation. Aquaculture. 32: 303-312.

Jensen, J.O.T. and Alderdice, D.F., 1989. Comparison of mechanical shock sensitivity of eggs of five Pacific salmon (*Oncorhynchus*) species and steelhead trout (*Salmo gairdneri*). *Aquaculture*, 78: 163-181.

4.11 Ponding

Rationale: Removing fry from incubators when 80-90% of fry have utilized 80-90% of their yolk-sac promotes growth and reduces fish health risks from early ponding. Not removing fry from incubators at this stage of development or not ponding fry based on a maximum wet weight measurement poses a risks to initiating proper feeding and to fish health from early ponding. The goal of this SOP is to ensure that fry are ponded at the appropriate time and in the appropriate manner to ensure maximum survival and transition to feed.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

4.11.1 Determination of swim up:

1. Check the ATU records (located in each office on site) to determine appropriate timing to check for swim up. Also observe for fry freely swimming in the tray basked and gulping air to fill their swim bladder. If the ATU's and the swimming behavior are consistent, proceed to the following examination.
2. Using a clear beaker, a small number of fry are removed (approx. 20-50 for checks) and visually evaluated as to the degree of yolk remaining based on species dependent characteristics.
    - This determination is species specific and is based on the degree of belly slit/yolk that is still visible.
        - Coho/Steelhead - almost buttoned up and slim.
        - Chinook – some yolk is still visible, the slit is not completely closed, and there is a visible roundness to the belly
        - Chum - very similar to the Chinook, with slightly less yolk remaining. Chum will be seen to begin emerging from the gravel in the Keeper channels. This is the main indication of swimup. A beaker check is generally not employed for these fish.

3. If it is questionable that the fry are prepared, a small number (single bucket) may be ponded and observed for swim up behaviour.

Notes:

If there is any doubt as to preparedness for ponding, a second staff member will examine the fry. Should there be any doubt, fry may be ponded a day or two later or a small group of fry may be tested to ensure that they will swim up when placed in their rearing container rather than remaining on the bottom.

4.11.1.1 Egg placement to Keeper Channels and Ponding Chum:

1. For large groups of eggs (i.e. chum) the eyed eggs are collected from Atkin's cells and poured into a sieve bucket
2. Drain the water from the eggs and take them to the fertilization room
3. Tare a second bucket (2.5 gal), containing a small amount of water, on a scale
4. Pour the drained eggs into this second bucket
5. Weigh the bucket of eggs
6. Determine total number of eggs per kg based on the enumeration samples (See Egg Shocking and Picking SOP)
7. Place the eggs on the vexar screen which sits on top of the layer of rock in the keeper channel. Numbers are based on the target number of eggs per m^2 per keeper channel loading
8. Eggs in the keeper channels are not picked after placement.
9. On hatch live alevins fall through the vexar screen, dead eggs remain on the screening.
10. Once a section has hatched, the lids are removed from the keeper channels, the vexar screens are placed aside and the dead eggs are counted on the screens for calculation of live on hand for purposes of inventory control.
11. Lids are replaced and fry remain until swim up stage.

Keeper channel checklist

1. Ensure there is a mixing chamber at the top end of the keeper channels for well and river water to mix thoroughly before going downstream to the keeper ponds full of developing eggs and alevins.
2. Make sure when using groundwater that overflow goes into a full mixing chamber to help prevent supersaturation issues and allow for the thorough mixing of well and river if that is the situation.
3. Use river water to keep growth as similar as possible to that of the wild fish in the river
4. Flow is started at 70 gallons/min (265 L/min) and increased to 100 gallons/min (380 L/min) following hatch
5. Clean channel divider screens twice daily

6. Check for alevin crowding
7. Record egg mortalities and remove egg support screens as soon as possible. Rebuild gravel berms if needed, it is important that the gravel berms reach the surface of the water to prevent migration

4.11.1.2 Ponding Fall Chinook

Fall Chinook are incubated in Atkin's cells. The process followed for egg placement and ponding in the keeper channels is the same as above for chum.

4.11.1.3 Ponding from Heath trays

1. Swim up fry are removed from Heath trays and poured into a bucket containing water (27L bucket approximately half full) (one heath tray per bucket). Use dark buckets to screen out daylight.
2. The bucket is carried out to the rooters (small raceways) (four buckets at a time can be moved) and the fry are gently poured into the raceways. Ensure that the transport is done within 5 minutes or less to prevent suffocation crowding of new fry while in their bucket. E.g. Fry tend to sound to the bottom to escape the trauma and particularly the light, which on bright days has more effecgt on this behaviour. Try to pond first thing in the morning when the day light intensity is low. Swim up after ponding can be slow when the day is bright. Over time they will swim up. Space the ponding out such that you avoid a large group clumping or sounding all at once to the bottom. This may happen if it a bright day and/or they are not ready or are severly stressed by delayed transport.
3. The healthy fry should all be swimming after two days, then first feeding can be initiated.

Notes:

- Summer Chinook are bulk incubated in Atkins cells and inventoried into Heath trays.
- Fry are moved to the Heath trays at the eyed stage following shocking and picking (See *Egg Shocking, Picking & Egg Enumeration*)
- Following swim up, fry are moved to raceways as above.

Forms & Records:

ATU chart
Egg inventories
Monthly juvenile rearing records


Juvenile Rearing Records.pdf


ATU sheet.xls

References:

Clarke, C. 1997. Predictions for salmonid egg development. Aquaculture Update no. 80. http://www.pac.dfo-mpo.gc.ca/sci/aqua/AQ/aq80.pdf

Rearing

Rearing constitutes the period immediately following ponding when feed is first offered until fish are released. This is obviously an important period, particularly in light of the fact that this is the period when the single most costly factor arises in hatchery production of fish, namely feed. If fish are not maintained in the healthiest manner possible, feed is being wasted as the fish partition energy into process other than growth.
Proper nutrition aids in growth and health, addition of immunomodulators may give an important boost to fish, especially during periods of stress such as handling, marking, higher than average water temperatures etc. The best foods available may lose their value through improper storage, therefore it is important that feed is maintained in a pest free, cool environment to ensure that fats and oils do not go rancid and that vitamins remain biologically available to fish. There is little point in spending money on fish feed if it is not cared for in a manner that ensures it meets the nutritional requirements of the fish.

Stress is a major factor in fish health and factors that result in stress to fish should be mitigated to reduce incidence of disease on any facility. Stress can result from many factors. Inadequate water quality accounts for more disease outbreaks than any other factor. High water temperatures, low dissolved oxygen levels, excessive suspended solids, nitrogenous waste build-up and a host of other factors can result in physiological stress which can funnel energy reserves away from the immune system reducing disease resistance in favour of maintenance of homeostasis. Improper protection of fish through the use of covers, predator netting or other deterrents may result in losses to predation and associated stress in surviving fish. Inadequate cleaning of enclosures can lead to biofilm development and may provide harbour for potential pathogens. These represent a fraction of the potential stressors that can occur on a fish culture facility and merely serve to highlight the importance of reducing stress during rearing.

While it is preferable to handle fish as little as possible, some handling is required to ensure appropriate daily rations and to avoid waste and associated reduction in water quality. To facilitate this, regular determination of average fish weight in an enclosure is necessary. It is important that representative samples are taken, thus it is important to take samples in a random manner with fish crowded to resolve any bias in the process.
In most cases, hatchery fish are marked as such through the use of fin clips and, in some facilities, the use of coded wire tags. Again, this is another handling procedure and in this case anaesthesia will be required to reduce the degree of stress on the fish during the process. As in all handling procedures, care should be taken to minimize stress and any possible damage to the mucus coat of the fish, both of which can lead to an increased susceptibility to pathogens present in the water system.

Rearing represents the greatest time and energy investment during the entire process of fish culture at an enhancement facility and as such, it is a period that requires care and attention to details that may seem relatively minor, but may well determine the overall health of the population.

4.12 Feed, Feed Storage, & Feeding Practices

Rationale: Proper storage and handling and distribution of fish feed is essential to maintain the nutritional value of the feed. Uneaten food generates an ammonia cloud as it breaks down and this can be detrimental to fish. Additionally, uneaten fish food generates suspended solids and these can lead to bacterial gill disease. If a maximum ration is fed to small fish, these constraints can be more restrictive than oxygen criteria. That is, more water is required to flush away particulates than is required to maintain dissolved oxygen levels. Low concentrations can be equally detrimental if sustained for long exposure periods. This SOP addresses section 2.1.2 of the General Principles of Fish Health Management. The goals of this SOP are to ensure that feed is stored in a manner that ensures its nutritional value is maintained and that feed is distributed appropriately to fish.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

4.12.1 Feed Storage

Feed is stored in the freezer in the main building such that wildlife is excluded and feed is kept protected from extremes of heat, light and humidity. Dry feeds should be stored at temperatures <20^{o}C and humidity <75%.

The freezer area is through the cooler area and is forklift accessible. Feed is stacked in a single layer to make access easier and safer for personnel.

Windows and doors to feed storage buildings are to be kept closed to exclude pests.

Feed for immediate use and feed in feeders should be similarly protected in sealed top containers to protect it from humidity and light, and should be replaced frequently with feed from storage.

4.12.2 Feed

Ordering of feed is limited to fewest times per year possible. Feed is rarely held for more than six months.

Feed is obtained from a feed mill that has been inspected by the CFIA. (EWOS and Skretting) and bags should be labeled with the date of manufacture and guaranteed analysis information.

Feed lot numbers are recorded to track feed and responses

Note: The hatchery intends to develop a feed recording chart to follow responses to different feeds and feed lots

Feed is rotated so that newer lots of feed on site are fed out last (moved to the back) and any spilled feed is cleaned up immediately.

Medicated feed, when in use, will be clearly identified and used immediately. (See *Medicated Feed: Storage, Handling, and Feeding*)

4.12.3 Feeding Practices

Feed is measured into lidded 5 gallon plastic buckets the day before feeding. Uneaten feed is not returned to the freezer but will be documented in the daily feed records. Unfed feed will be fed the following day unless contamination has occurred (i.e. it has become wet etc).

If the lids to the buckets crack or leak, they are replaced. Buckets are cleaned as needed (with soap and water). If feed gets wet, buckets are cleaned out that day and paper towels are used to wipe out excess feed and moisture. Buckets are wiped with paper towel on a daily basis to ensure feed residues do not become rancid or fungused.

Fish will be fed at appropriate intervals with a nutritionally adequate feed. Delivery is in excess for the first 5 days to get fish onto artificial feed. After first feeding (5 days) fish are moved on to a regular feeding schedule.

- The modified Stauffer's and modified Moore Clark(Skretting) feed schedules are used.
- Note: These feed schedules were modified to reflect the change from moist to dry feeds that took place over 10 years ago.

Feeding and feed size-sorting should be optimized to ensure all fish have the opportunity to feed. Feed schedules will be adjusted based on conversion rates and unaccountable losses (predation). Expected unaccountable loss is assumed to be 1% one month due to predation. Feed schedules are adjusted according to this rate.

- During the winter months, **coho** are placed on a maintenance diet and feed is reduced. Fish are fed three days out of seven and starved for four day periods when temps ~4^{o}C. When the temperatures begin to rise, feed is increased again.

Fish are observed regularly during feeding to determine if they are responding as expected and if the volume of ration is sufficient or if overfeeding is occurring (based on growth rates and waste).

If heavy rainfall leads to increased turbidity of the water feeding is stopped until clarity improves.

Overfeeding is avoided due to its effects on water quality and the stimulation of potentially harmful bacterial and fungal growth.

Fish are observed daily for signs of health, injury and disease during daily feeding. Observations of feeding behaviour, water quality etc, are noted. Feeding may be adjusted or removed based on these observations.

When automated feeders are used, the equipment is serviced regularly and the rate of intake of the fish checked frequently. Automated feeders are used in the concrete raceways and troughs when frequent feeding is required. The fish culturist is in charge of determining whether automatic feeders will be used. They are used when workload issues deem them necessary but feeding will be supplemented by hand feeding when in use.

Failure to begin feeding or to acquire a sufficient amount of food is considered a major cause of death of larval fish. In the event of food refusal or failure to gain weight (as determined by routine bulk sampling of newly ponded alevins), Fish Health Management, Support Biologists (Brian Anderson is the lead on food related issues), the Veterinarian and the feed manufacturer should be informed and the feed company contacted.

If feed is suspect, contact other facilities and determine if there is a common problem or if this is a site specific issue. Such communication may indicate that stress, O_2, loading rates, predators, etc may be the root cause of feeding changes.

Note: if a feed-related problem is suspected, a sub-sample of food from the lot in question should be bagged, labeled and frozen in case analysis is indicated.

Forms & Records:

EnPro
Stauffer's Feed schedules (Found in any office on site)
Daily feed records (Excel)
Monthly rearing records (in the species specific brood year record binders)

Juvenile Rearing Records.pdf

References:

Medicated Feed: Storage, Handling, and Feeding
EWOS Food Size Guidelines
Fish size feed size guidelines for Chinook, coho, steelhead and trout

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.13 Individual Length/Weight and Bulk Weight Sampling Protocols

Rationale:. Juvenile length-weight sampling is a random, unbiased method used to confirm and monitor fish development. Juvenile growth as well as environmental conditions will determine the ration and rate at which the juveniles will be fed during a rearing program.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Husbandry records should be reviewed to ensure no sign of disease within the population to be sampled. Time held off-feed should be confirmed. All equipment should be assembled and confirmed in good working order before starting.

Fish should be crowded toward the inflow end of the rearing container. Dipnet samples should be taken from various areas/depths of the crowded fish and placed into a large sample tote. This sampling protocol hopes to achieve a representative sample of the entire population.

During bulk sampling, a subsample of fish, totalling ~100 fish should be taken from this group and transferred to a smaller sample bucket (~5 L), and transported to the weigh station with minimum disturbance. Fish should be netted out and drained of excess water before being placed into a tared container of water. The weight should be recorded and fish should be netted out and counted back into a recovery container or back into their enclosure. Repeat samples may be done on each rearing unit.

During length weight sampling, a sub-sample, totalling ~ 50 fish should be taken from this group and transferred to a smaller sample bucket (~5 L), and transported to the weigh station with minimum disturbance. Anaesthetized fish should be gently placed on the measuring board; length (standard, fork or total as directed) should be recorded. The fish are then transferred to the balance for weight measurements and/or placed into a recovery bath. Repeat samples, to a total of 3 per rearing unit, may be done.

Anaesthesia and *Fish Handling Procedures* SOP guidelines should be followed. Anaesthetic baths should be changed between rearing containers, or if time till anaesthesia lengthens or if the bath temperatures differ >2^{o}C from that of the rearing container. Anaesthetic baths must be disposed of in accordance with local waste management regulations.

Details of the Operating Procedure:

4.13.1 Bulk Sampling:

Bulk sampling is used to estimate the weight of the entire population of a rearing container during juvenile development. Juvenile growth as well as environmental conditions will determine the ration and rate at which the juveniles will be fed. Lack of expected gain can be the first indicator of a feed

quality, disease or water quality issue. Additionally, sampling gives the opportunity to visually inspect juvenile fish for clinical signs of disease.

Bulk sampling is performed approximately every two weeks for determination of appropriate feeding rates and feed sizes.

Equipment list:

Person/equipment to crowd fish
Person to sample fish
Large sample dipnet
Smaller sub-sample net
Balance/scale
One appropriate sized tote
Sample pails (~5L)
Notepad with waterproof paper and pencil
Seine net for earthen channels

4.13.1.1 Small Fry in the troughs

Fry are bulk sampled once a week during rearing

1. Bulk sampling is carried out first thing in the morning, prior to morning feeding
2. A mobile scale on a cart is placed near the container being sampled
3. A small basin of water is placed on the scale and tared
4. The troughs are crowded by using a net to spook fish down to one end
5. Using a dip net, one dipnet of fish is removed from the main population of the crowded fish and placed into the tared container on the scale. Record the weight. A target of approximately between 100-250 fish is sampled. This sampling process aims to achieve a representative sample of the entire population.
6. A counting paddle is used to remove fish from the basin and counted back into the rearing container.
7. Equipment is cleaned and dried after use

4.13.1.2 Larger Fry and Smolts in the earthen channels

Juvenile in earthen channels are sampled on a monthly basis (usually at the end of the month)

1. A mobile scale on a cart is placed near the container being sampled
2. Three buckets of water are tared (the buckets are placed by the container)
3. Using a seine net (see steelhead) that stretches edge to edge, fish are crowed down to the lower reaches of the channel

4. A random sample is dip netted out of the main population of the crowded fish and placed into a large bucket of water at the side of the channel
5. The fish are divided up into the three tared buckets ensuring that the net has been drained of excess water (approx 150 fish per bucket)
6. The weight of fish in each bucket is recorded on the data sheet
7. This is performed again if there is considerable variance observed in the fish
8. Using a shallow counting net (holds approx five fish at a time), fish are counted back into their rearing channel and the numbers are recorded on the data sheet
9. Equipment is cleaned and dried after use

Mean Weight = <u>Total Weight of Sample</u>
Number of Juveniles

<u>Forms & Records:</u>
Weights and numbers entered into ENPRO

<u>References:</u>
Anaesthesia
Fish Handling Procedures
Equipment disinfection

4.13.2 Length/Weight sampling:

Juvenile length-weight sampling is a random unbiased method used to confirm and monitor fish development. Accurate size information is a valuable tool to help a manager coordinate release date and size targets in an attempt to mimic the natural life stages of wild juvenile fish. Juvenile growth, as well as environmental conditions, will determine the ration and rate at which the juveniles will be fed during a rearing program.

<u>Equipment list:</u>

- Person/equipment to crowd fish
- Person to sample fish
- Large sample dip-net and tote
- Smaller sub-sample net and labeled sample pails
- Gloves
- Anaesthetic equipment (drug, buffer, airstones, dedicated basin, thermometer, etc.)
- Balance
- Measuring board or ruler
- Notepad with waterproof paper and pencil or computer

<u>Details of the Operating Procedure:</u>

The Chilliwack River hatchery does not do length weight samples except on steelhead (in the earthen channels) just prior to their release as is mandated by the FFSBC.

1. Length/Weight sampling is carried out first thing in the morning, prior to the morning feeding during the week prior to transport and release.
2. The earthen channels are crowded using a seine net.
3. Using a long handled dip net, one large scoop of fish is removed from the crowded fish. This is randomly distributed to three buckets filled with water that have been tared on a scale. This sampling process aims to achieve a representative sample of the entire population.
4. Fish are anaesthetized with clove oil according to the *Anaesthesia* SOP.
5. Fish are individually removed from the bucket and gently placed on a modified ruler, and nose to fork length measurement are recorded.
6. Excess moisture is removed from the fish with a damp paper towel and the fish is placed into a tared container of water and the weight is recorded. The container is tared between each fish.
7. Fish are then placed back into a recovery bucket and are returned to their rearing container following sampling and recovery.
8. Anaesthetic baths are changed periodically during sampling to ensure that the quality of the water is maintained
9. Equipment is cleaned and dried after use

Fish and Wildlife takes the length weights and incorporates them into their own system.

Forms & Records:
All measurements will be recorded in ENPRO.
Wet field notes
Daily records (Excel)

References:
Anaesthesia
Fish Handling Procedures
Equipment disinfection
Growth prediction tables will be available for comparison

4.14 Fish Handling Procedures

Rationale: Handling of fish must be done in a manner that minimizes stress and injury and minimizes the risk of escape. This SOP addresses section 2.1.2 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that fish are handled in as stress free a manner as possible and to ensure that the risk of fish injury or escape is minimized.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Feed should be withheld from fish for a minimum of 12 hrs and a maximum of 72 hrs prior to handling. Determination of the time off food includes consideration of fish size, diet, water temperature and existing knowledge about gut emptying time (gut emptying times are longer for larger fish and colder temperatures).

The crowding of fish should occur for the least amount of time possible to reduce injury and minimize stress.

Materials used in handling fish should have smooth surfaces and be designed to minimize injury to the fish.

Fish must be adequately supported when out of water and must not be handled solely by the tail which can damage the vertebrae. Broodstock are handled gloveless if expected to survive for a period to continue to ripen. Ripe fish are handled with gloves prior to killing for spawning.

Time out of water should be minimized.

Prolonged physical restraint of un-sedated fish should be avoided due to possible damage to the skin and mucus coat. These barriers are critical to protect fish from osmotic stress and infectious agents. Anaesthetics or sedative agents can be used to minimize the stress and injury risk associated with handling procedures like vaccinating, marking, grading and sampling (see *Anaesthesia*).

When fish are handled out of water, anything they contact should be kept wet to minimize abrasions and loss of mucus. Mucus replacements/protectants (i.e. Vidalife™) may be used on handling equipment, within anaesthetic baths or transport water to protect the mucus coat of the fish.

Water quality (particularly oxygen and temperature) is monitored before handling fish. Depending on the procedure, water quality may be measured throughout the handling procedure.

Dip net loads should not contain excessive numbers of fish. Pipes used to move fish should be smooth inside with no sharp bends, or excessive or inadequate water flow.

After handling, fish should be examined for signs of injury or scale loss. Fish are monitored closely for several weeks following the handling episode to allow rapid detection of signs of injury or disease.

Details of the Operating Procedure:

4.14.1 Steelhead Grading

1. Fish are crowded to the upstream end of the trough
2. A divider is placed into the channel and a net basket may be inserted to grade fish into
3. A bar grader (basket with rods spaced a certain distance apart depending on size cutoff) with floatation is set in the water
4. Fish are dipnetted from the trough into the grader prior to marking (when average fish is ~2g)
5. The bar grader is lifted above the surface of the water. The smaller fish will fall out through the bars into the lower empty divided area behind the crowder (or into the net bag if using)
6. Smaller fish may then be moved to another trough

4.14.2 Seining

Juveniles are crowded by seine net from the earthen channels for sampling and transport

1. One staff member is positioned on each side of the channel
2. A seine net (of appropriate size so that fish are not gilled) is stretched across the channel between the two staff members
3. The seine net must be of appropriate length and height to adequately cover the channel and reduce fish escape
4. The seine net is dragged down the channel towards the downstream end where crowded fish are dip netted out according to requirement

4.14.3 Marking

1. Fish are crowded in troughs using a crowder.
2. They are then dip-netted out of the troughs into a net bag in a water filled transport tank and towed to the tagging trailer.
3. From the transport tank, the net bag of fish is lifted out and placed into a holding tank in the trailer.
4. From the holding tank they are taken out by markers and put into a recirculating bath of CO_2 until anaesthetized.
5. Fish are anaesthetized with CO_2 according to the *Anaesthesia* SOP for marking.
6. Fish are netted out of the anaesthesia bath and manually divided between the staff performing adipose clipping. (See Marking SOP)

4.14.4 Injecting

Steelhead broodstock may be injected on the advice of the Veterinarian. If excessive mortality is occurring prior to spawn, adult steelhead, samples will be sent to PBS. Depending on diagnosis a broad spectrum antibiotic may be prescribed and delivered via dorsal sinus injection

Forms & Records:
EnPro
Daily records
Prescription documentation
Juvenile records (Excel spreadsheets)

References:
http://www.syndel.com/handling/vidalife_info_sheet.html
Anaesthesia
Fish Handling Procedures
Equipment disinfection

4.15 Marking Fish

Rationale: Fish are marked for identification purposes. The procedure should be done in a manner that causes minimal injury and stress to the fish. This SOP addresses section 2.1.3.2 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that fish are marked properly with minimal stress or injury. Methods of marking should not negatively affect productivity or survival unless they are part of an institutional approved research protocol.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Crowding time is minimized and equipment used to handle fish has a smooth surface and is designed to minimize injury to the fish (see *Fish Handling Procedures*).

Fish may be collected in dip nets or pumped to the marking location. When dip nets are used, the mesh should be soft and knotless. Net loads of fish should not contain excessive numbers of fish. No more than 1/3 of the net volume should contain fish.

Time out of water must be minimized and if the transport to the marking station exceeds more than a few seconds the fish must be transported in a bucket or tote containing water.

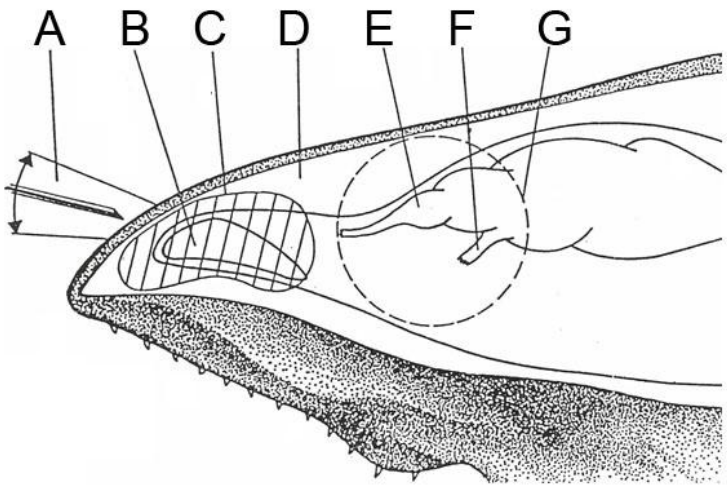
Fish are anaesthetized for the marking procedure (see *Anaesthesia*).

All equipment used for the tagging procedure is cleaned and disinfected prior to use and at reasonable intervals during use. This will decrease the risk of pathogen spread between fish (see *Equipment disinfection*).

For ***adipose fin clipping***, the adipose fin is commonly removed to serve as a quick visual identifier of hatchery origin fish. Proper removal of the adipose fin provides a life-long mark with is not considered to adversely affect the health, behaviour or social interactions of the fish.

For ***coded wire tags***, the tag is implanted in the rostral cartilage and the fish are immediately put into anaesthetic–free water for recovery. Periodically, fall Chinook will be humanely sacrificed to confirm proper placement of the tag.

Scissors are used to remove the fin and fish are placed in anaesthetic-free water for recovery. Scissors will be disinfected periodically and replaced as necessary to ensure sharp cutting edges are used.



Typical Coded Wire Tag Placement

A. Usual range of tagging needle angles
B. Muscle, adipose and fibrous tissue
C. Tag target area
D. Cartilage
E. Olfactory lobe and nerve
F. Optic nerve
G. Position of eye
H.

Details of the Operating Procedure:

4.15.1 Adipose Fin Clipping and Coded Wire Tagging

All juvenile coho and steelhead are adipose clipped prior to moving to earthen channels. Clipping commences at ~2g

Fall Chinook are generally double index tagged with both and adipose clip and a CWT

Transplanted summer red Chinook are not marked

1. Fish are crowded in troughs using a crowder.
2. They are then dip-netted out of the troughs into a net bag in a water filled transport tank and towed to the tagging trailer.
3. From the transport tank, the net bag of fish is lifted out and put into a holding tank in the trailer.
4. From the holding tank in the trailer fish are removed by markers and placed into a recirculating CO2 anaesthetic bath
5. Fish are anaesthetized with CO_2 according to the *Anaesthesia* SOP for marking.

6. Fish are netted out of the anaesthesia bath and manually divided between the staff performing adipose clipping.
7. The adipose fin is removed using sharp surgical scissors. The fish are gently placed into the fresh ambient water pipe leading to the recovery trough into an individual net bag (as outlined in the *Anaesthesia* SOP).
8. Each markers fish are sent to a separate net bag for quality and efficiency checks
9. If coded wire tagging is to be done, it is carried out following adipose clipping and it is performed using coded wire tagging machines.
10. Following marking (as outlined above) fish (fall Chinook) are placed into a trough with flowing water that leads to a shallow net back in the recirculating anaesthesia bath
11. The tagger removes fish from the holding net to inject the CWT
12. Each fish is held in the hand and the head is placed in the head mold. The machine injects the tag into the nose region of the head and the fish is released into the QCD (quality control device) to detect if the fish contains a tag.
13. If the tag is in place the QCD will direct the fish into tubes that leads to the tagged net bag in the recovery trough.
14. If the tag is not in place, fish will be directed to a small `reject' net submerged in water and held until the fish can be retagged.
15. Fish are dropped through the QCD to recheck that there is not a tag in place prior to retagging them.
    - A portion of fish will be placed into a trough to measure tag retention (24 hr and 30 day tag retention)
    - They will be put back through the QCD to measure retention after 24 hrs and after 30 days
    - The rest of the fish are returned to the original pond into an empty space determined for the marked group and monitored for mortality rates
    - After the completion of marking, fish will be released within a 2 week period (generally; as determined by smolting) the retention group is released later. The bulk are contained in their own section (usually the upstream section – best water) If no undue side effects from marking are observed, they will be mixed with the entire population, and within a week they will be ready to be released.
    - When recovery bags are filled, the fish are returned to their containers

    Notes: If marking commences in the second week of April, fish will generally show little impact from marking. However, if marking commences later than this there is an increased risk of the fish smolting when marked and this may lead to increased mortalities

16. The Tagging trailer is thoroughly disinfected between tagging programs. Alcohol sterilization is carried out on the Mark IV machines, cutter, CWT needles and Ovadine is used to disinfect walls, floors and plumbing (See *Equipment disinfection*)

4.15.2 Otolith marking

Otolith marking is performed on fall Chinook in keeper channels when they reach ~600 ATU's. A temperature change of 2 - 3^{o} C per day over a two week period (on and off high, low) creates a life-long mark with no known adverse effects on hatching success or subsequent fish survival, health, behaviour or social interactions.

The marking scheme for Chilliwack Chinook is achieved using a temperature shift between approximately 5.5^{o}C and 8.5^{o}C (depending on available water temperatures) by mixing river and well water. The temperature is cycled from high to low every day over a 14 day period.

However, this mark can only be judged through lethal means and is therefore more of a tool from a stock assessment perspective. As the samples must be sent out for analysis, and this analysis can take a considerable amount of time, it should not be considered to be a visual tool for hatchery staff.

Forms & Records:
Adipose clipping sheets
Coded wire tagging record form
Mark plans (From head office)


Adipose Clipping Form.pdf


CWT tagging form.pdf

References:
Anaesthesia
Fish Handling Procedures
Equipment disinfection

4.16 Juveniles-Health Observations

Rationale: Changes in physical condition and behaviour are good indicators of poor health and/or disease. Early detection is key to good disease management. This SOP addresses section 2.3.3 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that changes in physical condition and behaviour that may indicate poor fish health and/or disease are identified.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

Fish are observed daily for signs of health, injury and disease during daily feeding. Observations of feeding behaviour, water quality etc, are noted. Feeding may be adjusted or removed based on these observations.

Changes in behaviour (decreased feed response, decreased startle response, failure to evade capture, etc.) and physical condition (darkening in colour, failure to gain, external lesions, etc) are reported to the Supervisor and recorded in the broodstock forms and the juvenile rearing records. Any change should be investigated and the causes identified and corrected.

Any laboratory diagnostics are recorded and sheets are kept with the brood year records.

Groups of fish are tracked from their incubation containers to their rearing containers using the juvenile excel spreadsheets. Summary data will be entered into EnPro.

Biological records include: species, stock, ,bulk weight, condition, and comments on appearance.

Fish suspected of having bacterial gill disease or parasite infection will be examined using a microscope. Groups of fish suspected of having a disease are sampled according to the Veterinarian's instructions for lab analysis.

Forms & Records:
Diagnostic sheets
Growth models using EXCEL
ENPRO.

References*:*
Diagnostic Sampling protocols

Release

4.17 Pre-Release or Transfer Disease Risk Assessment

Rationale: Transferring fish between facilities and/or watershed represents a potentially serious breach in biosecurity. The risks are deemed acceptable in situations where the conservation concerns and or marginal water availability or quality make enhancing stocks at a single site impossible. The pre-transfer disease risk assessment helps to inform the Fish Health Management Team of the relative risks of moving fish between sites and to identify mitigating factors to lower the risks associated with animal transfers. The goal of this SOP is to ensure that the decision making process in the pre-release or pre-transfer disease risk assessment process has been appropriately detailed.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

(Please refer to the *Juvenile Release* and the *Juveniles-Health Observations* and *Mortality Classification*)

Assessment:

For each proposed transfer of fish the Fish Health Management Team will consider the following information:

- species, life stage, disease and treatment records
- location of receiving facility or watershed
- disease history of the current rearing facility
- history of pathogen surveillance within the population being moved
- history of pathogen surveillance and prevalence in the feral populations within in the receiving waters
- availability of post-release isolation or disease sampling and diagnostics

With a long-standing established program involving annual fish transfers between two sites, with appropriate surveillance data collected and historical knowledge in endemic disease issues in the two populations, the disease risk assessment may be relatively informal. Any such transfer program will be reviewed during the facility annual production planning process during the annual transfer approval process. This also occurs with fish being released into the same waters that they originated from. CA's must have approval and transfer permits to place fish into receiving waters.

In the case of new programs or where pathogen surveillance for either the receiving or rearing populations is lacking or in instances where the rearing population has suffered disease losses and treatment, the Veterinarian may request a sample of either healthy or moribund fish for disease prevalence estimation at least 2 weeks prior to transfer/release.

No assessment other than visual inspection, final bulk weights, and determination of smolting are performed at the Chilliwack River hatchery.

No sick fish will be transferred between sites or knowingly be released without disease evaluation. Depopulation, treatment and release options will be reviewed on a case by case basis.

Forms & Records

CA's must have forms of permission to place fish

References:

Juvenile Release
Juveniles-Health Observations
Mortality Classification

4.18 Transporting Fish

Rationale: Transportation of fish is a complex and stressful event. Fish must be handled in a manner that protects their health, minimizes the length of the stressful event and mitigates risks to any fish at the receiving site. This SOP addresses section 2.1.3.3 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that fish are transported in a manner that protects their health, the health of the fish at the receiving site and is done in accordance with all regulations.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Prior to transport

In consultation with a qualified fish health professional, the diagnostic and treatment history of any fish being moved should be reviewed prior to transport (see *Pre-Release or Transfer Disease Risk Assessment*). This includes mortality, diagnostic and treatment records and examination of a representative sample of dead fish and moribund fish within 10 days of transportation. Consideration should be given to any differences in the pattern of disease recipient area and the location which fish are being transferred.

Fish showing signs of illness or fish held under quarantine for any reason should not be moved.

All required transport permits are in place. Currently these are not required by the Chilliwack River Hatchery because fish are not transferred out of their originating watershed. Fish movements are covered under the annual permits. (Introduction and transfers licence, application for introduction of transplant of fish or aquatic invertebrates (Form B).

If fish are to be moved from fresh to salt water then the degree of smoltification may be assessed to ensure that fish are ready to be moved. In the past, saltwater challenges were performed. However, currently only a visual assessment of degree of smoltification is performed.

Water used for transportation should be whichever available source poses the lowest risk for pathogen transfer. In freshwater sites, ground water or treated surface water is preferable to untreated surface water.
Fish are crowded for the minimum time (not to exceed 1 hour) possible to allow collection into transport vessels via nets. Fish transfer into the vehicles/vessels must be conducted in the least stressful manner possible. Fish should be handled in a manner that minimizes skin damage or other trauma and leaves fish out of the water for as little time as possible. When fish are handled out of water, the equipment used to handle them must be kept wet to minimize trauma.

Dip nets should not contain too many fish.

Options to help lower the stress of transport and reduce the risk of injury to the fish include the use of mucus protectants (e.g. Vidalife™), the addition of 3-5 ppt of salt to the transport freshwater or the addition of a sedative (e.g. Aquacalm™).

During Transport

Water quality must be maintained at all times during transportation. Transport vessels are equipped with supplemental oxygen tanks and air stones. Oxygen levels should be checked and maintained throughout the transport procedures; frequency of monitoring will vary with the specifics of each transport, fish behaviour and oxygen is measured within the first 30 minutes. Fish should be monitored regularly (every 60 minutes) during transport to ensure they are behaving in an expected manner. Most transports to and from the Chilliwack River Hatchery are not of a sufficient length to warrant this however.

Temperature is measured initially and after one hour during transport, more if the day is particularly warm and the transport is long.

A contingency plan needs to be in place to ensure that if the transportation is delayed water quality can be maintained. Ice packs or ice made with confirmed non-chlorinated water may be used to keep transport water temperatures down. Ice slush is safer for the fish than chunks of ice.

Water quality in the transport vessel should be matched to that in the receiving water wherever possible. A slow acclimation to new water quality is preferable to dramatic changes. Water temperatures should not differ by more than 2^{o}C and dissolved oxygen levels should be equivalent so that gill tissue is not damaged.

Fish are released into the receiving waters in a careful manner. Locations of all groups are noted in the records.

After transport

Vehicles and vessels and equipment used in transport should be cleaned and disinfected after use.

New arrivals to a site should be isolated from fish already on site. Fish are monitored closely after transportation for signs of illness or trauma.

Details of the Procedure:

The only fish that are currently transported off site are steelhead and Elk Creek coho (as pre-smolts). These fish are taken off feed for at least 24 hrs prior to transportation. Fall Chinook may be seined and transported onto the site.

Ensure all required equipment is available and functioning.

Equipment

- Transport truck and transport trailer
- Dip nets
- Oxygen meter
- Transport tanks
- Release hoses and couplers
- Airstones and tubing (and extras)

- Crowders
- Waders
- Water pump
- Water
- Buckets
- Thermometer
- Oxygen regulator
- Oxygen canisters (2 are taken, 1 is in use at any point in time, and 1 is carried as backup)

The entire transport procedure will be pre-planned and dry transport runs using the transport vehicle may be done to ensure there are no anticipated problems along the route.

Transports are generally short and the preferred water source is that in which the fish were being reared in at the time of transport.

Prior to loading, the tank should be flushed with clean water to remove any residual contaminants. The tank is then refilled with fresh water.

Locate the transport tank as closely as possible to the rearing channel to reduce the amount of time the fish are out of the water.

Five to ten minutes prior to fish being added to the tank, the tank is saturated with oxygen (~12-12 ppm) for the period during loading.

Lower the tank water level to account for the anticipated mass displacement by the fish using tank specific water level gauge to determine the volume removed.

The duration of crowding and the density will be kept to the minimum possible to allow collection into transport vessels via dip-nets. Crowding fish is the most difficult and labour-intensive part of this process. It is also the part most likely to kill or injure fish.

Fish transfer into the vehicles/vessels must be conducted in the least stressful manner possible. Fish should be handled in a manner that minimizes skin damage or other trauma and leaves fish out of the water for as little time as possible. When fish are handled out of water, the equipment used to handle them must be kept wet to minimize trauma.

When being moved out for transport fish are coerced into moving upstream towards the head of the channel in front of a divider screen which is then dropped behind them to contain them. Two staff in waders will dip net the fish out and pass the nets up to staff on the walkways. They are walked over to the truck and passed up to another person on the truck for deposit into the transport tank. The weight of fish being transported is determined by water displacement.

Fish in the concrete raceways are crowded with a crowding screen or a seine net. The water level is dropped and the fish are dip netted out and weighed into buckets of water. Following weight determination, fish are placed into transport tanks.

Fish are loaded at a density of 0.1 kg/L. Maximum biomass should be 0.15 kg/L

Dip nets should not contain too many fish to ensure that fish on the bottom are not crushed during transfer

When there are few fish left in the enclosure (1-2% of fish remain in the channel) the water level is lowered to a depth where the remaining fish may be easily captured. Staff may use a square net bag dragged along the bottom of the channel to capture the remaining fish.

Once the fish are loaded in the transport tanks, wait a short period until the fish have calmed and the water level is topped up prior to moving the transport tank. Adjust the water level in the transport tank to bring it up to the collar and ensure that there will not be any sloshing of fish and water during transport.

Securely close the tank lid using care when fitting the lid to not damage the oxygen probe cord.

4.18.1 During Transport

The transport tank should be monitored continuously during transport and a dissolved oxygen level of at least 10 ppm should be maintained throughout the transport

Temperature is measured initially and if the transport is long, it will be checked one hour into transport, more if the day is particularly warm and the transport is long.

Fish are released into the receiving waters in a careful manner. Locations of all groups are noted in the records.

4.18.2 After transport

Vehicles and vessels and equipment used in transport are cleaned and disinfected after use if transporting fish onto the site. Equipment is not generally disinfected following transport of fish offsite.

New arrivals to a site are isolated from fish already on site. Seined, transported fish are kept in a separate raceway from swim-in fish, Fish are monitored closely after transportation for signs of illness or trauma. Mortality rates are calculated on a daily basis for adults and all fresh morts are examined for the duration of holding. Eggs are collected from female mortalities for use in minnow traps and as bait for the steelhead broodstock program. A visual examination will be performed.

Forms & Records

Inventory records, location records, fish health records, mortality records, water quality records

REVISION LOG

Revision Date	Authority	Reviser	Revision Details

4.19 Juvenile Release

Rationale: Fish are to be released in good health to minimize the transfer of pathogens to wild fish. The timing of release is also important to reduce stress and maximize survival of released fish. This SOP addresses section 2.5.2 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that the impact of hatchery fish on wild fish is minimized, to reduce stress and to maximize survival of fish being released.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

Fish may be released volitionally or transported off site. The only fish that are currently transported off site are steelhead and Elk Creek coho (as pre-smolts). All other fish are released forcefully or volitionally by pulling the outflow screens to the channels

Target numbers, weights and dates for release are determined according to stocking guidelines that are meant to maximize survival rates. These targets are determined to a large degree by production and surplus return targets.

The size and time of release are determined from downstream assessments of natural migrations and historical assessments designed to determine what is naturally in the system at what point in time. The hatchery attempts to match these natural conditions as best as possible.

A stocking rate formula is used to determine number of fry per reach for each stream and tributary. This is determined at RHQ and is dictated with input from the hatchery staff.

Chum are released as unfed fry (0.3 g in mid April). All other fish are released as smolts.

Release targets:

Steelhead are released in early April at a target weight of 80 g (dictated by the FFSBC)
Coho are subjected to a forced release in mid May at a targeted weight of ~20g
Transplanted red Chinook are released at the end of April at a target weight of 6-8 g
Fall white Chinook are released in the 3rd week of May at a target weight of 5-6g
Pinks are produced on request for other programs and are not released from this site

Fish are returned to their natal streams or into systems that are required and approved for transplant (e.g Seymour, Capilano, Chehalis systems).

Release sites and rivers are checked for adequate flow, level and temperature, prior to release. Generally if fish are deemed to be ready to go as evidenced by behaviour, they are released. Visible cues that fish are prepared for release are resting on the outflow screens altering swimming behaviour such that they move with the water flow rather than against it.

4.19.1 Volitional forced releases

Fish are not released if there is a potential for extreme conditions in the river. Release is preferable when the water in the river is moderately turbid to provide the fish with cover from predators. Forced releases are usually at dusk.

Volitional release has been performed, but most release is forced via removal of screens and lowering of water levels.

Fish are not fed on the release day, and may be sampled the morning of the release day depending on request. Fish that have not left by the target release date after a volitional release are forced to leave by lowering the water level.

4.19.2 Offsite release (Elk Creek Coho)

See *Fish Handling Procedures* for capture methods.

On reaching the release location, the truck is positioned as close as practical to the creek release site.

Release hoses are connected and laid out. Adapters are attached at the outlets if required. A net is placed under the outlet to catch any fish that may have migrated behind the tank gate valve.

The hose is attached and the gate is lifted and the fish are released through the hose. The person directing the outflow ensures an upward angle of dispersal to ensure proper release and break up the water surface to soften the landing.

Temperature and DO of the receiving water is usually recorded as is the final tank temperature

Fish are observed for behaviour at release

Equipment is collected and packed up, and put away in its appropriate location on return to the site.

Forms & Records:
Fish transport and release information is recorded according to the ENPRO
Finclip/unmarked release report form

References*:*
Pre-Release or Transfer Disease Risk Assessment
Transporting Fish
Fish Handling Procedures

Mortalities and Responses

4.20 Mortality Collection and Disposal

Rationale: The presence of mortalities in the rearing area can contribute to horizontal transmission of disease, attraction of predators and have negative effects on water quality and hygiene in the environment. This SOP addresses section 2.3.3.2 of the General Principles of Fish Health Management.

The goal of this SOP is to ensure timely removal of dead fish from the rearing environment; to ensure that dead fish are collected, stored and then disposed of in a manner that decreases predator attraction and pathogen spread and ensure hygiene and water quality protection.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Staff must take hygienic precautions to protect their own health; this includes wearing gloves while handling dead fish and washing hands after mort picking.

Mortalities should be picked from the youngest and healthiest groups of fish first. The same sequence for moving between tanks should be followed for routine sample collections.

Each holding unit has its own dedicated equipment (nets and buckets). Equipment used to remove mortalities is rinsed in the outflow water of the enclosure, and allowed to dry between uses.

All dead and moribund fish are to be removed and counted from holding units on a daily basis. Moribund fish are humanely euthanized prior to disposal (see *Euthanasia*). Fish may be flicked on the head to kill them. Adults are killed by a sharp blow to the head. Fry mortalities in the troughs are allowed to go down the effluent pipes into the effluent settling pond. Mortalities if they are few and the typical daily mortalities due to predation or sampling from the rearing channels are disposed of into the surrounding brush cover.

Where feasible, separation of staff occurs so that staff picking morts are not feeding fish or cleaning holding units on the same day.

Footbaths are used between the incubation area and the rest of the facility.

Mortalities are counted and classified as they are collected. (*Mortality Classification*)

In the event of unexpectedly high morbidity or mortality rates, the frequency of mort collection may be increased. If daily mortalities exceed 0.5%, fish health management should be notified and the veterinarian consulted. (see *Outbreak Response* and *Outbreak – Disinfection Protocols* SOPs)

Forms & Records
EnPro
Daily mort records

References:
Euthanasia
Mortality Collection and Disposal
Mortality Classification
Outbreak Response
Outbreak – Disinfection Protocols
Equipment disinfection
Site and staff disinfection and biosecurity

4.21 Mortality Classification

Rationale: Mortalities must be examined for signs of disease to allow the early identification of developing problems. This SOP addresses section 2.3.3 and 2.3.3.1 of the General Principles of Fish Health Management.

The goal of this SOP is to ensure proper classification of dead fish into general categories to assist in the early identification of developing problems.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles and Details of the Operating Procedure:

All mortalities should be classified and recorded in the husbandry logs.

A certain degree of historical mortality is presumed but staff should record data and examine the mortality curve to observe any trends in mortalities over time. This is useful information as some hatcheries have disease signatures and these affect at different life stages etc but are specific to sites. If levels are seen to be above these then investigation is initiated.

Standard mortality classifications:

Background Mortality (expected background losses)
Systems related (systems or equipment failure, anaesthetic overdose)
Environmental (water quality, temperature)
Disease related
Handling/transport (losses related to handling or transport)
Predators (fish killed or injured by predators)
Culls/Quality Control/Poor Performers (fish intentionally removed from the population – ex. Pinheads, runts, spawning rejects)

Forms & Records:
Daily mortality records
EnPro

4.22 Outbreak Response

Rationale: Unexpectedly high losses may occur for any number of reasons, including a precipitous decline in water quality, environmental or feed-borne toxin, infectious disease, etc. **In the event of a fish health crisis or potential disease outbreak, until the cause of mortality has been confirmed, the site should be managed as though an infectious agent is present.** Steps must be taken to keep the pathogen load as low as possible and to prevent spread of the pathogen both within and from the site.

This SOP addresses sections 2.3.4.3 and 2.3.4.3.3 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that the pathogen load is maintained as low as possible and spread of pathogens on or off the site is prevented.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

When an infectious disease problem is suspected the DFO Veterinarian is ***immediately*** notified.

- Staff will be communicated with to ensure that equipment in the affected area is not used elsewhere
- Disinfection procedures will be put in place
    - Sampling nets, cleaning equipment will be isolated to the affected enclosure
    - An Ovadine bath (250 ppm) will be put in place at the affected enclosure
- The public is excluded from affected units by lids and nets on troughs
- Other facilities will be contacted to identify if there are similar problems elsewhere
- No fish transfers will be allowed off site in the event of an outbreak
- In consultation with vet, hatchery staff will determine if feed rations need to be altered or ceased temporarily. Tradeoffs will be considered between feeding, growth and mortalities
- Fish will be sent in for diagnosis and an onsite evaluation/diagnosis may be requested depending on degree of issue

Staff may take extra steps beyond vet recommendation such as limiting who is in contact with the fish and the facility may impose a semi-quarantine on the area within the facility

Under veterinary recommendation the facility gate will be locked.

Affected areas may be roped off to prevent access by any other than knowledgeable staff

Trends in mortality will be monitored at all times. Any significant (tenfold) increase in mortalities tenfold (if mortalities rise from ten in an enclosure to 100+) will be considered a significant increase to trigger the above responses.

Based on past history, certain measures may be attempted prior to contacting the veterinarian. For example: staff may attempt treatment with Parasite-S or Chloramine-T prior to calling vet. Staff may examine gill tissue to look for bacterial gill disease (BGD) and attempt a corrective measure if problem is

suspected. Past disease history at this site includes BGD, myxobacterial infections, furunculosis, bacterial kidney disease (BKD), *Saprolegnia*, gill fungus in early rearing, *Trichodina*, and *Gyrodactylus*. Regardless, this will be followed up with a consultation with the veterinarian.

A certain amount of responsibility (judgment) is left to the fish culturists in charge of specific programs with respect to increasing mortality collection if mortalities are elevated.

4.22.1 Securing the Site

At the Veterinarian's recommendation the site may be officially quarantined and this quarantine will remain in effect until such time as the problem has been diagnosed and/or managed. (See *Quarantine/Isolation Procedures for Suspected Disease Outbreaks*)

No visitors or non-essential staff are to be allowed on site during an outbreak unless previously authorized by Management.

The hatchery management will notify other fish rearing facilities in the geographic area of the outbreak.

Any suspected infected population is to be quarantined/isolated from the healthy population, as are the items they may have contaminated (nets, buckets, siphons, etc).

Fish are not to be handled any further and any movement of fish on/off and within the site is to be halted.

The frequency of mortality collection is to be increased during an outbreak but affected tanks should be mort picked last and staff adheres to disinfection procedures between tanks and rearing units.

Separate equipment is designated for the affected unit. Equipment that comes in contact with infected fish or infected material may be disinfected after use. Where disinfection is carried out, a 250 ppm Ovadine is used.

4.22.2 Assessment

The Veterinarian is to be sent one weeks worth of daily records (prior to and during the episode) and a sample of live fish in oxygenated bag with water and ice (see Sampling and Shipping SOP's) and appropriate sampling information to determine cause of the outbreak and best course of action. The Veterinarian will provide instructions for proper sampling.

The Veterinarian will review management records including: species, age, year-class, source, movements, treatments, results of previous diagnostic screening or disease events, water quality, feeding history, mortality rate for several weeks prior to the outbreak and fish behavior in the weeks previous to the outbreak.

Fish are to be observed more frequently during a potential outbreak and monitoring will continue after the initial workup to determine the course of the outbreak and to assess whether treatment and/or management measures are effective. Feeding response and water quality are monitored and water and feed samples are taken if requested. During treatment, staff may switch to a different water source (i.e.

off river if dirty and onto well). If a feed issue is suspected, feed will be checked for lot numbers and samples will be taken and submitted.

Healthy fish are cared for first and personnel should disinfect themselves between handling groups to avoid inadvertent transfer.

Disinfection procedures (below) are to be followed for movements into and out of the affected areas of the facility.

On site post mortems and sampling may be performed at the discretion of the Veterinarian and may be conducted by fish health personnel after securing the site. (See guidelines under *Diagnostic Sampling protocols*). Such samples must be properly handled, properly stored and promptly shipped (See *Sample Shipment to a Diagnostic Laboratory*) as per the Veterinarian's instructions to ensure that they will supply relevant information.

Temporal distribution of disease will most likely be assessed by biweekly sampling at the request of the veterinarian. Spatial distribution may be assessed by conducting health checks on apparently healthy fish throughout the facility. Again, this will be at the discretion of the veterinarian.

Further diagnostic testing to be conducted is at the discretion of the Veterinarian responsible for the case, which may include health checks on 60 randomly sampled fish and 20 moribund fish.

A treatment or action plan will be determined by the Veterinarian and hatchery management. The Veterinarian and site management will work together to review fish health records and the incident and make recommendations on how to avoid or handle similar events in the future.

4.22.3 Outbreak – Disinfection Protocols

4.22.3.1 Personnel and Equipment

Foot baths are to be used by all personnel before entering and leaving the facility. In the case of viral outbreaks a 2% solution of Virkon™ is used in the foot bath. Foot baths are to be clearly marked and a log of when the bath concentration has been tested or when it has been changed should be kept so all personnel are aware of its efficacy.

Raingear, field kits and boots of fish health personnel should be disinfected before entering and leaving the site.

There should be a separate disinfectant bucket and brush for fish health personnel visiting the site.

A 1% solution of Virkon™ should be used for dip net disinfection.

4.22.3.2 Mortalities

Mort collection equipment should be disinfected after use, especially during any incidence of pathogenic outbreak. If there is a significant number of mortalities, fish may be buried.

Dissection of fish for examination and/or samples will be conducted in the wet lab which is a contained area and will prevent the spread of disease within the facility assuming staff follow appropriate personal disinfection procedures.

Any surfaces in contact with dead fish are to be disinfected after contact.

Note: feeders are designated to feed only, they do not pick mortalities

Forms & Records

All treatments and management changes are noted as they occur.
Daily mortality records
Sampling sheets
Treatment records

References:

Quarantine/Isolation Procedures for Suspected Disease Outbreaks
Diagnostic Sampling protocols
Sample Shipment to a Diagnostic Laboratory
http://www.syndel.com/d_p_f_s/Virkon™_info_sheet.html
http://www.syndel.com/d_p_f_s/dilution_testing_kits.htm
http://www.syndel.com/msds/Virkon™_msds.html

4.23 Quarantine/Isolation Procedures for Suspected Disease Outbreaks

Rationale: Quarantine is the enforced physical separation of the healthy population from a (potentially) infected population, their products or items they may have contaminated. [1] This will prevent transmission within and between facilities. It is virtually impossible to completely treat all effluent from our facilities, therefore this is not "truly" a quarantine as we cannot effectively halt all spread from an infected population in our facilities. However, we can isolate our fish from pathogens entering the site with due diligence. This SOP addresses section 2.3.4.3.1 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that disease transmission within and between facilities is prevented during a disease outbreak.

The procedures outlined in this SOP are set out as being appropriate by the DFO Veterinarian and are to be adhered to in the event of an infectious disease outbreak or a suspected disease outbreak

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly

Details of the Operating Procedure:

4.23.1 Securing the Site

Affected hatcheries are quarantined; facilities are locked down. Gates to the facility are closed and only essential personnel are admitted.

Disinfection procedures are followed for movements into and out of the facility.

The movement of fish, vehicles, equipment and personnel from the affected hatchery to fish bearing habitat or other fish rearing facilities is immediately halted.

4.23.2 Isolation of Infected Group

The affected fish rearing containers are isolated. Movement of fish into and out of these containers is stopped.

4.23.3 Mortality Removal

Depending on overall morbidity rate, all sick, slow swimming or moribund fish are removed from the environment. Mortality removal is done at least twice daily.

Mortalities are collected into spill proof containers with secure lids and transported to a composting landfill for disposal. Equipment and containers used to collect mortalities are disinfected after each use.

[1] Martin et. al., eds. Veterinary Epidemiology: Principles and Methods.

References:

Outbreak Response

Outbreak – Disinfection Protocols

4.24 Juvenile Treatments

Rationale: Due to a developing immune system and the physiological stress related to growth and smoltification, juveniles represent a particularly susceptible life stage. Judicious use of antimicrobial agents may help minimize losses due to infectious agents. This SOP addresses section 2.1.3.9 of the General Principles of Fish Health Management.

Often, the combination of historical disease incidence combined with clinical signs, can allow a presumptive diagnosis of a disease agent by hatchery staff. The commonly used external antimicrobial agents listed herein do not require a veterinary prescription. However, diagnostic sample submission and consultation with the Veterinarian is encouraged before attempting any treatment, and is strongly recommended in the event of treatment failure to produce the anticipated improvement in levels of morbidity and/or mortality. The goal of this SOP is to ensure safe administration of externally applied antimicrobial agents to minimize loss of juveniles during rearing.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Fish are to be held off food for 24 hours prior to treatment. This serves to reduce fecal fouling of the tank and lower the metabolic demands of the fish.

Tanks will be carefully siphoned/cleaned to remove as much detritus as possible before treatment. External antimicrobial agents will act on whatever organic matter is present; cleaning the tank helps ensure the highest activity against the pathogen in question. A high level of organic matter will render the treatment ineffective.

It is always safest to treat a small 'test' group of fish initially to detect errors in calculations during solution preparation and administration or any unusual species/stock/strain sensitivities to the treatment chemical.

Fish should be monitored closely during treatment for any adverse effects. Gathering at the inflow, gasping at the surface, attempts to jump out of the water, etc. should be considered signs of treatment toxicity. The treatment should be stopped ASAP and the water flow increased to rapidly dilute and flush out the offending chemical. The Fish Health Management Team should be informed and the details of the procedure (including tank volume, flow, concentration calculations, chemical expiration and storage, stock and working solution preparation, etc.) should be reviewed. Fish should continue to be held off food for a 24 – 48 hour recovery period before attempting further treatments.

Details of the Operating Procedure:

4.24.1 Chloramine-T

Chloramine-T is a disinfectant used for surface bacterial infections including bacterial gill disease and fin rot. Chloramine-T powder can cause burns or sensitization on skin contact and sensitivities upon inhalation; it is injurious to eyes and is harmful if swallowed. Staff should review WHMIS information prior to handling this product and employ appropriate personal protective equipment.

Chloramine-T is a gill irritant to fish; its toxicity is increased by soft water and low water pH. It is highly advisable to determine your water pH and hardness prior to using Chloramine-T to protect the fish. Where water chemistry is unknown, the low end of the recommended dosing range will be used to minimize the chances of toxic effects on fish.

The standard flush, bath or dip treatment with Chloramine-T is 8.5 – 12 ppm for one hour daily on three treatments on consecutive or alternating days. Chilliwack River Hatchery uses a concentration of 17 ppm.

Equipment/Preparation

- Chloramine T
- Scale
- Gloves
- Respirator
- Peristaltic pump
- Buckets
- Drip jugs
- Extension cord
- Flexible hose for pump
- Calculate flow
- Volume calculation

1. Prepare the troughs for treatment by cleaning them and removing mortalities
2. Set the flow appropriately. This will depend on loading rates (typically between 30-50 gpm).
3. Check and record flows prior to treatment to ensure appropriate calculations
4. Determine the target concentration - Treatment dose is 17ppm (or as directed by the vet)
5. Check treatment calculations on the computer
6. Weigh out required amount of Chloramine-T powder for the treatment – only the amount required for that day is measured out
    a. Wear gloves and a dust mask and eye protection
7. Prepare the peristaltic pump
    a. Check the hoses for leaks, cracks etc
    b. Adjust the pump speed appropriate to the calculations
    c. Calibrate the pump using a measured graduated cylinder
8. Prepare the stock concentration in a 5 gallon bucket
    a. Add Chloramine-T powder to bucket and add the required volume of water
    b. Mix thoroughly
9. Set the pump (on the cart) near the trough and place the bucket on the cart near the pump
10. Adjust the flow on pump according to the calculations

11. Run the pump with fresh water from the enclosure to flush/prime it and check the hoses and delivery
12. Place the suction hose into the stock bucket
13. Place the outflow hose into the treatment enclosure
14. Run the pump for one hour
15. After one hour, shut off the pump, and remove the hoses. It is preferable to flush the pump after treatment to reduce crystallization of the solution inside the hoses
16. Put all equipment away in the appropriate location
17. Do not feed fish for 2-3 hours following treatment

4.24.2 Parasite-S™ (Formalin)

Parasite-S™ is the trade name for an anti parasitic, formalin-based solution that is commonly used against parasitic and bacterial gill disease including those caused by the protozoans *Ichthyobodo* (Costia) and *Trichodina*. It is also a standard disinfectant used in hatcheries for the prevention and treatment of egg fungal infections (see *Egg Fungal Treatments*).

The normal dilution of formalin for treating fish is 1:6000 or 167 ppm. This concentration is achieved by combining 17 mls of Parasite-S per 100 litres of water. Exposure is normally 30 – 60 minutes daily, and may be done on consecutive or alternating days for three treatments in total.

Cautions:

Formalin should never be added to water containing fish without first diluting it and then mixing it in thoroughly to avoid 'hot spots'.

Formalin should not be used if :

- Dissolved oxygen of the water is <5ppm
- The water temperature is >27^{o}C
- Heavy phytoplankton growth is present.

4.24.2.1 Parasite-S MSDS information:

Formalin must be handled with care. It is harmful if inhaled, and can seriously irritate eyes and skin after contact. Formalin should only be handled in well ventilated areas, preferably while wearing a respirator and safety glasses. Staff should review WHMIS information prior to handling this product and employ appropriate personal protective equipment.

Parasite-S contains methanol which inhibits the formation of paraformaldehyde, a white precipitate that is extremely toxic to fish. Even so, formalin should be stored in the dark above 10^{o}C and not allowed to freeze. If Parasite-S is allowed to freeze, it should be discarded due to the rapid formation of paraformaldehyde.

The toxicity of formalin increases as temperature increases. In very soft water, concentrations of formalin should not exceed 25 ppm. Concentrations greater than 250 ppm may cause severe gill damage and should not be used on salmonids.

Formalin is a gill irritant and thereby reduces gas exchange. This is especially of concern as formalin is commonly used when fish gill function may already be compromised. Additionally, formalin is a reducing agent that absorbs oxygen from the water. Therefore, the safest course is to treat with formalin at the time of day when the water temperature is at its lowest, and to provide supplemental oxygenation via airstones. The fish should be closely monitored during treatment for signs of respiratory distress (increased opercular movements or gasping at the surface) and the treatment terminated if needed.

Equipment

- Parasite-S
- Gloves
- respirator
- Peristaltic pump
- Buckets
- Drip jugs
- Extension cord
- Flexible hose for pump
- Flow calculation
- Volume calculation

1. Starve the fish for 12 – 24 hours prior to treatment
2. Prepare the troughs for treatment by cleaning them and removing mortalities
3. Set the flow appropriately. This will depend on loading rates (typically between 30-50 gpm). If the container is large, the flow rates may be reduced to reduce volume of chemical required.
4. Check and record flows prior to treatment to ensure appropriate calculations
5. Determine the target concentration as directed by the vet (typically 1670 ppm for eggs and 167 ppm for juvenile fish)
6. Check treatment calculations on the computer
7. Measure out required amount of Parasite-S for the treatment
    a. Wear gloves and eye protection
8. Prepare the peristaltic pump
    a. Check the hoses for leaks, cracks etc
    b. Adjust the pump speed appropriate to the calculations
    c. Calibrate the pump using a measured graduated cylinder
9. Prepare the stock concentration in a 5 gallon bucket
    a. Add Parasite-S to bucket and add the required volume of water
    b. Mix thoroughly
10. Set the pump (on the cart) near the trough and place the bucket on the cart near the pump
11. Adjust the flow on pump according to the calculations

12. Run the pump with fresh water from the enclosure to flush/prime it and check the hoses and delivery
13. Place the suction hose into the stock bucket
14. Place the outflow hose into the treatment enclosure
15. Run the pump for the recommended treatment time, measure the dissolved oxygen levels at the outflow to ensure adequate oxygen is being delivered to the fish during treatment.
16. After one hour, shut off the pump, and remove the hoses. It is preferable to flush the pump after treatment to reduce crystallization of the solution inside the hoses
17. Restore flow rates if they were reduced
18. Put all equipment away in the appropriate location
19. Do not feed fish for 2-3 hours following treatment
20. Treatment may be required on consecutive days, Always refer to and check with the veterinarian and their prescription.

4.24.3 Antibiotic treatments

Antibiotics are utilized only on veterinary approval and only as directed by the veterinarian. Antibiotics are delivered via feed (See *Medicated Feed: Storage, Handling, and Feeding*)

Forms & Records:
Disease treatment binder treatment records
Computer calculation printout sheets
Brood summary binders
Prescription forms (kept in the disease treatment binder)

References:
Egg Fungal Treatments
http://www.syndel.com/d_p_f_s/parasite-s_info_sheet.html
http://www.syndel.com/handling/transportation_of_live_fish.html
http://www.syndel.com/handling/vidalife_info_sheet.html
Medicated Feed: Storage, Handling, and Feeding

4.25 Broodstock Treatments

Rationale: Broodstock are a sensitive life stage. They are channelling their energy stores into the maturation of their gametes, and undergoing the physical stresses related to migration, changing temperatures and re-entry into freshwater. The cumulative effects of these multiple stressors can result in fish whose immune system is compromised. As a result, broodfish may be shedding pathogens in increased numbers and may have an increased susceptibility to secondary, opportunistic infections. Broodstock treatments can help reduce pre-spawning mortality losses and can help reduce the risk of vertically transmitted pathogens being passed to the offspring. Brood fish can also be treated to synchronize spawning dates. This SOP addresses section 2.2.9 of the General Principles of Fish Health Management. The goal of this SOP is to ensure successful treatment of broodstock to lessen pre-spawning mortalities, reduce vertical transmission of pathogens in areas with a historically high prevalence of an antibiotic-susceptible pathogen and/or to synchronize spawning.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

4.25.1 Fungal infections

Brood fish are particularly susceptible to external fungal infections which can contribute to pre-spawning mortalities. Routine use of mucus protectants (e.g. Vidalife™) during handling events for ripeness checks and gender segregation, can help reduce the incidence fungal infections. Once established, antifungal formalin baths or salt treatments can be used to reduce the severity of fungal infection.

4.25.2 Bacterial infections

Based on historical disease patterns and/or pre-spawning mortality rates, antibiotic therapy may be indicated to reduce brood losses and as a prophylactic treatment to help decrease the vertical transmission of bacterial pathogens, such as Renibacterium salmoninarum, the causative agent of Bacterial Kidney Disease. Decisions to pursue antibiotic therapy will be made in consultation with the Fish Health Veterinarian. Antibiotics will be obtained and used as directed by veterinary prescription.

Broodstock antibiotic injections typically are given one month before the anticipated spawning date, as peak concentrations of antibiotic are present in the gametes 2 and 4 weeks post-injection. For the reduction of vertical transmission of bacteria, it is reasonable to inject the females only, however, if pre-spawning mortalities are high, treating both males and females may be beneficial.

Details of the Operating Procedure:

The only treatments currently in use for broodstock at the Chilliwack River Hatchery are formalin treatments on steelhead broodstock.

4.25.3 Parasite-S™ (Formalin)

Parasite-S™ is the trade name for an anti parasitic, formalin-based solution that is commonly used against parasitic, fungal and bacterial gill infections. It is also a standard disinfectant used in hatcheries for the prevention and treatment of egg fungal infections (see *Egg Fungal Treatments*).

The normal dilution of formalin for treating fish is 1:6000 or 167 ppm. This concentration is achieved by combining 17 mls of Parasite-S per 100 litres of water. Exposure is normally 30 – 60 minutes daily, and may be done on consecutive or alternating days for three treatments in total.

Cautions:

Formalin should never be added to water containing fish without first diluting it and then mixing it in thoroughly to avoid 'hot spots'.

Formalin should not be used if :

- Dissolved oxygen of the water is <5ppm
- The water temperature is >27^{o}C
- Heavy phytoplankton growth is present.

4.25.3.1 Parasite-S MSDS information:

Formalin must be handled with care. It is harmful if inhaled, and can seriously irritate eyes and skin after contact. Formalin should only be handled in well ventilated areas, preferably while wearing a respirator and safety glasses. Staff should review WHMIS information prior to handling this product and employ appropriate personal protective equipment.

Parasite-S contains methanol which inhibits the formation of paraformaldehyde, a white precipitate that is extremely toxic to fish. Even so, formalin should be stored in the dark above 10^{o}C and not allowed to freeze. If Parasite-S is allowed to freeze, it should be discarded due to the rapid formation of paraformaldehyde.

The toxicity of formalin increases as temperature increases. In very soft water, concentrations of formalin should not exceed 25 ppm. Concentrations greater than 250 ppm may cause severe gill damage and should not be used on salmonids.

Formalin is a gill irritant and thereby reduces gas exchange. This is especially of concern as formalin is commonly used when fish gill function may already be compromised. Additionally, formalin is a reducing agent that absorbs oxygen from the water. Therefore, the safest course is to treat with formalin at the time of day when the water temperature is at its lowest, and to provide supplemental oxygenation via airstones. The fish should be closely monitored during treatment for signs of respiratory distress (increased opercular movements or gasping at the surface) and the treatment terminated if needed.

Details of the Procedure:

Steelhead are treated in the condos Parasite-S is delivered via the head tank source water. The treatment may be delivered to the head tank source water via turkey waterers that have been modified with a small hole drilled into the base. The turkey waterer is set on top of the head tank where the inflow water enters and the treatment drips in at a known flow rate for 1 hour.

4.25.3.2 Parasite-S delivery via turkey waterers

The turkey waterers used have a 3.0 L capacity and have a small hole drilled in the bottom which has been determined to deliver a flow of 50 mL/min

1. Set pond flow to 84 L/min
2. Determine treatment dose (167 ppm)
3. Prepare 280 mL Parasite-S per L stock solution
4. Place 3.0 L of stock solution into the turkey waterer
5. Place the turkey waterer across the head tank inflow where the 3.0 L will flow into the water over a period of one hour
6. Check that the hole is clear and that the Parasite-S is dripping from the container
7. After one hour, remove and clean the turkey waterer

Alternatively, the treatment may be delivered via peristaltic pump as below.

4.25.3.3 Parasite-S delivery via peristaltic pump

1. Determine the flow in the head tank. It should be set to 80 L/min
2. Prepare a stock solution of Parasite-S

   Stock solution = 267.36 mL Parasite-S/L

   6.7 L Parasite-S + 18.3 L water = 25.0 L stock solution
   13.35 L Parasite-S + 36.65 L water = 50 L stock solution
2. Set up the peristaltic pump to run at 50 mls/min
3. Check and record flows prior to treatment to ensure appropriate calculations
4. Determine the target concentration as directed by the vet (typically 167 ppm)
5. Check treatment calculations on the computer
6. Measure out required amount of Parasite-S for the treatment (3.0 L per condo unit)
   a. Wear gloves and eye protection
7. Prepare the peristaltic pump
   a. Check the hoses for leaks, cracks etc
   b. Adjust the pump speed appropriate to the calculations

c. Calibrate the pump using a measured graduated cylinder

8. Prepare the stock concentration in a 5 gallon bucket
   a. Add Parasite-S to bucket and add the required volume of water
   b. Mix thoroughly
9. Set the pump (on the cart) near the condo and place the bucket on the cart near the pump
10. Adjust the flow on pump according to the calculations
11. Run the pump with fresh water from the enclosure to flush/prime it and check the hoses and delivery
12. Place the suction hose into the stock bucket
13. Place the outflow hose into the treatment enclosure
14. Run the pump for one hour, measure the dissolved oxygen levels at the outflow to ensure adequate oxygen is being delivered to the fish during treatment.
15. After one hour, shut off the pump, and remove the hoses. It is preferable to flush the pump after treatment to reduce crystallization of the solution inside the hoses
16. Restore flow rates if they were reduced
17. Put all equipment away in the appropriate location
18. Treatments are repeated 3 times per week, on alternating days (M,W,F)

Forms & Records:
Treatment records in the disease treatment binder

References:
Fish Handling Procedures
Anaesthesia
Egg Fungal Treatments

4.26 Top-Coating Medicated Feed

Rationale: Small volumes of medicated feed are required at sites with lower production numbers. At these sites, medication may be top-coated on to appropriate food and fed as required by veterinary prescription. The goal of this SOP is to ensure that medicated feed is mixed properly.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

All staff members who will be handling medicated feed are required to be familiar with the MSDS information and take precautions to protect their health.

Details of Procedure:

Feed is obtained from a feed mill that has been inspected by the CFIA.

Medicated feed is to be clearly identified in the storage area by use of different coloured bags and clear labels. It should be physically separate from non medicated feed. Medicated feed is fed out according to veterinary prescription. All equipment which comes in contact with medicated feed will be cleaned and disinfected thoroughly after use.

Medicated feed will only be used under the direction of the veterinarian and according to the prescription and directions provided.

Feed is weighed out and mixed on a daily basis on the day that feed is to be used. Gloves and a dust mask must be worn when preparing medicated feed for personal protection against absorption across the skin

Calculate a reduced daily feed ration to ensure that the medicated feed is completely consumed each day Reduced ration during medicated feeding is 50% of the normal ration.

1. Put on gloves and a dust mask prior to beginning
2. Weigh out the recommended dose of antibiotic as provided by the veterinarian
3. Place the daily ration of feed into a bucket
4. Using a spray bottle, spray the feed lightly with a mist of canola oil. Mix the feed with the oil until it reaches a consistency such that the food is not broken down and retains its pelleted form but that it is evenly coated with oil
5. Slowly mix the antibiotic in by hand or using a feed scoop until all of the daily dose is dispensed into the days ration of feed
6. Feed is delivered by hand (using gloves to protect personnel) to the appropriate container using a feed scoop

If the food is being fed at less than 5^{o}C, the addition of garlic powder or krill may increase its palatability to the fish.

Forms & Records

Disease treatment records (stored in the (Disease treatment binder)
Treatment records
Veterinary prescription,

References:

Treatment records.

4.27 Medicated Feed: Storage, Handling, and Feeding

Rationale: This SOP addresses section 2.3.3.3 of the General Principles of Fish Health Management.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Medicated feeds must only be used under veterinary prescription with accompanying caution for withdrawal times. Rational antibiotic selection will be based on the Veterinarian's clinical judgment, the use of antimicrobial sensitivity testing, and due diligence with regards to the prevention of promoting antibiotic resistant bacteria.

Medicated feed will be clearly identified. Daily rations may be kept in seal-top container at tank side, with remaining feed refrigerated.

Persons dispensing medicated feed should wear protective latex gloves.

Medicated feed prescription amounts are based on the most accurate information available regarding the size and number of fish to be treated. All medicated feed should be fed out as directed for the total number of days prescribed, leaving no food leftover.

Failure to see expected improvements after 5 days on medicated feed should be reported to management and the prescribing Veterinarian.

Adverse reactions to medicated feed will result in immediate cessation of the treatment and consultation between Fish Health Management and the prescribing Veterinarian.

During a treatment course with medicated feed no handling (i.e. sampling, marking, grading etc.) will be carried out. Once medicated feeding is initiated, it will not be discontinued without the approval of the prescribing Veterinarian.

Medicated feed is not as palatable and the fish may refuse to eat it. It is important to closely monitor the feeding response of the fish when starting treatment to ensure:

- That fish are consuming the food without subsequent regurgitation
- The feeding rate is slow enough to prevent excess feed from reaching the tank bottom
- There is adequate coverage to all areas of the tank/raceway

Staff may help encourage eating by holding fish off food for 24 - 48 hours before starting medicated feed or by initially mixing decreasing amounts of non-medicated food for the first couple of feedings. Palatability can also be increased by the addition of krill or garlic powder. This may be especially valuable at temperatures < 5^{o}C.

If a feeding hierarchy exists within the tanks, it may be safest to start each day feeding a few handfuls of non-medicated feed to take the edge off the more aggressive feeders to ensure they don't consume a higher proportion of medicated feed than other fish. This should be followed with the daily allotment of medicated feed given at normal feeding intervals. After the daily medicated feed ration has been fed, the fish may be fed to satiation with non-medicated feed.

At high water temperatures, lower oxygen solubility can become a limiting factor for fish culture. For health compromised fish, this is even a greater concern as any stressor can increase the risk of death. If temperatures are >16^{o}C, dissolved oxygen levels should be measured 2 hours after feeding to ensure adequate dissolved oxygen is present. If dissolved oxygen measures < 6.0 mg/L, the timing of feeding should be changed to avoid mid-day, when water temperatures are highest.

Details of the Operating Procedure:

Medicated feed is mixed up on a daily basis according to the veterinarian's prescription and gloves and a dust mask are worn when mixing and measuring antibiotics (See Top Coating Medicated Feed SOP)

Gloves are worn when feeding to ensure human safety and prevent antibiotic absorption across the skin.

Medicated feed is used the day it is mixed, it is not stored. Feed additives may be added to increase palatability.

All buckets are labelled by rearing container. Rearing containers receiving medicated feed are noted in the feeding schedule sheets, on the daily board in the feed room, on the daily white board in the office and feed buckets are placed accordingly. Troughs receiving medicated feed are also noted in the computer records.

One staff member is designated as the feeder for each week and this individual is informed on which containers are to receive medicated feed for the period. Regular staff meetings (held on Mondays) are used to ensure that staff is up to speed on this sort of information.

Forms & Records:
Prescription file
Treatment records
Disease treatment binder

4.28 Diagnostic Sampling protocols

Rationale: Samples of fish for diagnostic purposes must be collected properly to ensure that results obtained are useful. This SOP addresses section 2.3.3 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that samples are collected properly.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

Details of the Operating Procedure:

The best fish to sample are moribund fish. Mortalities should only be sampled if their gill tissue is red.

Samples may be collected for parasitology, bacteriology, virology or histology.

Fish are humanely euthanized prior to sample collection. It is preferable to do this by an over dosage of anaesthetic as blunt trauma can cause gill aneurysms and make interpretation of some histopathology difficult. (see *Euthanasia*).

Bleeding fish prior to sampling can be done to limit the amount of blood pooling during sample collection; the gill arch can be cut on large fish and the tail cut off on smaller fish.

Fish are examined visually for evidence of BKD, but are not screened. If BKD is suspected, fish may be opened and visually examined. If signs of BKD are evident, fish will be sent to PBS for diagnostics.

4.28.1 Sampling for Juvenile Bacterial Gill Disease

1. Moribund fish are netted from the rearing container and are euthanized by a flick to the head
2. A portion of the gill is removed
    a. The gill tissue is placed on a clean slide
    b. A drop of water added
    c. A cover slip is placed over the sample
    d. The slide is examined under oil immersion at 100x
3. Observation of filamentous bacteria, piled atop each other allows a presumptive diagnosis of bacterial gill disease and will initiate treatment with Chloramine-T
4. The veterinarian will be notified and consulted regarding treatment

4.28.2 Otolith Sampling

Equipment

- Sharp, thin knife
- Forceps or tweezers
- Numbered containers (small plastic tubes are preferred)
- Data sheets

1. Locate the cranial otolith pockets by cutting directly down from the top of the head, approximately midway, between the eye and the operculum
2. Collect both otoliths, unbroken and as clean as possible with forceps or tweezers
3. Place otoliths in numbered containers, usually small plastic tubes
4. Record all information that is needed for each individual fish sampled. (Date, area, species, sex, fin clip, length)
5. Once all otolith are taken for the sampling season, send samples by courier to the lab for analysis

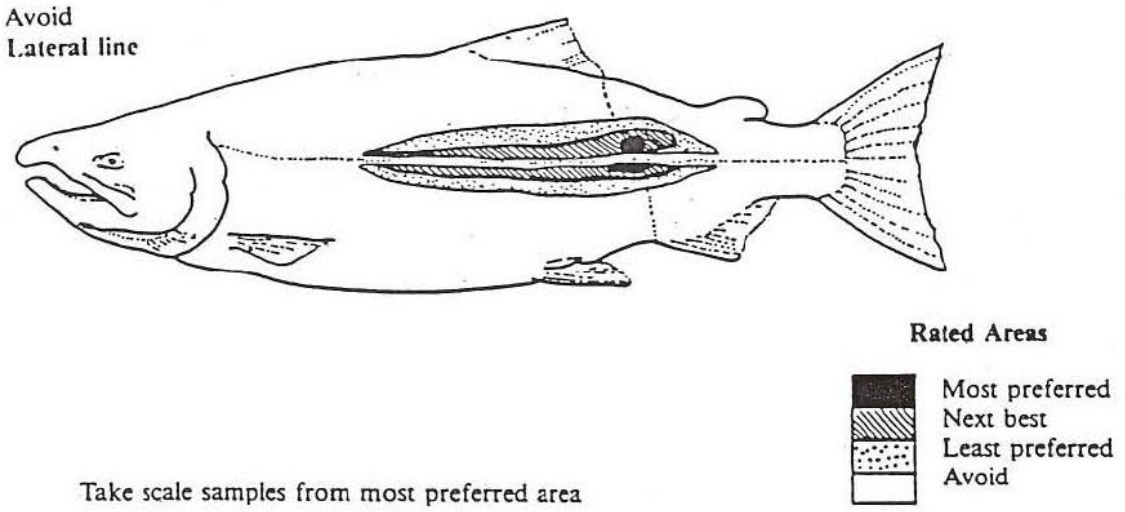
4.28.3 Coded Wire Tag(CWT) Sampling

1. Fish must be anaesthetized to check for CWT presence/absence and an associated adipose clip or no adipose clip. Anaesthetize fish according to the *Anaesthesia* SOP
2. When the fish is sufficiently anaesthetized for easy handling, pass it through the tag detector .
3. If a CWT is detected, use a tag detector wand to double check for the presence of a pin
4. It is important when using both detectors that they are frequently checked to make sure they are operating correctly.
5. If a CWT is detected, fish are euthanized according to the *Euthanasia* SOP
6. Once it is determined that a fish has a pin, record all data required on a Bio sampling sheet before removing the fish head such as date, area, species, length, scales, finclip
7. Remove the head of the fish with a sharp knife, cutting vertically behind the eyes, to improve the pin recovery rate
8. Attach an “E” label to each head, using a Swift attachment gun, affixing the label with three plastic anchors. Ensure the label is securely attached
9. Place each head in a bucket for that sampling period.
10. At the end of the sampling period, freeze all the heads.
11. At the end of the sampling season, send in the frozen heads to the Head Dissection Lab. Contact the lab before sending in the heads, making sure to follow the detailed procedure(s) that the lab requests.

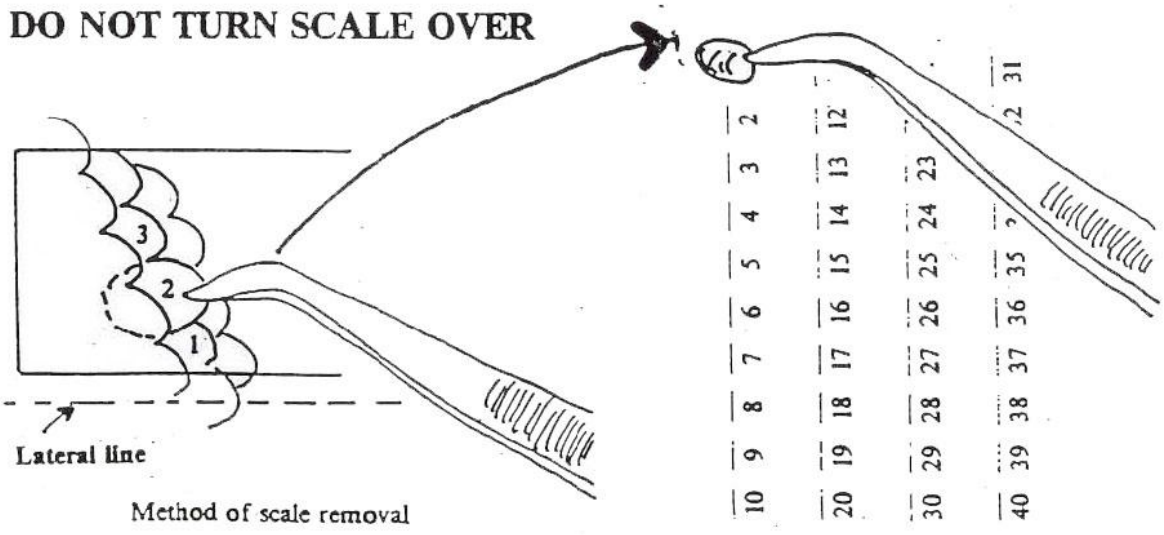
4.28.4 Scale Sampling – Adult sampling program

1. Place the fish on its side.
2. Wipe the preferred area clear of water and mucus.
3. Remove the scale by grasping its exposed edge with tweezers and pull straight back on the same plane as the scale to avoid scale damage. Normally the fresher the fish into the river system, the easier it is to remove the scale.
4. Hold the scale up to a light source to check for deformation or regeneration. Scales with these signs are unreadable. Take another sample scale from the next rated area. For further explanation please contact the morphology lab.

5. Center the scale on the numbered square on the scale book so that the side that faced up on the fish remains facing up on the book. (See Figure below.)
6. To check if the correct side is facing up, scrape the surface of the scale. It should feel rough with ridges.
7. Be sure the scale is sticking firmly to the scale booklet.
8. Depending on how many scales are requested you may have to turn the fish on its other side and repeat the procedure.
9. The scale book surfaces *must* be kept dry. Excessive moisture will dissolve the book's adhesive coating and cover the scale or wash away the adhesive so that the scale cannot stick to the book.



Take scale samples from most preferred area



Method of scale removal

Forms:

Fish health records, results of diagnostic testing

References:
Anaesthesia
Euthanasia

4.29 Sample Shipment to a Diagnostic Laboratory

Rationale: In order for accurate diagnoses to be obtained, fish samples must arrive at the laboratory in suitable condition. The goal of this SOP is to ensure correct transport of live or dead fish to the fish pathology laboratory in order to receive valid results. The goal of this SOP is to ensure that fish samples are shipped in a manner that protects the sample integrity.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Deciding when diagnostic support is needed can often be difficult. Shipping samples is time consuming and costly. If mortalities are unexpected, clinical signs are suggestive of a disease of concern (eg. popeye and/or swollen abdomens at a facility with a history of recurrent BKD infection), or if the daily mortality rate exceeds 0.5% of the population or is displaying an upwards and exponential trend, a sample of the affected fish should be transported to the Fish Pathology Laboratory at the Pacific Biological Station.

Details of the Procedure:

4.29.1 Before shipping:

Collect fish history information, including: population size, clinical signs, mortality and morbidity rate, diet and feed consumption, water quality conditions, records of recent stressful events (e.g. low water event, marking), vaccination status, disease and treatment history.

Contact the fish pathology laboratory technical staff at the Pacific Biological Station, Rm T308, 3190 Hammond Bay Road, Nanaimo BC, V9T 6N7. Phone (250) 756-7057; Fax (250) 756-7053, westbyc@pac.dfo-mpo.gc.ca .

or

Contact the DFO staff Veterinarian at the PBS, Dr Christine MacWilliams at (250) 729-8377, macwilliamsc@pac.dfo-mpo.gc.ca .

A determination will be made whether live or dead fish are required for evaluation. In most cases live fish are preferable for diagnostics; however, for some situations dead fish may suffice.

Moribund fish are the ideal samples to collect for submission. The diagnostic lab may also request a sample of apparently healthy fish from the population.

If moribund fish are not available, fresh mortalities may be submitted. **Evaluate fish condition**. Fish found dead must have red gills and firm flesh in order to be of any value for diagnostics.

Ensure the diagnostic lab is aware of fish on their way to the lab and provide the estimated time of arrival.

Fish must arrive at the diagnostic laboratory by mid day at the latest to ensure staff has time to work on the fish.

4.29.2 Selecting the samples:

Where possible, select moribund fish for shipment. Seek advice from the Veterinarian and fish health management to determine how many fish and from which locations the fish should come.

There may be a need to randomly sample apparently healthy fish from the population; rely on veterinary advice for this decision.

4.29.3 Shipping live fish:

1. Place 3-4 inches of water in the bottom of a 5 gallon black bucket and place it in the freezer overnight.
2. Contact the courier company (Baxter Air) to check flight schedules
3. Contact the lab for assurance that fish can be received and processed
4. Place a single, heavy duty, clear plastic bag inside the 5 gallon bucket (if bags are lightweight, double bag) If using a white bucket use black bags inside to reduce visual stress on the fish
5. Fill the bag with 1-2 gallons of water and weigh it (the plane will allow 25 lbs per container before extra cost is incurred)
6. Add fish (20-30 fish of less than 10 g each is a feasible sample size)
7. Inject oxygen into the bag
8. Twist the bag top closed to slightly pressurize the Oxygenated atmosphere inside the bag with water and fish to prevent the bag from collapsing thus reducing the atmosphere/water interface.
9. Remove the air tube close the hole off with another twist
10. Knot the top and tape with electricians tape
11. Place lid on bucket and tape it closed
12. Include a *Sample submission form* describing the fish population and the problem and/or an accompanying letter with more detail.
13. Label bucket with address, contact person name and phone number at PBS
14. Phone lab and provide flight information and request that the airline company call the lab for pickup on arrival

4.29.4 Shipping fresh dead fish:

In the event that no moribund fish are available for sampling, morts can be shipped. Only ship morts which still have red gills otherwise it is doubtful that any useful information can be gained from the samples.

Fresh mortalities (red gills, firm flesh) should be placed in labeled, sealed double plastic bags without water. Ship dead fish in a container on ice. Fish should not come in contact with the ice or freezer packs.

Freeze adult mortalities, wrap them in a plastic bag and place them in a styrofoam shipping container (cooler) with small amount of ice packed in newspaper

Contact the courier company (Baxter Air) to check flight schedules

Contact the lab for assurance that fish can be received and processed and notify them of the flight schedule

Include a *Sample submission form* describing the fish population and the problem and/or an accompanying letter with more detail

Seal the cooler with duct tape
Label container with address, contact person name and phone number at PBS

Phone lab and provide flight information and request that the airline company call the lab for pickup on arrival

4.29.5 Shipping samples that have been collected from the fish:

This applies to samples collected for bacteriology, virology or histopathology (see generic *Diagnostic Sampling protocols*)

All samples must be clearly labeled.

Tissue samples must be maintained at 4-7°C for shipment and they must be reached by the diagnostic laboratory within 24 hrs of sampling.

Place double bagged samples in a cooler and ship to the diagnostic laboratory.

4.29.6 Following Transport:

Follow up with diagnostics laboratory to confirm receipt of the samples and tentative time frame for diagnosis and treatment recommendations.

Note: if the Fish Pathology Lab is unable to accept your samples due to scheduling conflicts, alternate user-pay diagnostic facilities are available:

Animal Health Centre
B.C. Ministry of Agriculture and Lands.
1767 Angus Campbell Road
Abbotsford, British Columbia
V3G 2M3
contact: Dr. Gary Marty
phone 604-550-3003
fax 604-556-3010

Microtek International, Inc.
6761 Kirkpatrick Crescent
Saanichton, British Columbia
V8M 1Z8
contact: Tim Hewison
phone: 1-800-667-5062 (ext. 201)
fax: 250-652-4802

Forms & Records
Sample submission form (see Appendix)

References:
Diagnostic Sampling protocols

Chemicals & Disinfectants

Veterinary Chemicals for use in Fish/Egg Disinfection in Canadian Fish Hatchery and Aquaculture Facilities

Fisheries and Oceans Canada (DFO) as the lead federal department for aquaculture management for Canada is providing the following list of chemicals that can be administered under the regulatory authority of Health Canada's Veterinary Drug Directorate (HC-VDD) for fish egg disinfection in facilities producing fish for food directly (via aquaculture) and indirectly (via salmonid enhancement programs). The Canadian Food Inspection Agency (CFIA) is responsible for monitoring to ensure that fish and fish products meet the requirements of the Fish Inspection Act and the Food and Drugs Act, and will take appropriate regulatory action when unapproved or banned substances are found. Since 1992, a prescription from a licensed veterinarian is required for the use of many veterinary drugs in hatchery and aquaculture facilities.

The following list and comments related to use for fish egg disinfection has been provided by licensed fish health veterinarians and complies with the regulatory requirements of Health Canada and the CFIA. A licensed veterinarian should be consulted to determine the appropriate treatment and dosage that is required for any of these treatments.

Approved Veterinary Chemicals
Note – the use of any other chemical for egg disinfection of food fish is illegal

Parasite-S® or Formalin-R Solution is a formalin-based solution that also contains methanol to prevent the formation of paraformaldehyde, which is toxic to fish. It is used as a bath to control external parasites on the gills, skin and fins of fish and to surface disinfect eggs.

Perox-Aid™ (hydrogen peroxide) is an antifungal agent for use on fish eggs. In Canada, it is the only product that is officially approved for use on food fish.

Salt Solutions. High salt concentrations can kill surface parasites and fungal infections. Treated fish may produce extra mucus from the skin and gills which assists in the removal of external parasites. Care must be taken with the concentration of salt used to ensure that treated fish do not experience osmotic shock.

Veterinary Chemicals Available through Emergency Drug Release (EDR)

Pyceze® (Bronopol) is an antimicrobial agent that is used as a preservative in health care, food-contact materials and cosmetics as well as an antifungal treatment for salmonid eggs. It is not approved for use in fish hatcheries in Canada and is only available by prescription from a licensed veterinarian through Health Canada's Emergency Drug Release program. Use of this drug should be discussed with your provincial or private fish health veterinarian

Ovadine® is under review by the VDD for approval as a fish egg disinfectant. Until approval is received, it is available only by prescription from a licensed veterinarian, through Health Canada's Emergency Drug Release program.

For more information, contact:

National Registry of Aquatic Animal Health
Fisheries and Oceans Canada
200 Kent St
Ottawa, ON K1A 0E9
Nrfd@dfo-mpo.gc.ca

4.30 Anaesthesia

Rationale: All operators need to anaesthetize fish from time to time for handling, vaccinating, marking or sampling procedures. Anaesthesia is used to minimize the stress of such procedures. This SOP addresses section 2.1.3.1 of the General Principles of Fish Health Management.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

Prior to Anaesthesia:

Approved anaesthetics are obtained by veterinary prescription. The only anaesthetic agents registered for veterinary use with fish in Canada are TMS and Aquacalm.

Health risks associated with handling the fish are reviewed by fish health staff and the Veterinarian prior to procedure. All staff handling anaesthetics must be aware of WHMIS information.

Fish are taken off feed for 24 hrs prior to being anaesthetized. Determination of the time of fasting includes consideration of fish size, diet, water temperature and existing knowledge about gut emptying times.

Anaesthetic baths are prepared according to manufacturer's directions and should be made up using water from the enclosure the fish are being taken from to minimize stress.

Ensure fish are healthy prior to using anaesthesia

During Anaesthesia:

Staff should wear personal protective equipment to minimize exposure to anaesthetic agents. Many agents are known to present health risks, others are currently unknown. It is advisable to be pro-active in preventing personal risk. Recommended gear includes dust mask, latex or nitrile gloves and rubber boots. When measuring out TMS and Aquacalm powder any spilled materials are wiped up and disposed of properly (according to WHMIS)

Fish are handled gently using nets with smooth surfaces. Larger fish are supported ventrally when handled by hand; smaller fish will be handled with a dip net. Any dropped fish or jumpers will be handled by net instead of hands.

Mucus protectants (e.g. Vidalife™) may be employed to minimize damage to the fish mucus-skin barrier (see the *Fish Handling Procedures*). In transport of adults this has been used according to manufacturers directions (instructions provided on the container) at the Chilliwack River Hatchery.

A few fish are tested first before adding larger numbers of fish to the anaesthetic bath, as the effect of an anaesthetic may vary with local water conditions, as well as the species, life stage and size of the fish. This step ensures that an incorrect dose will result in minimal losses.

The action of anaesthetics is affected by water quality. Water quality parameters, especially temperature and dissolved oxygen, are monitored during the procedure. Ideally the temperature of the rearing unit and the anaesthetic and recovery baths should not differ by more than two degrees.

Visual behaviour of fish is monitored during the anaesthetic bath. Fish are observed for signs of visible distress or cessation of opercular activity which can be life threatening.

Airstones are placed in the anaesthetic solution, with the airflow regulated for small bubbles to optimize oxygen exchange.

Fish are never left unattended while in the anaesthetic bath. Once the desired plane of anaesthesia is reached, the fish may be removed and the handling/procedures performed.

More fish may be transferred to the anaesthetic bath as required but any degradation in water quality or change in the time to anaesthesia should be monitored and addressed. When induction time increases to > 2 minutes or water quality deteriorates (becomes visibly murky, temperature increases noticeably) the anaesthetic bath will be renewed.

Following Anaesthesia:

After the procedure, fish are recovered in a separate container prior to being gently returned to their rearing unit. Fish are monitored for recovery. Fish are fully recovered prior to being put back into their enclosure.

Anaesthetic baths are disposed of in accordance with manufacturer recommendations and waste management regulations. Baths are disposed of down the drain when used inside the hatchery building. This drain goes into the effluent pipe and into the septic field and sewage lift system. If dumped outside, baths will enter the fish gutter and proceed through the effluent pipe into the swamp.

Fish populations are monitored closely after all handling events. Mortality and morbidity are assessed daily post handling, mortalities are recorded.

Some anaesthetic agents are subject to a withdrawal time. This is indicated on the prescription for the product. Fish are not released or slaughtered for human consumption until after the withdrawal period has expired.

Fish production records should be highlighted to indicate that a withdrawal period is in place for the treated groups if using TMS

<u>Details of the Operating Procedure</u>:

4.30.1 TMS Anaesthesia:

Equipment List

- Buckets and basin of appropriate size for fish being treated
- Anaesthetic stock solution or pre-weighed amount of drug to be used
- Sodium bicarbonate (baking soda) pre-weighed
- Supplemental air; tubing and airstones
- Thermometer
- Dissolved oxygen meter
- Personal protective equipment (gloves, dust mask)
- Scale to measure TMS
- Spoon for measuring
- Weigh boat

The dose for TMS anaesthesia is 40 – 50 ppm.

Prepare sedative bath according to manufacturers directions. Calculate the volume of water to be treated, and the appropriate amounts of drug and buffering agent (sodium bicarbonate for freshwater baths).

Dissolve the calculated amount of TMS needed in the holding tank. Mix well.

In freshwater, buffered TMS should be used for the safety of the fish.

- Check the pH of the water following TMS addition to determine the amount of sodium bicarbonate required. Add sodium bicarbonate till the solution has reached a pH of 7.0. Extremely hard water may not require buffering while soft water may require more than equal weight.
- Where measuring pH is not feasible, the standard rule of thumb is to add an equal amount of sodium bicarbonate to that of TMS added.

Aeration is supplied to both anaesthetic and recovery baths. Measure starting water quality parameters (dissolved oxygen, pH and temperature) and note the time of the addition of fish to the tank.

Test a small group of fish initially to detect any adverse response which could indicate either a species or strain sensitivity or a drug dosing miscalculation.

TMS is seldom used at this facility, and would only be potentially used for steelhead and coho length weight sampling

1. Measure out appropriate weight of TMS (use gloves and dust mask when measuring)
2. Make up a 50 g/L stock solution in water
3. Use 10 mL stock solution in a half full round basin 20 L well water (5 gallons). This is the equivalent of 20 milligrams per liter or 20 ppm.

   2 capfuls of stock solution into the anaesthetic basin
4. Add 1 g baking soda to buffer the solution
5. Aerate the water

6. Add a few fish to test the anaesthetic dose. Ideally the fish should become easy to handle within 2 minutes. If fish succumb faster (less than 1 minute), dilute the bath with water. If they succumb more slowly discard the bath and make a new one with a slightly higher dose and test again with a few fish. A recovery time of 2 min or less is desirable. If fish are taking longer to recover the concentration may be too high or the temperature may be higher than desirable. In either case, a fresh bath with a lower anaesthetic concentration should be prepared and fish should be placed into a recovery container with fresh clean water
7. Change the anaesthetic bath on a regular basis and monitor temperatures regularly
8. Change the anaesthetic bath at breaks, if the temperature increases, if it begins to lose its effect or if the time that it takes fish to succumb increases appreciably
9. Change the bath for each separate sampling of fish for length weights

Withdrawal time: At temperatures greater than 10 ^{0}C, fish treated with TMS must be held 5 days before they are safe for release or human consumption. At temperatures < 10 ^{0}C, the withdrawal time is 21 days.

4.30.1.1 MSDS Information:

TMS is generally considered to be of low hazard, nonetheless it should be handled with caution. It is important that TMS, and all pharmaceuticals be handled in a safe manner using normal precautions.

May be harmful by inhalation, ingestion or absorption. Avoid contact with skin, eyes and clothing. Use in well ventilated areas. Wear gloves, dust mask, safety goggles and protective clothing. Wash exposed surfaces well with soap and water after use. Wash contaminated clothing before re-use. Do not breathe dust.

In case of contact with:

Eyes: immediately flush with plenty of water for at least 15 minutes.

Skin: immediately wash with soap and water

Inhalation: immediately remove to fresh air, if not breathing give artificial respiration or oxygen.

Ingestion: give copious quantities of water.

Medical attention should be sought, especially if any irritation persists.

4.30.2 Carbon Dioxide:

CO_2 is used when marking fry and sorting and selecting broodstock at the trap

Note: This is not a veterinary approved anaesthetic drug.

The dose for carbon dioxide gas in water is 150-200 mg/L to produce a loss of equilibrium in salmonids. To safely induce anaesthesia, dose testing with close monitoring of fish response, may be required.

Carbon dioxide should be used with caution as it has a low margin of safety due to its acidifying effects on the water, which are stressful for the fish.

Deeper anaesthetic planes are unreliable with this chemical and hyperactivity is a common response.

Note:

The acidification of bicarbonate or carbonic acid evolves CO_2, which is similar in producing a hypercapnic condition in the water similar to CO_2 gas. One difference is the unknown contribution of the added acid to the pH change of the water. A common field method of using CO_2 is to use Alka-Seltzer® tablets. This requires some degree of testing to determine the appropriate dose for the fish in use and will depend on several factors but the literature indicates that a dose of four tablets per 500 mL provides euthanasia[2]. Narcosis to enable humane euthanasia has been reported to be induced by using 2-3 tablets per litre[3]. However, the problems with this chemical method of anaesthesia (hyperactivity, low plane of anaesthesia, low margin of safety, etc) persist despite source of carbon dioxide.

4.30.2.1 MSDS Information:

CO_2 is a colourless, odourless gas. CO_2 may cause asphyxiation if used in a closed space without adequate ventilation. Inhalation of carbon dioxide acts as a weak narcotic at high concentrations. Inhalation of high concentrations of carbon dioxide can cause headaches, reduced hearing acuity, changes in respiration and increased blood pressure and pulse and asphyxiation. Contents of cylinders are under pressure. Liquid and cold vapour may cause tissue freezing.

4.30.2.2 Fry marking CO_2 anaesthesia bath in the tagging trailer:

Equipment List :

- CO_2 cylinder
- O_2 cylinder
- Pressure regulator
- Porous tubing (or other means of dispersing the gas in water)
- Sodium bicarbonate
- Microbubble diffusers

1. With the chiller sitting in the CO2 tank, fill the system up with river/well water so that the water level stays 1 inch above the cowling surrounding the chiller mixing impeller and cooling tube.

[2] Agriculture Fisheries and Forestry — Australia (2002). Destruction Manual (Version 1.0). Australian Aquatic Animal Diseases Emergency Plan (AQUAVETPLAN), Edition 1, Agriculture Fisheries and Forestry — Australia, Canberra, ACT.

[3] Handlinger, J. Collection and Submission of Samples for Investigation of Diseases of Fin Fish. of Fin Fish. Australian and New Zealand Standard Diagnostic Procedures. 2001. Available for free download. from http://www.affa.gov.au/aquaplan

a. Using 1 tagging trough plus the CO2 reservoir = 190 L
b. Using 2 tagging troughs plus the CO2 reservoir = 242 L

2. Add 200 g sodium bicarbonate to buffer (fill the graduated measuring cup halfway)
3. Start the recirculating pump to pump water through the tagging trough(s). Maintain the water level in the CO2 tank as in step 1
4. Adjust the chiller water temperature to the same temperature as the water the fish will be subject to following marking
5. Turn on the CO2 to 2.5 L/min for 15 minutes and then adjust back to 0.5 L/min to maintain anaesthetic levels. Adjust O2 flow to 0.5 L/min and deliver simultaneously with CO2. Fish should take approximately 2 minutes to anaesthetize. Flush the system with fresh water if the are anaesthetizing in less than 2 minutes
6. At lunch break, flush the CO2 reservoir tank with fresh water for 5 minutes, while still keeping the CO2 levels at 0.5 L.min. Add 100 g sodium bicarbonate to reservoir

4.30.2.3 Adult CO_2 anaesthesia – trap

Equipment List :

- CO_2 cylinder
- O_2 cylinder
- Pressure regulator
- Porous tubing (or other means of dispersing the gas in water)
- Sodium bicarbonate
- Microbubble diffusers for CO2 and O2

1. Adult anaesthesia is performed in the concrete tank and brailer system
2. Close the downstream gate in the fishway
3. Add 2 kg of sodium bicarbonate to the concrete tank in the brailer
4. Fill the tank to the green line
5. Turn on the CO2 and bubble it into the tank at 50 cfm for 15 min
6. After 15 minutes, turn the CO2 down to 10 cfm for maintenance
7. Bubble O2 into the tank at 2 L/min for the duration of the anaesthesia
8. Crowd fish down to the brailer trap and close the upstream gate
9. Lower the basket and raise a quantity of fish using the brailer into the elevator basket (in the tank)
10. The volume of fish is estimated by water volume displacement. Try to displace from the green fill line up to within 6 inches of the top of the tank (to avoid spillage)
11. Fish should take approximately 4 min to anaesthetize (longer if fish are overly active)
12. When the fish have succumbed to the anaesthesia, the basket is raised onto the sorting table and fish are sorted by species and sex into raceways. Fish are delivered to appropriate enclosures through sorting tubes
13. When fish are raised to the sort table, send another batch of fish into the anaesthetic bath

14. The anaesthetic bath may require topping up and will need to be changed at least once (mid day break) and potentially twice per day (peak conditions) depending on numbers of fish and time required for sorting
15. After sorting is completed, raise the elevator and place a rigid support rod in place (to ensure there is no possibility of it dropping and posing a human hazard)
16. Drain the anaesthetic bath to the swamp
17. Remove any fish and eggs that are remaining in the tank
18. Drop the brailer down and raise the gates to allow fish to enter the raceway
19. Flush the tank with clean water in between operations and at the end of the day

4.30.3 Clove Oil

Clove oil is used for anaesthesia of steelhead juveniles and adults. Juveniles and adults receive the same dose.

This is not a veterinary approved anaesthetic drug.

4.30.3.1 MSDS Information:

Clove oil is not believed to present any risk at present.

Equipment List :

Clove oil
Denatured alcohol
100 L tank

1. Measure out 100 mls clove oil and add to 900 mls denatured alcohol (ethanol)
2. Shake well to mix
3. Use at a dose of 30 mls clove oil solution to 100 L water
4. Test a few fish first to ensure proper dose

Use for adult ripeness checks and air spawning

1. Shelter light bags are placed inside a plastic tote to protect adults from abrasion with a line that notes 100 L water
2. Add clove oil solution (30 mls)
3. Aeration is not supplied
4. Two fish are netted out of the condos and placed into the anaesthesia bath until they are easily handled (usually takes 3-4 minutes)
5. Fish are removed from the bath by hand and checked for ripeness
6. Records which fish are ripe
7. If there are ripe spawning pairs available, they are spawned the following day

8. After spawning they are returned to the condo until release several days later (see Gamete Collection SOP)

References:

Canadian Council on Animal Care: Guidelines for use of fish for teaching and research
(http://www.ccac.ca/en/CCAC_Programs/Guidelines_Policies/GDLINES/Fish/Fish%20Guidelines%20English.pdf)
CCAC Guidelines for Anaesthetics
(http://www.ccac.ca/en/CCAC_Programs/Guidelines_Policies/GDLINES/Fish/Fish%20Anesthetics%20-%20ENG.pdf)
http://www.syndel.com/anesthetics/anesthetics.html
http://www.syndel.com/anesthetics/aquacalm_info_sheet.html
http://www.syndel.com/anesthetics/tms_info_sheet.html
Fish Handling Procedures

4.31 Euthanasia

Rationale: In the uncommon event where fish require euthanasia (i.e. pathogen/disease sampling, disease control strategy) the procedure shall be done in a humane manner and rapidly and irreversibly result in loss of consciousness. This SOP addresses section 2.1.3.5 of the General Principles of Fish Health Management.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:
All methods of euthanasia must result in a rapid and irreversible loss of consciousness. *It should be noted that while it is recognized that many facilities engage in suffocation by bucket, this is currently considered to be an inhumane procedure by the CCAC.*

All fish culturists and fish health staff is required to know how to euthanize fish in a humane manner.

Fish handling should occur in a humane and stress free a manner. (See Fish Handling SOP)

Acceptable methods of euthanizing fish include:

- Overdose with an anaesthetic agent (see *Anaesthesia*).
- A sharp blow to the head for larger fish held out of the water.
- Cervical dislocation and destruction of brain tissue.

When fish are killed for disease control purposes, biosecurity procedures will be followed to minimize the risk of disease spread within and from the premises.

Anaesthetic baths are disposed of in accordance with manufacturer recommendations and waste management regulations.

Details of the Operating Procedure:
Moribund fry are first euthanized then put down the effluent pipe which enters into the swamp

Small fish (in small numbers) will be killed by a flick to the head. If large numbers of juveniles are encountered, they will be euthanized by an overdose of anaesthesia

Adults are killed by a blow to the head with a club

Forms & Records:
EnPro and daily rearing records in excel. (culling records)

References:
Anaesthesia

4.32 Chemicals & Disinfectants: Supplies and Storage

Rationale: Chemicals and disinfectants must be handled, stored and administered/used properly to be efficacious. Selection of a disinfectant will depend on several factors, including the spectrum of activity of the disinfectant, the nature of the surface being treated, and the cost, safety, and ease of use of the available disinfectants. This SOP addresses section 2.3.5 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that all chemicals and disinfectants are used and stored in a manner that is efficacious and safe. All staff handling chemicals must be aware of WHMIS requirements.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Hatchery personnel are responsible for carrying out the procedures contained within this SOP and for ensuring that the SOP is carried out correctly.

General Principles:

The following personal protective equipment is to be used when required:

- Latex gloves or heavy rubber gloves (latex gloves must not be reused beyond a single day)
- Rubber boots
- Safety glasses
- Respirator
- Coveralls, lab coats or a change of clothes as required for biosecurity purposes.

Chemicals will be stored in a manner that ensures both worker safety and prolonged efficacy and expiration information will be consulted prior to use where applicable.

Chemicals will be stored as recommended by the manufacturer. Provisions will be made to control temperature extremes, UV exposure, ensure adequate ventilation, etc. Disposal of chemicals will occur on the expiration date or sooner if there are any indications of decreased efficacy or problems encountered during storage.

All unused or spent chemicals will be disposed of according to manufacturer's directions in compliance with local waste management regulations.

Details of the Operating Procedure:

4.32.1 Compressed Gas Cylinders Storage

Compressed gas cylinders must be stored in a clearly identified, dry, well-ventilated storage area away from doorways, aisles, elevators, and stairs. Store cylinders in the upright position and secure to the walls with an insulted chain (not in the yellow cages where they are tightly enclosed) and secure the protective caps.

Compressed gas cylinders are stored in cages (metal shop chained to the side wall) when not in use and at the egg cage station in a locked metal cages and in the metal locker under the operating platform for the brailer, chained to the wall in the incubation room when in use.

The area is well ventilated and cylinders are on a fireproof surface. The enclosure is tamper-proof and cylinders are protected from contact with ground, ice, snow, water, salt, corrosion, and high temperatures.

Oxygen and fuel gases are stored separately.

Indoors, oxygen must be stored at a distance from fuel gas cylinders of at least 6 metres (20 feet), by a wall at least 1.5 m (5 feet) high, or in cylinders rated for 1.5 hour fire resistance

Ensure that there is always an extra full cylinder of oxygen and CO2 on hand

Cylinders are moved by cylinder dolly

The cylinder is cracked to blow out any contaminants and debris prior to attaching the regulator.

4.32.1.1 MSDS Information:

CO_2 is a colourless, odourless gas. CO_2 may cause asphyxiation if used in a closed space without adequate ventilation. Inhalation of carbon dioxide acts as a weak narcotic at high concentrations. Inhalation of high concentrations of carbon dioxide can cause headaches, reduced hearing acuity, changes in respiration and increased blood pressure and pulse and asphyxiation. Contents of cylinders are under pressure. Liquid and cold vapour may cause tissue freezing.

4.32.2 Vidalife

Vidalife is the trade name for a specially formulated water conditioner for use in hatchery and transport tanks, on handling equipment and handling surfaces. Vidalife can be used whenever fish are handled or moved. Used as described, Vidalife will help protect fish by preserving the natural mucus layer as it purportedly forms a coating on contact surfaces to reduce friction and abrasion when handling. Vidalife helps make a protective barrier between fish and handling equipment and is suggested to reduce the toxicity of heavy metals. Vidalife may help reduce stress and abrasions during any handling process and therefore, it may reduce vulnerability to pathogens that may affect a fish.

Vidalife is stored in the cupboard in the dry lab

Used according to manufacturers recommendations

4.32.2.1 MSDS information:

Vidalife contains polyvinylpyrrolidone and tetrasodium EDTA, both of which are suspected to be carcinogenic. Irritation may result from eye contact or ingestion.

4.32.3 Parasite-S

Parasite-S™ is the trade name for an anti parasitic, formalin-based solution that is commonly used against parasitic, fungal and bacterial gill infections. It is also a standard disinfectant used in hatcheries for the prevention and treatment of egg fungal infections (see *Egg Fungal Treatments*).

The normal dilution of formalin for treating fish is 1:6000 or 167 ppm. This concentration is achieved by combining 17 mls of Parasite-S per 100 litres of water. Exposure is normally 30 – 60 minutes daily, and may be done on consecutive or alternating days for three treatments in total.

Parasite-S is stored in the Parasite-S storage shed near well #2 (It will be moved into a Hazardous Materials shed in the near future)

Cautions:

Formalin should never be added to water containing fish without first diluting it and then mixing it in thoroughly to avoid 'hot spots'.

Formalin should not be used if :

- Dissolved oxygen of the water is <5ppm
- The water temperature is >27^{o}C
- Heavy phytoplankton growth is present.

4.32.3.1 Parasite-S MSDS information:

Formalin must be handled with care. It is harmful if inhaled, and can seriously irritate eyes and skin after contact. Formalin should only be handled in well ventilated areas, preferably while wearing a respirator and safety glasses. Staff should review WHMIS information prior to handling this product and employ appropriate personal protective equipment.

Parasite-S contains methanol which inhibits the formation of paraformaldehyde, a white precipitate that is extremely toxic to fish. Even so, formalin should be stored in the dark above 10^{o}C and not allowed to freeze. If Parasite-S is allowed to freeze, it should be discarded due to the rapid formation of paraformaldehyde.

The toxicity of formalin increases as temperature increases. In very soft water, concentrations of formalin should not exceed 25 ppm. Concentrations greater than 250 ppm may cause severe gill damage and should not be used on salmonids.

Formalin is a gill irritant and thereby reduces gas exchange. This is especially of concern as formalin is commonly used when fish gill function may already be compromised. Additionally, formalin is a reducing agent that absorbs oxygen from the water. Therefore, the safest course is to treat with formalin at the time of day when the water temperature is at its lowest, and to provide supplemental oxygenation via airstones. The fish should be closely monitored during treatment for signs of respiratory distress (increased opercular movements or gasping at the surface) and the treatment terminated if needed.

4.32.4 Sodium chloride

Sodium chloride is stored in the bone yard. Small bags are stored in the cupboard in the dry lab

Sodium chloride should not contain the anti-caking compound YPS (Yellow Prussiate of Soda

4.32.5 Oxyvet (Oxytetracycline)

OXYVET® 200 LA is a sterile, long-acting, stable, aqueous solution containing oxytetracycline dihydrate equivalent to 200 mg oxytetracycline base per mL. It is an injectable solution used in various cultured animals including fish.

Treated animals must not be slaughtered for use as food for at least 21 days after the last treatment with this drug.

All prescription drugs are labeled and stored in the chemical fridge

4.32.6 TMS

TMS is a chemical used to provide anaesthesia to fish, thereby reducing the degree of stress associated with many fish culture procedures.

TMS is stored in the chemical cupboard in the dry lab

4.32.6.1 MSDS information:

TMS is generally considered to be of low hazard, nonetheless it should be handled with caution. It is important that TMS, and all pharmaceuticals be handled in a safe manner using normal precautions.

Avoid contact with skin, eyes and clothing. Use in well ventilated areas. Wear gloves, dust mask, safety goggles and protective clothing. Wash exposed surfaces well with soap and water after use. Wash contaminated clothing before re-use. Do not breathe dust.

May be harmful by inhalation, ingestion or absorption.

In case of contact with:

Eyes: immediately flush with plenty of water for at least 15 minutes.

Skin: immediately wash with soap and water

Inhalation: immediately remove to fresh air, if not breathing give artificial respiration or oxygen.

Ingestion: give copious quantities of water.

Medical attention should be sought, especially if any irritation persists.

4.32.7 Chloramine-T (Halamid)

Chloramine-T (Halamid) is a disinfectant used for surface bacterial infections including bacterial gill rot.

Chloramine-T is stored in the fume hood in the dry lab

When handling Chloramine-T a respirator and rubber gloves are worn.

4.32.7.1 Chloramine-T MSDS information

Chloramine-T powder can cause burns or sensitization on skin contact and sensitivities upon inhalation; it is injurious to eyes and is harmful if swallowed. Staff should review WHMIS information prior to handling this product and employ appropriate personal protective equipment.

4.32.8 Bleach (sodium hypochlorite)

Household bleach, also known as chlorine bleach (sodium hypochlorite (NaClO)), has a pH level of 11 and is commonly used as a disinfectant.

Bleach has been used for surface disinfectant on counters at this facility, but normally Ovadine is used for disinfection procedures

Bleach is stored under the sink in the coffee room

4.32.8.1 Bleach MSDS Information

Sodium hypochlorite yields chlorine radicals — oxidizing agents readily reacting with many substances.

Mixing bleach and cleaners containing ammonia can create toxic chloramine gases resulting in respiratory distress.

Chlorine is a respiratory irritant. It also attacks mucus membranes and burns the skin.

4.32.9 Ovadine™

Ovadine is a specially buffered, non-corrosive, aqueous iodine solution used by fish culturists as a general disinfectant on equipment, tanks, nets, hands and clothing in hatcheries and at farm sites. It is also used to disinfect eggs. It is a fast acting disinfectant that has been shown to be effective against many gram-positive and gram-negative bacteria and fungi.

Ovadine is stored in the lower cupboard in the wet lab

4.32.9.1 Ovadine MSDS Information

Synonym- 10% Povidone iodine solution

There is no evidence of any hazard associated with inhalation of Ovadine solution. There is no evidence of any adverse effects of ingestion or skin contact with Ovadine. Ovadine solution is classified as practically non-toxic. Even so, eye and skin protection is advised .

Storage in high temperatures results in a loss of available iodine in solution.

4.32.10 Virkon

Virkon is the trade name of a disinfectant chemical containing peroxygen compounds, a surfactant, organic acids and an inorganic buffer system.

Virkon is stored in the dry lab underneath the sink

4.32.10.1 Virkon MSDS Information

Rubber gloves, a dust mask (stored in the cupboard above the counter) and protective eyewear are worn when measuring out Virkon powder as per manufacturers requirements. Good ventilation should be used. Care should be used when measuring out Virkon powder to avoid the generation of airborne dust which can be irritating.

Virkon may be very irritating to the skin, eyes and mucus membranes and should be handled with a degree of caution. If contact is made with skin, rinse well. If eye contact is made, rinse eyes well with water for at least 165 minutes and obtain medical attention. Ingestion may result in severe irritation tot eh throat, digestive tract and stomach. Do not induce vomiting, drink plenty of water (or milk) and seek immediate medical attention.

4.32.11 Ethanol

70 – 95% ethanol (also known as ethyl alcohol or EtOH) may be used as surface disinfectant for instruments (i.e. spawning knives, egg picking tweezers, dissection equipment, etc.) or lab benches. Note: 70% is commonly used due to the rate of evaporation at higher concentrations.

Ethanol can be stored in sealable glass or plastic containers when not in use, and poured into a small beaker for instrument tip disinfection when required.

For lab bench surfaces, 70% ethanol may be transferred into a plastic spray bottle for use. It should be sprayed to coat the desired area of a clean bench top, left for roughly one minute contact time, then the excess may be wiped off with a paper towel.

Ethanol is used for otolith storage, clove oil dilution and equipment sterilization

Ethanol is stored in the chemical cupboard in the dry lab

4.32.11.1 Ethanol MSDS Information

Although Ethanol is relatively stable, it is hygroscopic and substances to be avoided include strong oxidizing agents, peroxides, acids, acid chlorides, acid anhydrides, alkali metals, ammonia, moisture. It may forms explosive mixtures with air.

Ethanol may cause skin and eye irritation. Ingestion can cause nausea, vomiting and inebriation; chronic use can cause serious liver damage. Note that "absolute" alcohol, which is close to 100% ethanol, may nevertheless contain traces of 2-propanol, together with methanol or benzene. The latter two are very toxic, while "denatured" alcohol has substances added to it which make it unpleasant and possibly hazardous to consume.

Extreme caution should be exercised if working with ethanol near flame sources as it is highly flammable and the flame may be invisible in well lit areas.

Forms & Records:
Ovadine usage sheets, EDR form

References:
Virkon™ data sheet: http://www.antecint.co.uk/MAIN/vkuse.htm
Ovadine™ data sheet: http://www.syndel.com/d_p_f_s/Ovadine_info_sheet.html
WHMIS Material Safety Data Sheets

4.33 Equipment disinfection

Rationale: Equipment is to be kept clean at all times to limit pathogen spread. Movement of equipment between sites provides easy access for pathogens to migrate to facilities in different geographical regions. This should be avoided to reduce the risks associated with pathogen transfer. This SOP addresses section 2.2.7 of the General Principles of Fish Health Management.

Authority: Site and fish health management staff is responsible for information contained in the SOP. All site staff is responsible for ensuring the SOP is carried out correctly.

General Principles and Details of the Procedure:

4.33.1 Between sites:

This site has designated equipment that should not be shared with other sites.

On the rare occasion when equipment must be shared with other sites/organizations it should be cleaned, disinfected and dried prior to leaving the site and prior to returning to the originating site.

For example: when the fish scale is used for the Cultus Lake fishing derby

This site has designated raingear and it is not to be transferred between sites.

4.33.2 Within the site:

Each rearing unit has designated equipment that should not be used in other rearing units.

After use, equipment such as dip nets, buckets and feeding equipment will be cleaned, disinfected (by drying), dried and put away in the proper location. Nets will be disinfected when warranted (sick fish in an enclosure, working in a creek system out of normal areas, field nets (seine nets), not used for fish culture) are cleaned and disinfected by sun baking

When equipment must be shared between rearing units (for example: large objects such as grading tables), it will be cleaned, disinfected and dried between uses on different fish groups. Sampling trolley and scales are not cleaned between troughs, sick fish would be sampled last or not handled and would have their own sampling equipment.

The wastes from cleaning operations should be managed in a manner that minimizes pathogen spread and environmental damage. The use of high pressure water generates aerosols that can spread pathogens easily. Caution should be exercised whenever high pressure water is being used for cleaning of any type.

Holding units are cleaned, pressure washed and sun baked between groups of fish housed in the facility. Tanks are cleaned whenever organic matter has accumulated or algal growth becomes problematic. High pressure water is often insufficient to remove biological matter and surfaces may require manual scrubbing.

Holding units should be cleaned and disinfected prior to housing different groups of fish. Acceptable methods of disinfection include fallowing, drying, ultraviolet light and chemical disinfection.

4.33.3 General Disinfectant Protocols:

Disinfectants are chosen based on the anticipated degree of microbial killing required, the nature of the surfaces involved (i.e. rubber versus stainless steel versus concrete), and the cost, safety and ease of use of the chemical. Selection of appropriate disinfectants is made by the site management in consultation with the Veterinarian.

Products should be used according to manufacturer's directions.

Disinfectant concentrations are maintained either by checking concentration (e.g. Virkon™ using test strips) or regular renewal of the product (e.g. Ovadine™ dips replaced twice weekly or when indicated by a colour change).

Disinfectants are disposed according to manufacturer directions in such a manner that meets the requirements of waste management regulations.

Details of Operating Procedures:

4.33.4 Equipment Disinfection Protocol:

Smaller pieces of equipment (eg. buckets) should be cleaned and scrubbed with soap and water prior to drying to remove all visible organic matter.

Clean equipment should either be immersed in a disinfectant bath or sprayed down if too large.

Ten minutes of contact time is required for successful disinfection with most products. Some products may require a greater degree of contact time. Follow the manufacturer's recommended guidelines. Equipment will not be left in the disinfectant bath indefinitely as this can result in deterioration of equipment.

All disinfected items should be rinsed with fresh, clean water before being put away in their proper storage location. Inadequate attention to rinsing can leave residual disinfectant behind that can be harmful to fish.

Equipment should be allowed to dry before re-use.

4.33.5 Tank Disinfection Protocol:

Tanks are rinsed of debris, pressure washed, rinsed with fresh, clean water, and allowed to dry after the removal of fish and prior to the introduction of new fish.

If a disinfectant (Ovadine) is used, adequate contact time for the disinfectant is allowed (please review this for the disinfectant concentration being used – a minimum contact time of 10 minutes is standard).

Where possible, a fallow period of at least one week between fish groups will be allowed.

Pond walls are been washed with Ovadine, generally pressure washed and allowed to sit between groups of fish

Transport tanks are rinsed before and after use allowed to dry between uses

4.33.6 Foot Mat Disinfection Protocols:

Drain spent footbaths and rinse foot mats of residual solutions by squeezing out as much liquid as possible and rinse them with freshwater

Dispose of excess solution into a drain that goes to municipal sewage or dispose to ground.

Add an appropriate volume of fresh pre-mixed disinfectant solution.
Where possible, test the dilution strength to ensure a minimum concentration of disinfectant is present.

Monitor footbath concentration at a minimum of twice weekly and change when the concentration has declined below effective levels or when it appears heavily soiled. Add when the volume is low

Suggestion – charge on a weekly to biweekly basis. Mats are tough to judge and get diluted

4.33.7 Instrument Disinfection Protocol:

70 – 95% ethanol (also known as ethyl alcohol or EtOH) may be used as surface disinfectant for instruments (i.e. spawning knives, egg picking tweezers, dissection equipment, etc.) or lab benches. Note: 70% is commonly used due to the rate of evaporation at higher concentrations.

Ethanol can be stored in sealable glass or plastic containers when not in use, and poured into a small beaker for instrument tip disinfection when required. The beaker needs to be wide enough or heavy enough to resist tipping over when handled instruments are placed tip-down inside it.

For lab bench surfaces, 70% ethanol may be transferred into a plastic spray bottle for use. It should be sprayed to coat the desired area of a clean bench top, left for roughly one minute contact time, then the excess may be wiped off with a paper towel.

Organic matter should be brushed or wiped off prior to instrument immersion in ethanol to ensure effective disinfection.

Instruments should be immersed for at least one minute prior to re-use to allow sufficient time for disinfection.

Pass the instrument tip through a flame to burn off the alcohol and allow the tip to cool for 5-10 seconds before use.

Cautions:

- during flaming, the instrument tip showed be angled downward to prevent burning ethanol from running down the instrument and coming in contact with operator
- burning ethanol may not be visible beware replacing a flaming tip back into the ethanol.

4.33.8 Ovadine™

For use as a **general disinfectant** for dips for equipment or footbaths, a 250 ppm available iodine solution is made by diluting 25mLs of Ovadine™ to 1 litre of clean water.

A change in the solution colour from dark brown to light yellow indicates a loss of activity.

For use as an **egg disinfectant**, a 100 ppm available iodine solution is made by diluting 10 mLs of Ovadine™ to 1 litre of clean water. (see *Egg Disinfection*)

Ovadine™ may be stored at room temperature (20 – 30^{o}C) for periods greater than two years if containers are kept tightly sealed and away from direct sunlight.

4.33.9 Virkon™

To create a 1:100 solution (1%) of Virkon™ add 100 mg of disinfectant to 10 litres of fresh water. The pink colour is an indicator of efficacy; concentration test strips are also available.

Footbaths are replenished every 2 – 3 days depending on traffic or when heavily soiled or when the colour changes.

Nets, or other surfaces which are difficult to remove organic matter from, are soaked in Virkon™ solution for 20 – 30 minutes followed by rinsing with water.

Virkon™ should be stored at room temperature. For the powder, a 2.3% loss in activity will be seen following 36 months in storage. For a 1% working solution, a 10% loss of activity will be seen after 7 days in 350 ppm hard water.

Forms & Records:
Chemical inventory
Foot bath log

References:
Egg Disinfection
Hyperox™ data sheet: http://www.antecint.co.uk/Main/hypox.htm
Virkon™ data sheet: http://www.antecint.co.uk/MAIN/vkuse.htm
Ovadine™ data sheet: http://www.syndel.com/d_p_f_s/Ovadine_info_sheet.html

General Practices and Procedures

4.34 Predator exclusion

Rationale: Predator interactions with fish can result in stress, injury, and death. These interactions create stressful situations which predispose fish to disease and decrease productivity. Predators and scavengers can introduce pathogens to the fish and predator damage to infrastructure can lead to fish escape. This SOP addresses section 2.2.4 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that predators do not gain access to fish holding units.

Authority: Site management is responsible for ensuring this SOP is carried out.

4.34.1 Infrastructure

The use of predator exclusion devices is critical. Indoor facilities, fully fenced sites, covered fish holding units, the use of bird netting on fish holding units and screens on effluent drains are some predator exclusion options. Furthermore the site must adapt to new threats and as such respond to predator and human threats to fish on site and site operations.

This site's perimeter has a continuous chain link fence and utilizes predator netting on the tops and sides of earthen channels. On the outside of the chain link fence along the river dyke, two strands of electric fencing wire is rigged at the top and bottom. Chain link fencing is erected on the top of the bank on either side of the entrance waterway approach to the fish ladder. Double strand electric fencing is used at the bottom of the chain link fence on the waterside.

Lids are used on intermediate rearing troughs but raceways are open and subject to some predation

This facility currently experiences difficulty from otters, mink, racoons, herons, kingfishers, and dippers and adults have been lost to bears in the adult area below the fence

In addition, video cameras are used as surveillance to protect the site and fish stocks against human intrusion.

4.34.2 Procedures

Facilities are checked daily for signs of predators. Any damage to predator nets or other predator exclusion infrastructure is repaired as soon as possible.

Feed is stored and distributed in a manner that does not increase attraction to scavengers and predators. (See *Feed, Feed Storage, & Feeding Practices*) Spilled feed is cleaned up immediately. When there are problems with bears, the feed is kept on a truck and not left out near troughs.

Household refuse is properly contained in garbage bins prior to removal from the site. These are emptied on a frequent basis.

Mortalities are examined regularly for signs of predator attack (See *Mortality Classification*)

4.34.3 Contingency plan

When exclusion methods have failed and all other options have been exhausted, a conservation officer should be called and permits must be obtained in order to trap and relocate or terminate predators. Predator destruction must be done in as humane a manner as possible. The predator population must not be put at undue risk.

Several staff members at this facility are registered for firearms and with appropriate certification may shoot and kill predators other than protected species. Staff must have a current medical certificate, firearms acquisition certificate, firearms training course, and are required to undergo annual requalification for this purpose

Forms & Records

Annual bird kill permit (Environment Canada Damage Permit)

Herons that are caught in predator nets are reported as entanglements in the annual migratory game bird report in order to maintain the EC damage permit.

References:

Feed, Feed Storage, & Feeding Practices
Mortality Classification

4.35 Site and staff disinfection and biosecurity

Rationale: All necessary precautions are taken to ensure that pathogens are kept out of a facility. This SOP addresses section 2.2 and 2.3.4.3.3 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that staff members decrease the risk of pathogens being transferred onto the site or between groups of fish.

Definitions:

Isolation: Separation for the period of communicability of infected animals in a manner that prevents or limits the transmission of an infectious agent to susceptible individuals.

Authority: Fish Health Management and the Veterinarian are responsible for information contained in the SOP. All staff is responsible for ensuring that the SOP is carried out.

Details of the Operating Procedure:

4.35.1 Personnel Movements:

Staff should not visit more than one site on the same day. If this is unavoidable, staff members should disinfect footwear between sites, and change into clean, dry clothing if appropriate.

Generally staff will only visit another site for meetings and not fish culture purposes. Staff from other facilities may come to acquire fish or eggs (Capilano, Chehalis, CA groups) It is expected that these staff arrive, with their own equipment and tanks, to acquire fish/eggs, receive these and leave. Eggs have been disinfected prior to leaving the site

Footbaths and hand wash stations should be used when provided.

If a site has a known disease problem occurring, that site should remain isolated from other sites; the site should be visited only if absolutely necessary and the visitor should not visit any other sites that day or return to his/her normal work site.

Where possible, use of personal protective equipment, including raingear, is limited to single sites and is to be disinfected after use.

4.35.2 Visitors

As publicly funded hatcheries, we have a unique mandate which includes public education and involvement. Visitors can compromise site biosecurity in a number of ways. They may inadvertently transport pathogens onto a site or may pose a risk to fish and tanks directly with the accidental turn of a valve. Site biosecurity protocols address minimizing the movement of pathogens onto the rearing site and prevention of pathogen movement throughout the site. This SOP addresses section 2.2.3 of the General Principles of Fish Health Management.

Visitors are welcome on our sites during posted business hours. This site is open to visitors between 8:30 – 3 pm seven days a week.

Self guided tours are excluded from incubation. Visitors are able to walk by all earthen channels, the troughs and one side of the raceways in the intermediate rearing area. Signage is utilised to attempt to restrict movement and keep public safe.

Scheduled public/school tours are allowed in incubation rooms. Tours are guided in one entrance and exit the same way and are under complete supervision during tours.

Work experience students are provided with routine orientation and safety information and are directly supervised by staff.

Open houses are scheduled in alternate years and at these, stations are set up to view adult fish and dissections, see spawning, feed, scopes etc. Fishery reps are on site during this period.

Areas holding critical life stages (i.e. incubation rooms) will be off limits unless tours are scheduled, as will any areas holding potentially compromised fish (i.e. broodstock, fish showing signs of illness).

Footbaths are placed at the entrance to the incubation room and visitors are expected to use them.

Tours are conducted according to the life cycle.

4.35.3 Supplier Procedures

Suppliers can transport pathogens from one site to another as they make deliveries and pickups at fish farms and hatcheries. This SOP addresses section 2.2.5 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that the risk of suppliers moving pathogens onto the site is minimised.

All suppliers should be informed of site procedures and biosecurity protocols prior to delivering anything to the site or removing anything from the site. (Refer to the *Site and staff disinfection and biosecurity*)

All deliveries should be made to the front of the main building and/or workshop only. Delivery trucks should not enter the area of the facility where fish are contained, particularly in the event of an outbreak or a suspected outbreak.

Feed is brought to the side of the building by suppliers and fork lifted into freezers by the staff. All other deliveries are brought to the front desk in the main building.

In the event of a disease outbreak, deliveries would be made to the front gate, suppliers would not be allowed on site.

If there was a problem in the rearing area, the lower road could be blocked off to divert traffic

It is preferable for suppliers not to visit more than one fish producing site per day. Where this is unavoidable, they must adhere to biosecurity protocols. Suppliers are not allowed on the site other than to the drop off point.

When there is a known infectious agent on site, suppliers should be warned in advance, to allow them to modify their delivery schedule to protect other sites on their route. Where possible, the infected site should be the last site visited in the day and the delivery vehicle/vessel should be disinfected after visiting the infected site. When disinfection is not possible, transferring supplies to a site vehicle outside the gates of the site might be a consideration.

4.35.4 Facility Maintenance:

Facility maintenance is not the sole responsibility of the Maintainance Superintendent. It is the responsibility of all staff at every level. The site is far too big and complicated to depend upon just one person.
A preventative maintenance program is in place and is run by the Maintenance Superintendent on staff. All equipment required in the operation of the facility is on the maintenance schedule. It includes, pumps, valves plumbing, alarm ,monitoring, buildings, vehicles and other equipment needed to conduct they day to day operations of the hatchery. Priority maintenance includes that which ensures the safety and well being of staff and maximizes the survival of fish stocks.

Hatchery staff in general are responsible for the day to day operating of equipment related to the incubation, rearing and holding of these stocks in all their developmental stages. As such valves, incubators, rearing units , holding and transport tanks and other containers will be kept clean, tidy and operational. They are to report any hazardous conditions and maintenance problems immediately to Management and the Maintenance Superintendent to ensure corrective measures can be taken so there is continuance of efficient and effective equipment and hatchery operations. It is important that regular meetings and updates being given on facility maintainance and equipment in order for Managers and Maintenance staff to plan and budget for maintenance and replacement of equipment and the purchasing of tools needed to do their jobs.

Where there are areas that can accumulate fish carcasses, fish food and sediment from settled effluent, and garbage, it can present a bio-hazard. These areas include fish ponds, fish traps, fish totes, effluent settling areas downstream of fish holing and rearing areas, incubation room and wet lab gutters and fish food storage rooms, automatic fish feeders, food weighing stations. These areas need to be cleaned on a regular schedule to prevent rot, decay, foul odours and byproducts. This accumulation poses a threat of disease and attracts unwanted pests such as bears, rats, crows, gulls and other animal scavengers.

Part of keeping a site well maintained is the necessity of keeping the staff informed of policies and procedures regarding operations and managements objectives to keep the site running efficiently and effectively and well organized. This can be noted in existing SOP's . Standard Operational Procedures and newly developed SOP's as the needs arise.

E.g. 1. SOP can be All floors in fish holding or rearing areas will be kept clear of non-essential equipment, fish food, dead fish, debris, in other words kept clean ..

2.. Policy on footbaths to be placed at critical locations throughout the site, notably the entrance and exit points of the incubation and rearing units.

4.35.5 Disinfectant protocols:

Disinfectants include chemical products determined by the site management in consultation with their Veterinarian.

Products should be used according to manufacturer's directions.

Organic matter must be removed from boots and equipment prior to disinfection to ensure efficacy.

Disinfectant concentrations are maintained either by checking concentration (e.g. test strips or visual inspection) or regular scheduled renewal of the product.

Disinfectants are disposed of according to manufacturer directions and following the requirements of waste management regulations.

References:

Chemicals & Disinfectants: Supplies and Storage
Egg Disinfection
Equipment disinfection
Outbreak – Disinfection Protocols
Quarantine/Isolation Procedures for Suspected Disease Outbreaks

4.36 Water quality monitoring

Rationale: Maintaining good water quality is vital to good fish health. Generally hatchery sites are chosen because of their desirable quality and quantity of water discovered through testing and monitoring beforehand. Stability of the supply is not always guaranteed. As such weather and human induced variables can effect change in water quality and quantity. This can happen rapidly or slowly overtime. Therefore the kind of and frequency of monitoring will vary between the sites due to location and site specifics. This SOP addresses section 2.1.1.2 of the General Principles of Fish Health Management. The goal of this SOP is to ensure that water quality is monitored consistently and accurately.

Authority: Site management is responsible for information contained in the SOP. Trained site staff is responsible for carrying out the SOP.

General Principles:

All pumped well water supply(s) is treated through aeration and the river water supply passes through a settling basin before distribution to fish and eggs. Before eggs and fish are subjected or exposed to any water source, the water must be flushed for a predetermined amount of time to adequately remove standing/stale water in plumbing pipes and rearing containers. E.g. Standing water in a closed system has a high risk of low oxygen due to BOD and *in situ* contaminate leachate as well as ambient temperature changes.

Where the operation requires a mix of well and river water, ensure that it is properly mixed and temperatures moderated before being distributed to incubators or rearing containers. It is preferable to use a mixing chamber or failing that arrange the two water sources in close proximity at the most upstream end of a container or head trough to allow for complete mixing before exposure to fish or eggs.

After initial treatment of river and well water, consideration must be given to water quality management which requires knowledge of fish density, feeding rate, volume, and source supply. If densities or feeding rates are too high, and/or if water volume and/or quality are too low, fish health will suffer significantly.

Incubators and rearing tanks are kept clean and water flows must be sufficient to maintain dissolved oxygen levels and remove metabolic wastes. Water quality should be measured frequently enough to differentiate normal variation from declining water quality conditions.

Indications for spot-testing water include: losses from an unknown source, temporary rearing at higher than normal densities, behavioural changes associated with water quality E.g. fish gasping at surface or crowding at inflow, historical patterns (i.e. seasonal high water temperatures can be associated with critically low dissolved oxygen), if fish show signs of distress after eating when the metabolic oxygen demand is the highest, etc.

Parameters measured and frequency of those measurements will vary between facilities and their water source and whether water is recirculated or single pass. A water quality monitoring program should be designed to consider natural spatial and temporal variation in water quality and provide an overview of the variation of water quality within a culture facility.

Details of the Operating Procedure:

The Chilliwack River Hatchery operations has established densities, flows and biological loading rates, which were based on known bio-standard of the day, local water quality and experimentation. Current hatchery practise are also based on past experiences and on other historical data.

4.36.1 Temperature

Temperature is measured daily in the ponds using a thermometer.

At the troughs, temperature is measured at the outflow of each enclosure if on mixed well and river water. If a series of containers is on straight river or well water, a representative temperature reading is taken for the series of enclosures.

Daily measurements are taken of the river water and well water temperature and recorded. The use of data loggers for temperature monitoring is encouraged. They have the ability to monitor as little or as often as you desire. Wherever there is a mix of waters used, a temperature is taken and comments recorded in the daily Excel spreadsheets. This data is transferred to EnPro on a daily/weekly basis.

4.36.2 Dissolved oxygen

Oxyguard meters are to be used to measure DO under situations where there is a concern if unseasonable water temperatures are occurring. This is based on observations of fish. DO will be monitored during treatments when flow rates are lowered.

The D.O probe is calibrated according to manufacturer's directions prior to use. Specifics of probe calibration are included in the attached file below.

Form & Records:

Enpro
Juvenile daily records (if related to disease, recorded in disease records)

References:

OxyGuard probe instructions

OxyGuard meter.pdf

4.37 Water quality contingency plan

Rationale: Acute deteriorations in water quality can result in mass mortality of fish populations. A plan needs to be in place to protect fish from declining water quality. This SOP addresses section 2.1.1.3 of the General Principles of Fish Health Management.

The goal of this SOP is to have a system in place that will protect fish from catastrophic poor water quality events. Examples of catastrophic water quality failures include issues both within (pump failure, pipe burst, filter clogging, etc.) and upstream of the hatchery (turbidity events from landslides, chemical spills during transport, etc.).

Definitions:
Turbidity: A cloudy condition in water due to suspended silt or organic matter.

Authority: Site management is responsible for information contained in this SOP. Site staff is responsible for ensuring it is carried out properly.

General Principles

A water quality monitoring program must be in place (see *Water quality monitoring*).

A site may have access to a variety of water supply options. This redundancy in supply has multiple advantages. It allows the cleanest possible water to be directed to sensitive lifestages (i.e. well water during egg incubation), allows mixing of different water sources (i.e. well water and surface water) for cost-effective temperature manipulations, and allows immunocompetent juvenile fish to be reared in the same water they will eventually be released into, allowing imprinting to their native streams and controlled exposure to endemic pathogens. The main value of redundant water sources however, is that in the event that one water supply is compromised, alternate sources may be available till normal supply is restored.

Details of the Operating Procedure:

There are two water supplies at the Chilliwack River Hatchery, and there are multiple sources for each supply.

4.37.1 River water

There are two river water intakes. Only one of these is currently functional however. The upper intake is the primary intake and the lower (old) intake currently only functions to bypass the settling basin

4.37.2 Well water

There are three well water supplies on site.

Well #1 pumps at 7-9 L/sec (420 -540 l/min)
Well #2 pumps at 2650 L/min

Well #3 pumps at 9000 L/min

Fish are monitored multiple times daily. A disease outbreak will initially have visible effects on susceptible, individual fish while overall the population may appear normal. However, in the event of a water quality failure, all fish on that water source will be similarly affected.

The river gravity feeds into the hatchery. Well pumps move the water into the aeration tower columns and is collected in the distribution tanks below. From the distribution tanks the well water gravity feeds to rearing and incubation. There are 3 backup generators which are located at the main building site, which also powers well #1 and a generator at well #2 and #3 to ensure power is available in the event of a power failure. Backup generators are tested on a regular basis as per preventative maintenance schedule and prior to any anticipated/predicted storm events to ensure they are functioning properly. If Well/Genset #3 fails, Well #2 wiil be turned on as a back-up. Because it can not deliver the same amount of well water as well #3, incubation or rearing areas on well will have to be supplemented with river water.

A disadvantage of flow through water supplies is that in the event of water flow shortage or water quality failure, large numbers of fish in contained enclosures will quickly exhaust the dissolved oxygen levels in stagnate water. The Chilliwack River Hatchery has the capacity to provide supplemental oxygen via air stones in an emergency. Water pumps can also be spliced into lines to move water between areas in the event of a water line break.

If no mitigation options are available, or if they prove unable to prevent fish losses, humane euthanasia of compromised stocks is preferable to suffocation (see *Euthanasia*).

If mitigation efforts are not successful and losses are high, the premises will be quarantined until it is determined that a disease outbreak is not occurring (see *Outbreak Response*).

4.37.3 Alarms

Incubation head tanks, fish rearing troughs, earthen rearing channels, raceways, aeration tanks, settling basin and distribution chamber are equipped with alarms to address water flow rates and water level and possibly critical water quality parameters like dissolved oxygen levels. Alarm systems vary with the type of water supply. A designated staff member is on standby to respond to alarms 24/7.

In addition high and low level alarms are present in several locations on the site.

E.g. Cap trough 1 has a low water level alarm to indicate if there are any breaks in the flow. There are low level alarms in the wells and in the aeration tower to indicate low flow situations. High level alarms are present in each of the earthen channels and in the distribution channel prior to the earthen channel. These alarms are triggered in the event of extra flow which could cause screen plugging and high levels. The sensor is at the top end of the channels.

References:
Euthanasia
Outbreak Response

5 Appendices

5.1 BKD sampling procedure (revised 2006)

Only females are to be sampled

1. Label Whirl-pak™ bags with a waterproof felt pen.

2. Put the scalpel and tweezers into a beaker of alcohol. Burn off the alcohol by passing the blade of the scalpel and the tweezers through a propane torch flame (called "flaming"). Tools may be laid across the top of the beaker until used.

3. Do an external examination. Record any abnormalities.

4. Pull away swim bladder and other internal organs using the scalpel handle. Start at the anterior (head) end of the swim bladder and pull down and towards the tail end. DO NOT TOUCH the middle or posterior (tail end) kidney with the scalpel handle!

5. Dip the scalpel blade in alcohol and "flame" the blade. Cool for a few seconds.

6. Cut a chunk of kidney (about 1cm wide x 1cm deep x 2 cm long, or roughly the distance between the tip of your thumb and the knuckle) from the posterior portion of the kidney. Use the tweezers to put these into the labeled Whirl-pak bag and seal. DO NOT TOUCH THE KIDNEY SAMPLE WITH ANYTHING BUT THE TWEEZERS!!! Put the Whirl-pak™ bag on ice in either a garbage bag or cooler to keep the samples cool. Wipe the scalpel blade and tweezers with Kleenex and return them to the alcohol beaker. Frequently change the scalpel blade as it becomes dull easily and scrub tweezers with a wire brush to keep them clean.

7. Examine the internal organs and record any abnormalities.

8. Discard any eggs from fish with obvious pustules in the kidney or if the ovarian fluid is cloudy.

9. Phone the lab at 250-756-7057 with the sample size, then ship the samples (with ice packs) the following morning. Samples must reach the lab ASAP after field collection. Please include the address of the hatchery and the phone number of the contact person. If you are shipping by air, we need to know the airlines, arrival time at Nanaimo Airport and the airline's waybill number.

10. It is VERY IMPORTANT that the samples be kept cool at all times. They are to be frozen if shipment must be delayed for more than one day. Please indicate which samples have been frozen and which are fresh.

Required sampling equipment for fall BKD survey

1. Small (6 oz.) Whirl-pak bags ---one per fish

2. Scalpel handle with blades
3. One pair of Tweezers
4. Isopropyl alcohol
5. Small container for alcohol and instruments, preferably with a layer of wax in the bottom
6. Kleenex
7. Propane torch or alcohol burner to sterilize instruments
8. Waterproof felt pen for labelling
9. Container with ice of freezer packs to keep samples cool
10. Garbage bags or other plastic bags to protect samples from the melting ice water

Sources of equipment

Prices are subject to change – use these prices as an approximation.

FISHER SCIENTIFIC 1-800-234-7437

Disposable-Blade Dissecting Knives Size 4 Stainless steel
Cat. No. 08-917-5 Approx. $18.00 each

#22 Stainless-steel Blades
Cat. No. 08-918-5C Approx $45.00 for pack of 100

Blunt-Pointed Forceps---Curved
Cat. No. 08-875-5 Approx $4.00 each

VWR SCIENTIFIC 1-800-932-5000

6 oz. Whirl-Pak Disposable Sampling Bags
Cat. No. 11216-012 Approx $95.00 for box of 500

5.2 Sample submission form

Fish Pathology Laboratory
Pacific Biological Station
Nanaimo, B.C., V9T 6N7
Tel: (250) 756-7057 Fax: (250) 756-7053

DATE: _____ HATCHERY OR SAMPLE SITE:_____

SUBMITTED BY:	MAILING ADDRESS:
_____	_____
PHONE:_____	_____
FAX:_____	_____

SAMPLE INFORMATION

BROODSTOCK CODE: _____ LAB CASE NUMBER:_____

SPECIES:_____ SAMPLE SIZE: _____

SAMPLE TYPE (√):

RANDOM		MORTS		SICK		NORMAL	

REARING CONTAINER I.D.:_____(TROUGH/TANK/POND)

AGE (FROM HATCH): _____AVERAGE WEIGHT (gm):_____

DIET:_____

WATER SOURCE: (√)

SALT		RIVER		LAKE		WELL		SPRING		MIXED		CITY	

TEMPERATURE:_____ºC OXYGEN (AVERAGE):_____ PPM

NUMBER OF FISH IN REARING CONTAINER: _____

LOSS RECORDS (PLEASE INCLUDE DATE):

TODAY:_____PAST 10 DAYS:_____

REASON FOR SUBMISSION:_____

_____

DESCRIPTION OF FISH BEHAVIOUR , APPEARANCE, AND OTHER PERTINENT INFORMATION:

_____

5.3 Ovadine™ Emergency Drug Release (EDR) – Hatchery Reporting Requirements

Ovadine is commonly used at fish hatcheries for equipment disinfection. It has also been safely used for over two decades as an egg surface disinfectant during water hardening.

Ovadine is currently (January 2007) under review by the Veterinary Drug Directorate for approval as a fish egg disinfectant. Until approval is received, it is available only by prescription from a licensed veterinarian, through Health Canada's Emergency Drug Release (EDR) program.

The EDR process:

The Veterinarian applies for approval for Site X to use X litres of Ovadine to disinfect X Pacific salmon eggs.

For example: PBS Hatchery - 20 L of Ovadine to disinfect 4 million eggs.

If approved, the site is issued an EDR#, which can be used to order Ovadine from an approved supplier (currently Syndel is the only approved supplier). Along with the EDR#, you will be supplied an Ovadine Usage Record Form (see next page). This form must be filled out when using Ovadine on eggs and must be returned to your Veterinarian within 6 months, to be included in a report to Health Canada. If you see any problems with your eggs or hatch that you think might be related to Ovadine egg disinfection, this form is where you record your concerns. This is an important part of the approval process.

If you need Ovadine only for equipment disinfection, you may order and use it without keeping any records.

If you already have sufficient Ovadine on site for both equipment disinfection and egg disinfection needs, you must still inform the Veterinarian to receive approval for its use on eggs and you are still required to keep records of the amount used on eggs.

If you require Ovadine, you must contact Syndel Laboratories and order the total volume desired for all disinfection needs. To complete the order, you must quote the EDR # for the volume (in litres) for which you have been approved of for egg disinfection.

For example: Order 56 L of Ovadine with 20 L to be used for egg disinfection under EDR # 2006-17xxx.

Use Ovadine as directed for egg disinfection. At the end of each spawning day, record the total volume of Ovadine used on eggs on the following form.

After incubation is complete, or when requested to do so, please return the Ovadine Use Record Form to your Veterinarian.

5.4 Ovadine™ Six Month Usage Record

(To be returned to the Veterinarian at the end of the spawning season)

EDR#: _____

DFO Facility Name: _____

Ovadine supply company: _____

Lot number and expiration: _____

Veterinarian: _____

Each date used on eggs	Volume used on eggs only (L)	User initials	Comments (include species, number of eggs treated and any adverse effects noted)

5.5 Guidelines for in-Stream Placement of Salmon Carcasses for Nutrient Enrichment

Introduction

Historically, large numbers of salmonid carcasses provided entire watersheds with abundant nutrients and organic matter derived from the ocean. Recent research strongly supports the hypothesis that salmon carcasses play a key role in maintaining the productivity of salmonid systems and benefiting the aquatic and terrestrial ecosystem as a whole. Rearing juveniles consume salmon eggs, feed directly on spawned-out carcasses, and benefit from increased abundance of invertebrates and algal growth. The presence of carcasses in streams has been related to increased juvenile density, growth rate, body size, improved fish condition, improved over wintering survival and ultimately increased marine survival.

These guidelines have been developed to regulate the in-stream placement of hatchery salmon carcasses from Fisheries and Oceans Canada enhancement facilities where there is a desire and the capacity to distribute carcasses. The guidelines are not intended to enforce the distribution of carcasses, nor to replace harvest under an Excess Salmon to Spawning Requirements (ESSR) authorization.

These guidelines are meant to increase the overall benefits from carcass placement by minimizing disease risks and other concerns, providing general management strategies for carcass placement, and highlighting the interagency process to avoid conflicts with potentially affected groups and agencies. Numerous factors affect the benefits of carcass placement in streams. These include ambient nutrient content in treatment streams, abundance of native salmon spawners, presence of fish disease agents in carcasses, retention and distribution of carcasses in waterways, water temperatures, flow levels, light penetration, and predator / scavenger activity on carcasses by insects, fish, birds and mammals. These factors have been considered in the development of the guidelines The guidelines were developed utilizing current relevant literature, input from DFO fish health specialists and ecological research scientists, and guidelines prepared by the Washington Department of Fish and Wildlife.

Planning, Review, And Awareness

Carcass placement plans must be reviewed by a DFO member of the Introductions and Transfers committee. Projects that meet the terms of the carcass placement guidelines will be issued a letter from the Department allowing the transport and deposition of carcasses. This letter must accompany all carcass movements. Carcass placement plans should be discussed with all relevant groups and agencies. These groups will include DFO local area staff in stock assessment, habitat, and resource management, and Conservation and Protection (Fishery Officers), as well as local First Nations, stewardship groups, affected landowners or any other affected groups. It is also important to contact the regional Ministry of Environment office to ensure that carcass placement is coordinated with inorganic nutrient enrichment projects. The Ministry of Environment should also be contacted if placement is considered in non-anadromous waters.

Under the Water Act, downstream water users (primarily local municipalities), must be advised of activities that may potentially impact water quality of their withdrawals. Accordingly, Water Licensees on treatment streams should be advised prior to placement programs. Carcasses should be distributed in such a way so as to avoid or minimize impacts on domestic and other types of intakes or water

supplies. Background material and signage may be provided to advise members of the public of carcass placement activity and its benefits.

Carcass Management and Condition

The placement of salmon carcasses in streams may pose a risk of disease transmission if carcasses of infected fish are used, if carcasses are moved to areas within the watershed that are normally not accessible to salmon, or if carcasses are moved to streams outside the watershed. Streams that receive carcasses are referred to as "treatment" streams and those that provide carcasses are referred to as "donor" streams. In general, no carcasses may be moved outside their natal stream because of concerns regarding disease transmission. However, in specific circumstances, movement of carcasses from the watershed to nearby streams may be considered if all of the following conditions are met: donor and treatment streams are geographically proximate and, treatment stream is within the zone of influence of the donor stock (i.e. adults may be straying from donor to treatment stream), and current disease history is available. If sufficient information is not available, health testing of fish in the donor stream and treatment stream may need to be undertaken. Historical information can be obtained by searching the Pacific Biological Station (PBS) Fish Health Database; the Fish Pathology Program may be contacted at (250) 756-7057. Please note that wild fish surveys have not been conducted in many locations in recent years so that information contained in the database does not include current disease status for many salmon stocks.

Only those fish killed with CO2 or blunt trauma that show no visible evidence of serious disease should be used for carcass placement. Carcasses of recently dead salmon from managed spawning channels may also be considered for placement.

Because of drug clearance times, and the length of holding, fish previously treated with an antibiotic or chemical anaesthetic (i.e. TMS™, Aquacalm™) must not be used for carcass placement. However, fish treated with external chemicals that do not require a withdrawal period (e.g. Parasite-S™ or Chloramine-T) are considered safe for placement. If in doubt, contact the Fish Pathology Program. Carcasses may be frozen for later use. However, as freezing will not significantly reduce disease organism loads, it should not be considered a disease management tool.

Carcass Loading Density

All salmonid carcasses are considered equal from a nutrient content basis. That is, required placement load may be calculated as biomass and then converted to fish numbers of the available species. For example, Chinook carcasses may be substituted for coho, and vice versa. Where system-specific weight data are not available, the following average weights for returning B.C. salmon are provided for weight conversion.

<u>Suggested Average Weights for B.C. salmon *</u>
Pink 1.5 kg
Steelhead 4.0 kg
Sockeye 2.5 kg
Chum 4.5 kg
Coho 3.0 kg
Chinook 8.5 kg
* Data sources: mean weights from B.C. catch statistics (J. Bateman, pers. comm.)

The maximum carcass placement within a stream segment (including the areas into which carcasses drift from the distribution point), over the course of a spawning season should be 1.9 kg/m² based on Wipfli et al. (2003) and WDFW (2002). In treatment streams with continuous escapement records, the carcass numbers may be reduced by the recent 10 year average for natural escapement to the treatment reach.

For determining total carcass deposition maximums for streams used by more than one salmon species, the area historically available to each salmon species should be used to calculate the loading rate. Spawning timing should be factored into distribution schedules.

Maximum loading densities may be adjusted to reflect the stream's carcass retention properties. Carcass retention in streams is affected by predator / scavenger activity, carcass transport during high flows, and abundance of in-stream structures to catch and retain carcasses. Accordingly, for streams with expected good carcass retention, maximum carcass densities may be reduced by the current spawner densities. For streams with expected poor carcass retention (high gradient, high flows, few pools and few in-stream structures), carcass loading densities need not be adjusted for current spawner densities.

Carcass Distribution

The temporal and spatial distribution of carcasses should reflect the historic spawn timing and abundance of salmon in the treatment reach. Carcasses should be placed in stream areas that are normally (or recently historically) accessible to salmon, (i.e., not above barriers). Carcass placement into inaccessible stream segments may be permitted where juvenile salmon of the same stock and species have been previously out planted (e.g., colonized upper areas above impassable barriers) but consultation with regional Ministry of Environment staff is necessary.

Placement in the riparian zone is not necessary and often results in increased numbers of blowflies. (Reimchen et al, 2003.). Natural predators will remove carcasses from the treatment stream and distribute them in riparian zones.

For streams with poor access (and low public use), a few accessible sites may be used for regular carcass placement. These sites should be inspected periodically to ensure adequate natural dispersion of carcasses. Where dispersal is poor, carcass loading should be reduced.

Carcasses should be distributed in stable stream areas, where possible. This will help avoid rapid downstream transport of carcasses. Optimal sites include shallow backwater pools, side-channels, small headwater tributaries, areas with abundant woody debris and beaver-dam complexes. However, note that placing excessive numbers of carcasses in side pools with sluggish or intermittent water exchange may cause de-oxygenation (E.A. MacIsaac, pers. comm.). Carcass placement should be avoided or delayed during high flow events, especially where anchoring and/or riparian placement is not feasible. Carcass distribution schedule should consider anticipated problems of poor stream accessibility due to snow, high water, and other constraints.

Timing of carcass placement is also important as nutrients should be made available to young salmon upon their emergence from the gravel. Placement timing may be early, mid or late, and may be used to

influence the ecological response to loading within watersheds. For example, the use of carcasses from later runs of native salmon (fall and winter) may benefit the next growing season, provided that some nutrients are stored through the winter (Wipfli et al. 1999). Also, the use of carcasses from several species, each with a different run timing (e.g., early sockeye, mid-chum, late coho), will provide a longer nutrient pulse in the treatment stream than if only one or two species were used, each with a brief spawning period.

If a treatment stream has a late natural spawning timing, carcasses from earlier runs to the treatment stream may be frozen and stored for later placement. The use of frozen carcasses is also convenient for long-distance transport.

Carcass Anchoring/Mutilation

Carcasses may be tethered or anchored in place, especially in unstable, higher-flow areas in order to improve carcass retention. Where carcass anchoring is desirable, natural anchors (e.g., large woody debris, logjams,
beaver-dams) or bio-degradable tethers such as natural-weave ropes, should be used where possible. External identification tags should be removed from carcasses prior to their placement. Non-bio-degradable tethers should be collected and removed from the stream after carcass decomposition. Where frozen carcasses are used, they should be tethered in place (frozen carcasses float and may be readily transported downstream). Where tethering is not possible, it is preferred to thaw out at least one fourth of the frozen carcasses before distributing them in order to enhance carcass retention at the point of access.

Where escapement enumeration programs will be conducted on treatment streams, carcasses should be cut in half or otherwise mutilated at placement, as directed by area stock assessment staff. This is crucial in order to avoid double-counting and ensure that enumeration programs are not affected.

Records of Carcass Placement

Records of numbers and species of carcasses placed in treatment streams should be maintained in annual data summaries, including areas and dates of placement. Summaries should be provided to the contact member of the Introductions and Transfers Committee.

References and Background Literature

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5.6 National Aquatic Animal Health Program

The following excerpt explaining the functions of the NAAHP are extracted from: http://www.dfo-mpo.gc.ca/Aquaculture/health-sante_e.htm

The NAAHP is a science-based regulatory program for aquatic animal diseases which have been designated reportable or notifiable in Canada because of their potential impact on trade and our economy. The program consists of measures needed to prevent, control and/or eradicate aquatic animal diseases of concern. The NAAHP is modeled after Canada's internationally recognized terrestrial animal health program, and will respect the health measures of the Aquatic Animal Health Code of the World Organization for Animal Health (OIE).

The NAAHP is comprised of the following key elements for listed diseases of concern:

- Listing of aquatic animal diseases meeting international and national criteria for mandatory reporting
- Legislation, regulations and policies
- Surveillance (early detection), monitoring and reporting
- Zonation (regionalization)
- Disease databases
- Laboratory diagnostic testing and capacity building
- Quality Assurance/Quality Control
- Scientific research and technology development
- Import controls
- Export certification
- International relationships (influencing setting of standards, trade negotiations)
- Contingency planning
- Disease control and eradication (containment standards and quarantine, disease preparedness and response etc.)
- Education and training
- Risk analysis
- Awareness
- Animal welfare
- Record keeping (tracking and tracing)
- Codes of practice
- Hatchery Program

As a member of the OIE and the World Trade Organization, Canada is obliged to implement OIE standards for trade purposes, including trade in aquatic and terrestrial animals. In addition, Canada is a member of the Food and Agriculture Organization (FAO) and signatory to the Code of Conduct for Responsible Fisheries aimed at conservation of resources for sustainable economic productivity. Canada's major trading partners are adopting regulatory frameworks for their own aquatic animal health programs to meet these international scientific standards. Canada may be required to attest, for export purposes that aquatic animals and their products originate from regions, farms or sites that are free of reportable or notifiable diseases.

The Minister of Agriculture and Agri-Food, who is responsible for the CFIA, and the Minister of Fisheries and Oceans are jointly implementing the federal responsibilities for the NAAHP. This collaboration

between Canada's veterinary services and fisheries authority will greatly facilitate Canada's capacity to meet international obligations for aquatic animal health management.

The CFIA provides the overall program lead for the NAAHP under the legislative authority of the Health of Animals Act and Regulations. The Agency is responsible for the disease surveillance/monitoring protocols and control measures for reportable diseases. DFO delivers and oversees the National Aquatic Animal Health Laboratory System (NAAHLS).

Since the management of the wild and aquaculture industries is a shared responsibility in Canada, the NAAHP is designed to respect federal and provincial/territorial jurisdictions. Expertise and collaboration from provinces/territories and industry will continue to be sought to minimize duplication or gaps in an effort to ensure that all aquatic animal diseases are well managed by government and industry.

The Aquatic Animal Health Committee (AAHC) has members which include the Canadian Aquaculture Industry Alliance (CAIA), the Fisheries Council of Canada (FCC), the Aboriginal Aquaculture Association, the Canadian Veterinary Medical Association (CVMA), provincial representatives, Fisheries and Oceans Canada and the Canadian Food Inspection Agency. The AAHC advises the CFIA and DFO on matters relating to the development and implementation of the NAAHP. Information will be shared extensively with all stakeholders as major components of the NAAHP evolve. This approach will ensure a comprehensive and coordinated aquatic animal health management program for Canada.