Department of Fisheries and Oceans Salmon Enhancement Program

Snootli River Salmon Hatchery and Atnarko Channel

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 are 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 facility staff and the Enhancement Support and Assessment Unit.

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	250-982-2214
Hatchery fax	250-982-2971

Hatchery staff list:

Russ Hilland	Manager
John Willis	Project Manager
Denis Tippie	Maintenance Superintendent
Tom Loosmore	Fish Culture Officer
Carl Siwallace	Fish Culture Officer
Lawrence Michalchuck	Fish Culture Officer
Blair Mack	Assistant Maintenance Man
Marshall Hans	Assistant Fish Culturist
Samson Mack	Assistant Fish Culturist
Marie Salome	Administrative Assistant

D.F.O. CONTACT PHONE NUMBERS

D.F.O. Community Advisor (Sandie MacLaurin)	250-982-2663
D.F.O. Veterinarian (Dr. Christine MacWilliams)	250-729-8377
Fisheries Officer (Leila Aus)	250-799-5345
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

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

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

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.

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

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.

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

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.

ppm: parts per million, equivalent measurement to mg/L (milligrams per litre)

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 (e.g., those weakened by primary pathogens or stress) and become pathogens.

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.

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

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.

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

Vertical transmission: spread of a pathogen from the parent to the offspring

*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 include (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 health 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 backup 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.

SOP: Vaccine handling, storage and administration

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 and surface disinfected 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.

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 *2.2.7*.

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

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 Treatments
Adult Carcass Disposal

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 should be 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 should be 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 should be 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 should 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 should be 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

Sample Shipment to a Diagnostic Laboratory
Diagnostic Sampling protocols

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

3.1 General Description

Snootli Creek Hatchery is located at the head of North Bentinck Arm on the Bella Coola River near the town of Hagensborg (Figure 1).

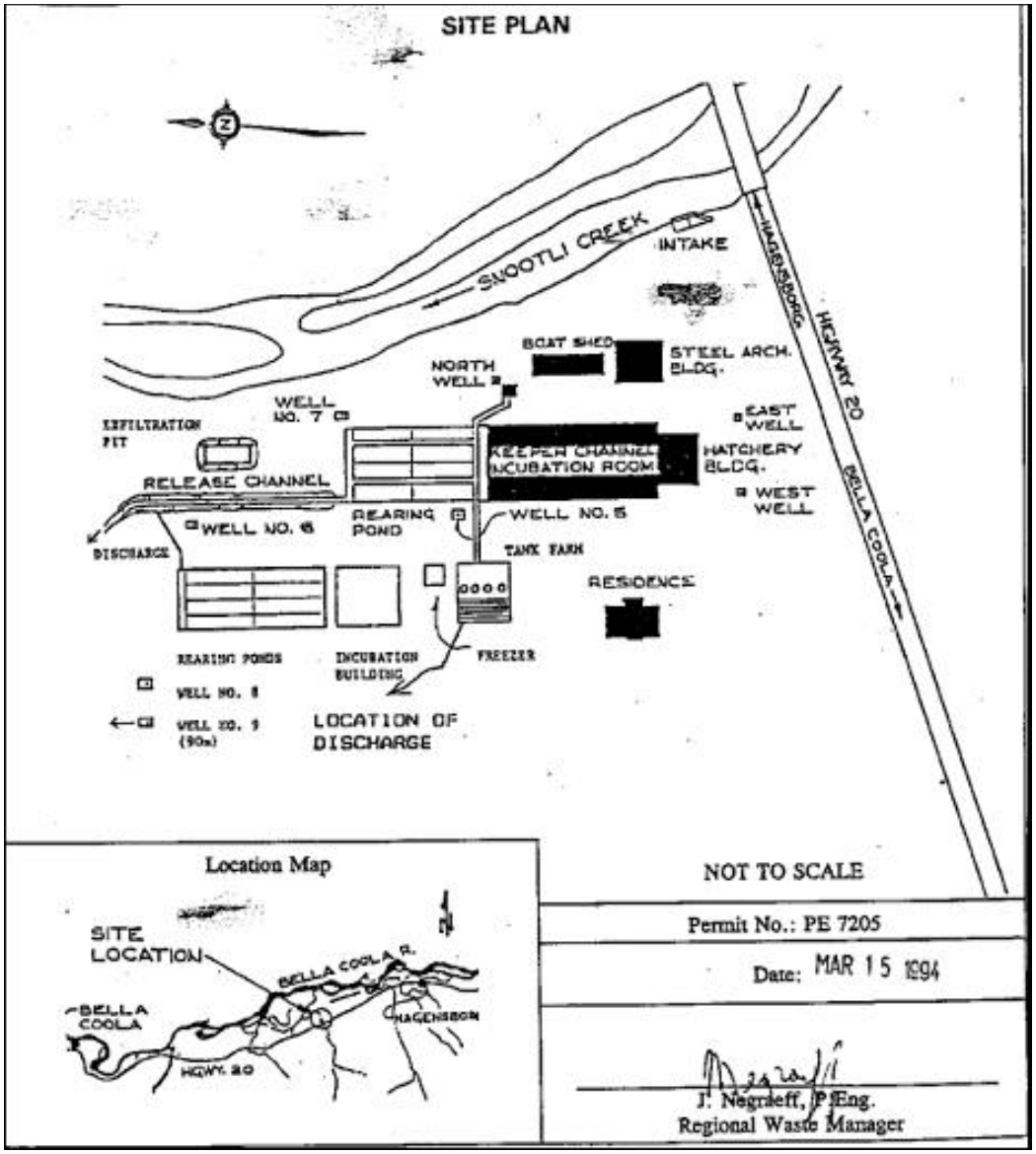


Figure 1. Snootli Creek Hatchery Site Plan

An unmanned spawning channel and earthen rearing channels are located adjacent to the Atnarko River in Tweedsmuir Park, 40 km east of the Snootli Creek Hatchery site (Figure 2).

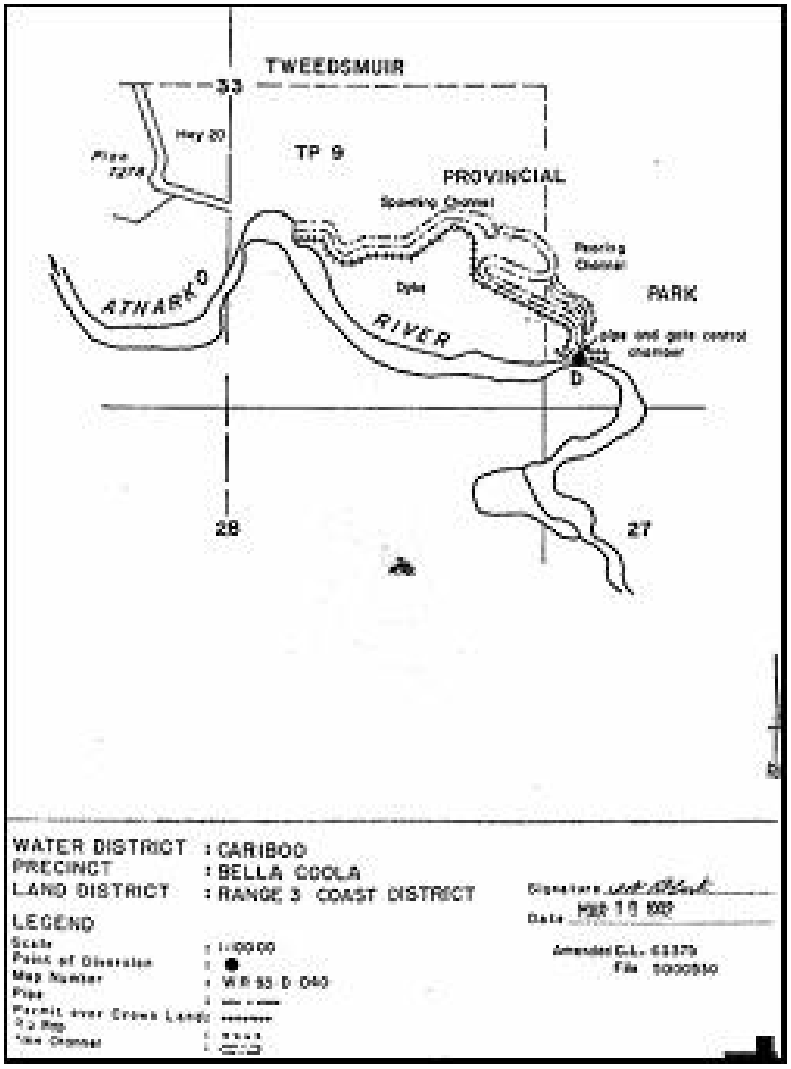


Figure 2. Atnarko Spawning Channel Site Plan

Built in 1978, with an initial capacity of 10 million eggs, this Japanese-style hatchery was designed to increase adult chum salmon returns to the Bella Coola River and its tributaries by 160,000 fish annually. Additions to the hatchery in 1986, 1991 and 2000 provided capacity to culture up to 3 million Chinook, 500,000 coho and 1 million sockeye (Figure 3).

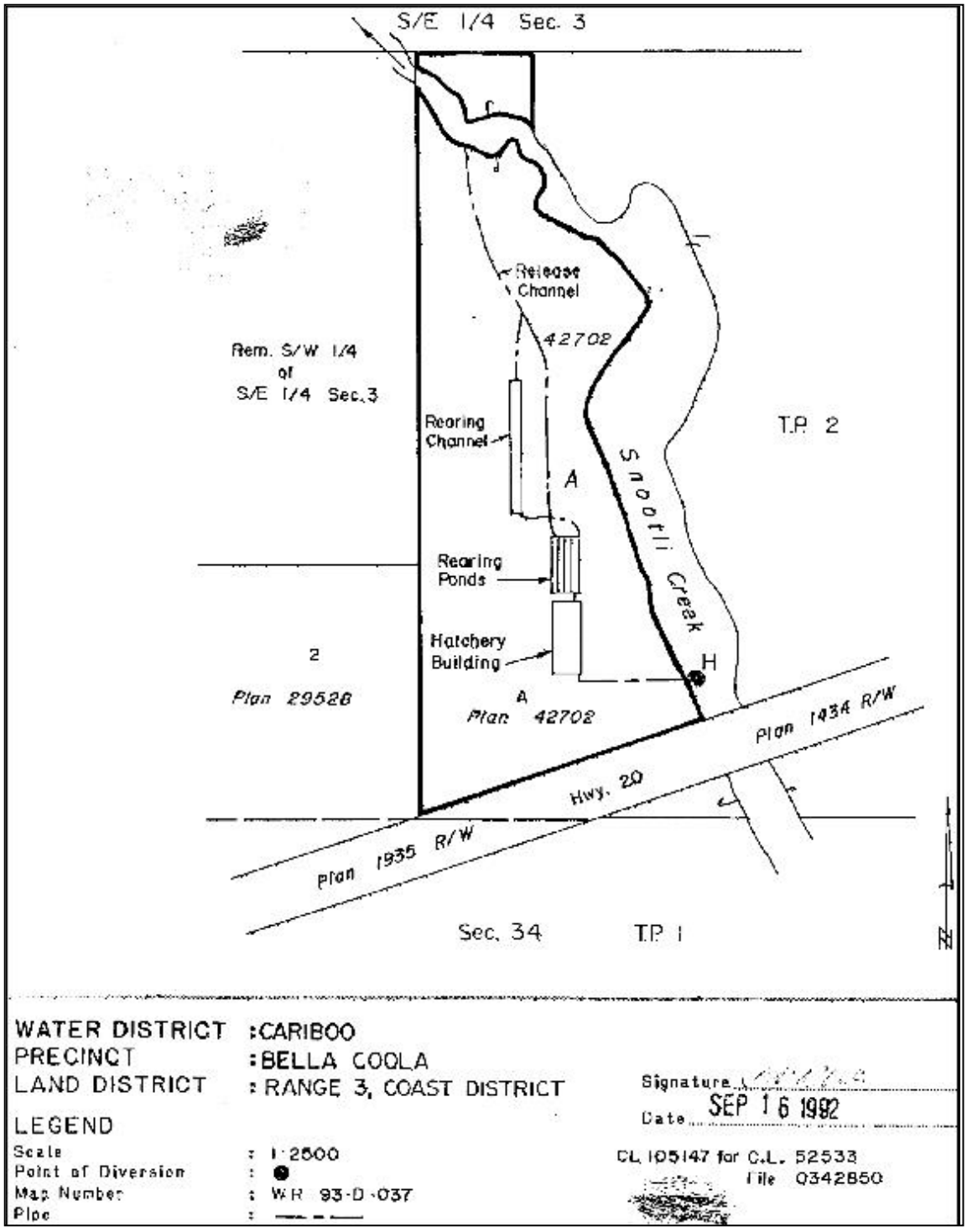


Figure 3. Snootli Creek Hatchery Site Plan Prior to Expansion

3.1.1 ***Facility Description***

3.1.1.1 <u>Hatchery Buildings</u>

- Wood frame office 180 m^2
- Steel arch incubation (chum) 1080 m2
- Wood frame early rearing 270 m2
- Wood frame incubation (Chinook) / lunch room / office 270 m2
- Wood frame boat shed/shop 156 m2
- Steel arch shop/storage 387 m2
- Two story duplex, wood frame residence 316 m2
- Freezer/cooler 60 m2
- Post and beam storage 160 m2
- Aeration tower, reinforced concrete 25 m2
- Incubation trailer (sockeye) 4m x 13m

3.1.1.2 Structures

- Concrete chum rearing ponds (8) 540 m2
- Concrete Chinook rearing ponds (2) 135 m2
- Reinforced concrete surface intake 12 m2
- 8 well houses, well capacity 5000 - 6000 L/min 42 m2
- Enfiltration pit 30 m2
- Roofed concrete slab (sockeye rearing) 25m x 6.7m

3.1.1.3 Other

- Release channel, 2 m wide x 200 m long, upgraded spawning gravel, upgraded rearing capacity.
- Site surrounded on east and north sides by 2000 m. rip-rap dyke.
- Three-phase power; 600 Volt 200 amp back-up generator.
- Radio alarm system linked to pagers and portable alarms for emergency call out.
- All stocks at Snootli Creek Hatchery are segregated throughout incubation and rearing.
- 'Fish Culture Facilities and Strategies' from 'Snootli Production Review and Operational Plan'.
-

3.1.2 ***Fish Culture Facilities and Strategies***

3.1.2.1 Chum

3.1.2.1.1 Thorsen Creek, Snootli Creek, Fish/AirSide Channel & Salloompt River Chum

Eight six unit rows of Atkins cells located in the 'Keeper Channel/Incubation Room' provide segregated green egg to eyed egg incubation capacity for eight groups of 1 million eggs. Eight Keeper channels provide segregated-eyed egg to fry incubation capacity for eight groups of 1 million eyed eggs. Four concrete rearing ponds, divided in the middle, allow for the segregated rearing of each group of Keeper channel fry.

Throughout incubation and rearing, water is supplied from wells E, W, 5, 7, 11 and/or the Snootli Creek surface intake.

3.1.2.2 Chinook

3.1.2.2.1 Atnarko River Chinook

The Chinook Incubation Building contains 12 four-unit rows of Atkins cells. Each cell is capable of incubating 100,000 green eggs to the eyed stage of development (total capacity 48 x 100,000 = 4.8 million). Sixty-four, eight tray Heath Techna incubators provide eyed egg to ponding facilities for up to 3.2 million Chinook eggs (64 stacks @ 50,000/stack).

Currently, 2 million Atnarko River Chinook are cultured to "swim-up" in these facilities. At maximum alevin weight, they are ponded to a divided concrete raceway. One million Lower Atnarko Chinook and one million Upper Atnarko Chinook can be reared to 1 gram in segregation in the raceway. At 1 gram average weight, these Chinook are transferred to the Atnarko rearing channels and raised to 6 grams average weight prior to release.

Water for incubation and early rearing is supplied by Snootli production wells 5, 8, 9, 10, 11 and/or Snootli Creek surface water. At the Atnarko River site, rearing water is supplied by a production well and/or the Atnarko River channel surface intake.

3.1.2.2.2 Wannock River Chinook

Up to 250,000 Wannock River Chinook are incubated to "swim up" in the unused Atkins Cells and Heath trays in the Chinook Incubation Building. They are ponded into two 1m x 3 m oval fiberglass tubs in the Chinook Incubation Building and moved out to the chum ponds when they outgrow these tubs.

In the past, several fish culture strategies have been employed

- Transfer and release to the Wannock River at 1 gram average weight.
- Transfer at 1 gram to seapens in the Wannock River estuary for "grow out" to 10 – 20 grams average weight.
- Transfer and release to the Wannock River at 3 grams average weight.

3.1.2.2.3 Nusatsum, Noosgulch and Saloompt River Chinook

Eggs are taken opportunistically during the chum egg take, incubated to "swim up" in the Tank Farm Heath Stacks, and then reared in the Tank Farm oval fiberglass tubs and/or Capilano troughs. Resultant fry are trucked back to their natal stream for release.

3.1.2.2.4 Kilbella River and Chuckwalla River Chinook

The Tank Farm contains 20 eight tray Heath Techna incubators, capable of incubating (50k/stack x 20 stacks) 1 million green eggs to the eyed stage of development and/or

"swim up". Water is supplied by wells E, W, 5, 8, 9, 10, 11 and/or the Snootli Creek surface intake. In the past, a number of fish culture strategies have been pursued:

- Transport of eyed eggs to the Shotbolt Bay hatchery for hatching, ponding and rearing.
- Ponding at Snootli Hatchery, transport to Shotbolt Hatchery for further rearing.
- Rearing at Snootli Hatchery coded wire tagging (funds permitting), transport and release to Kilbella and Chuckwalla Rivers.

The Tank Farm contains eight 1m x 3 m oval fiberglass tubs and 4 Capilano troughs for ponding and initial rearing.

3.1.2.3 Coho

3.1.2.3.1 Thorsen Creek, Saloompt River, and Snootli (Lobelco) Creek Coho

In co-operation with the Central Coast Fisherman's Protective Association, groups of 50-100,000 coho eggs are incubated in the Tank Farm Heath Stacks, ponded to the Capilano troughs for initial rearing, then transferred out side to aluminum 'Eagle troughs' for "grow out" and released to their natal streams as yearling smolts.

3.1.2.3.2 Upper and Lower Atnarko River Coho

Eggs are taken from the Upper and Lower Atnarko River, incubated in the Tank Farm Heath stacks and ponded to the Capilano troughs. Fry are then either transferred to the 'Eagle troughs' at Snootli Hatchery or transferred to the Atnarko rearing channels. All are released to the Upper or Lower Atnarko River, depending on where the eggs originated.

3.1.2.4 Sockeye

3.1.2.4.1 Sockeye

A portable hatchery was constructed on the Snootli Creek hatchery site in 2000 to facilitate the strategic enhancement of 7 stocks of sockeye from Owikeno Lake in Rivers Inlet and 2 stocks of sockeye from Long Lake in Smith Inlet (Figure 4). There are eight 1.3 m x 0.72 m x 1.1 m deep and fourteen 1.83 m x 1.1 m deep (e.g. 22 tubs).

Rivers Inlet and Smith Inlet sockeye are no longer cultured at Snootli Creek Hatchery. However, Snootli Creek Hatchery currently enhances up to 300k Lake Else Lake sockeye in partnership with the Lake Else Salmon Enhancement Society, 100k Atnarko River and 100k Lonesome Lake sockeye in partnership with the Nuxalk First Nation. As well as, 25k Curtis Lake and 25k Mikado Lake sockeye in partnership with the Git'Gat First Nation in 2007. (In 2008 this was changed to 250,000 – 300,000 Curtis Lake eggs for release in Bachelor Lake as .5 gram fry)

Thirty-six shrouded 8 unit vertical tray Heath Techna incubators were installed in a 4 m x 13 m modular building, to accommodate up to 750,000 eggs from green egg to "swim up". Eight 1.3 m x .72 m x 1.1 m deep and fourteen 1.83 x 1.1m deep circular fiberglass tubs were installed on 25 m x 6.7 m concrete slab to provide segregated rearing units capable of rearing resultant fry to 0.5 grams average weight.

Throughout incubation and rearing each stock is segregated so that they can be flown back to their natal stream for release.

Fish free water for incubation and rearing is provided by production well 10 and/or Hagensborg Water District domestic water.

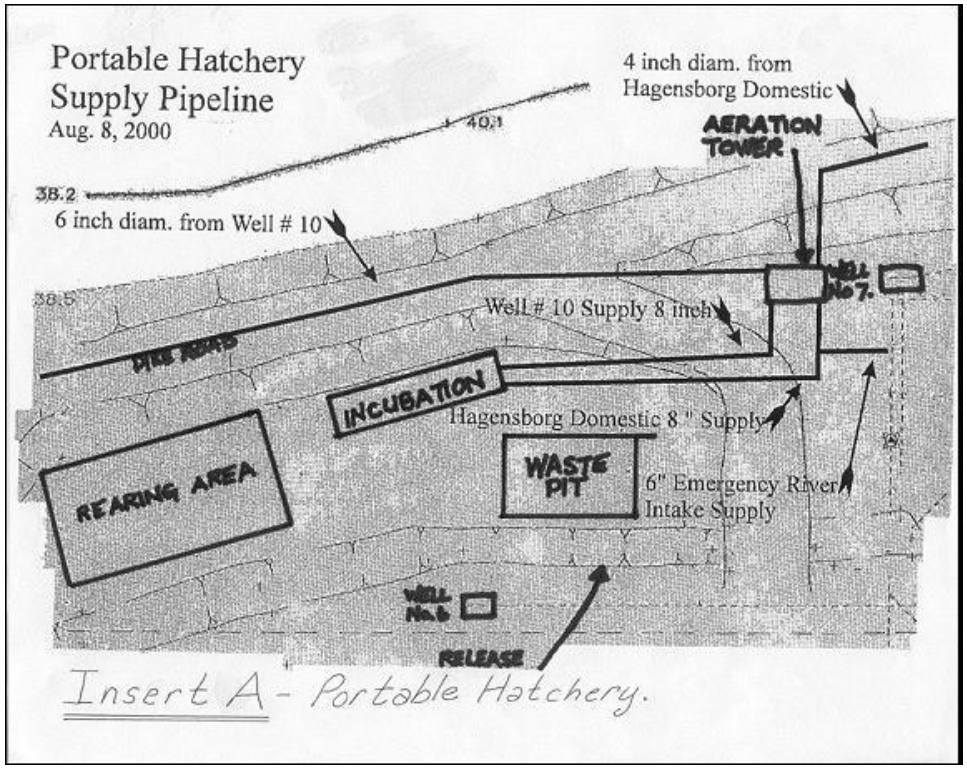


Figure 4. Portable Hatchery Site

3.1.2.5 Pinks

3.1.2.5.1 Atnarko Pinks

In 1986, a 1500m long x 20m wide spawning channel was constructed using a side channel of the Atnarko River. Gravity fed water from the Atnarko River is supplied through two culverts, regulated by gate valves, at a rate of 60-80 cfs. The channel is

designed to accommodate 70,000 pinks, produce 15,000,000 fry and 150,000 adults, as per SEP standards (Shepherd 1984).

Two parallel earthen rearing channels with a capacity of 20 million grams were constructed adjacent to the spawning channels for rearing Chinook and coho.

A 5400 L.min capacity well provides water for rearing and de-icing.

3.1.3 ***Fish Culture Objectives***

3.1.3.1 Stock Re-Building

Snootli Hatchery was designed to increase adult chum returns for various stocks on the Bella Coola River to increase fishing opportunities and mitigate the effects of spawning habitat loss in the Lower Bella Coola River and its tributaries. Chinook and coho enhancement began in response to declines associated with high exploitation in non-target (mixed stock) fisheries. The hatchery is also responsible for maintaining a pink spawning channel to buffer against the loss of natural production during high water events. Three other Lower Bella Coola tributary Chinook stocks (Nusatsum, Saloompt and Noosgulch Rivers) are supplemented to maintain population levels. Coho supplementation at the Atnarko River site and Snootli Creek Hatchery was discontinued by 2000 due to apparent recovery of the Lower Bella Coola River and Atnarko River stocks.

The sockeye programs are part of a recovery plan whose goal is to rebuild these severely depressed stocks to self-sustaining population levels. Rivers Inlet Chinook stocks are enhanced in cooperation with local sport fishing groups.

3.1.3.2 Fishery

The majority of Atnarko River Chinook are harvested in non-target fisheries in Alaska (30%) and the North Coast Areas (17%). The targeted terminal fisheries occur in Area 8 and include a gillnet fishery, First Nations FSC fishery and recreational fishery. Wannock River Chinook are exceptionally large bodied, red-fleshed fish, much prized by recreational anglers.

The chum fishery targets enhanced chum in North Bentinck Arm. The hatchery has been very successful in providing a large, consistent commercial catch almost every year since operations began. An average of 109,000 (26%) chum have been harvested in Area 8 between 1985-1999. The scale of sockeye enhancement is to rebuild these stocks to self sustaining levels, not to support a fishery. Atnarko River pinks and Atnarko River and Lower Bella Coola River coho are supplemented at levels meant to ensure against loses associated with floods and other potential natural disasters.

Table 1

Species	Run	Stock	Release	Expected Adults*
Chinook	Summer	Atnarko R	1,808,000	7,000
Chinook	Summer	Noosgulch R	43,000	175

Chinook	Summer	Nusatsum R	86,000	350
Chinook	Summer	Saloompt R	86,000	350
Chinook	Fall	Wannock R	86,000	350
Chum	Summer	Fish+Airport	1,656,000	23,500
Chum	Summer	Saloompt R	1,656,000	23,500
Chum	Summer	Snootli Cr	1,656,000	23,500
Chum	Summer	Thorsen Cr	1,656,000	23,500
Sockeye	Summer	Lake Else Lake	300,000	2,000
Sockeye	Summer	Atnarko River/Lonesome Lake	200,000	1,000

3.1.4 ***Assessment***

Snootli Creek chum stock is fin-clipped every year and escapement assessed to provide contribution and exploitation estimates for this stock. This exploitation rate is used to estimate exploitation rates for the other enhanced stocks that are marked cyclically. Atnarko River Chinook were marked every year until 2003 for assessment of hatchery contribution. Extensive enumeration and mark recovery occurs in the FSC fishery and escapement. StAD is currently investigating the use of the hatchery Chinook stock to estimate exploitation rates for other Central Coast stocks. The hatchery works with community groups to culture, mark and assess a local coho stock (either Saloompt River, Snootli Creek or Thorsen Creek coho). A portion of the sockeye is adipose clipped prior to release at the request of the sponsoring agencies. Returning adults have not yet occurred. Contribution of Atnarko channel pinks to the overall Atnarko River return is not assessed.

4 Standard Operating Procedures for Snootli Creek Hatchery and the Atnarko Project

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 fish, 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 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.

General Principles:

The percentage of Jacks in the broodstock should reflect the proportion in the population.

Some captured adults may be released to achieve a balanced sex or age ratio or to exclude any fish with apparently questionable health status.

All attempts should be made to ensure the selected broodstock population contains individuals collected across the time course (early, middle and late) of the run.

Details of the Operating Procedure:

Broodstock selection follows the recommendations in the Wild Salmon Policy (WSP) Broodstock – Operation Guidelines for Pacific Salmon Hatcheries, to ensure that enhanced fish maintain the fitness characteristics of the native stock.

Clean healthy broodstock (adults and jacks) with no obvious physical defects (boils, lesions, discoloration, etc.) are selected. Selection is not biased for size and jacks are not rejected. Some captured adults are released based on unbalanced sex or age ratios or apparent health condition. Both wild fish and hatchery returns are used as broodstock, according to the WSP - Genetic Management Broodstock Collection and Spawning Practices.

Nusatsum, Saloompt and Noosgulch River Chinook may be transported to the hatchery and held to maturity. Adult fish are not generally held on site for more than 2-3 weeks for maturation. Those fish that are to be held for maturation are transferred from the site of capture to the transport tanks using backpacks and water-filled plastic bags. Fish are transferred to the transport tanks by gently tipping the backpacks and plastic bags into the tanks. Transport tanks are filled to the brim with water to avoid sloshing during the drive back to the facility.

For the chums, we intentionally “front end load”, taking brood stock from the “front end” of the run. This strategy enables the fisheries managers to target the enhanced portion of the run, thereby reducing harvest of the unenhanced component.

For Chinook, coho and Atnarko sockeye, we take brood stock throughout the run. Normally
We start brood stock capture and spawning when the adults move out of the pools onto the spawning beds. This is to reduce the number of “green fish” handled, thereby reducing pre-spawn mortality. We finish when we have reached our egg target or there are no more spawners to be had.

For sockeye from other watersheds, we generally take broodstock at the peak of the spawning, since these are ‘fly in’ operations. And there is only one opportunity to get the eggs.

4.1.1 ***Rejection criteria:***

If damage to the abdominal wall (seal bites or bear scratches) is visible, the fish may be rejected as these may result in the influx of water into the abdominal cavity

Forms & Records:
Sort sheets
EnPro

References:

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.

General Principles:

Fish may be crowded to make brailing or dip netting easier. The duration of crowding and the density should be kept to the minimum amount of time possible. Nets used for crowding and netting should be knotless and numbers of fish in the nets should be kept low (<1/3 of the net volume) to prevent fish on the bottom of the load from being crushed.

If using anaesthetics (see *Anaesthesia* SOP), the fish should be monitored until they are ready to be handled. The anaesthetic bath may contain mucus protectants (e.g. Vidalife™) to protect the fish's cuticle from subsequent opportunistic infection. Water quality should be monitored during anaesthesia. When easily handled, fish should be netted out of the anaesthetic bath and assessed for 'ripeness'. If antibiotics have been prescribed by the Veterinarian (see *Broodstock Treatments* SOP), they may be injected at this point.

Female fish are considered ripe when the body wall feels soft and thin and loose eggs are palpable within the coelomic cavity. Male fish are considered ripe when milt is easily expressed. Milt should be white and opaque; if the fluid is clear or watery, the fish is not yet ripe.

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.

Details of the Operating Procedure:

Fish handling equipment is inspected before each use for sharp edges or projections that might cause damage to fish skin, and repairs are made before being used. Fish-friendly nets (knotless nylon) are used to minimize skin abrasion.

Handling equipment is cleaned thoroughly between operations. Portable handling equipment (nets, backpacks, etc.) are sterilized and rinsed between uses with 200ppm Ovadine (buffered 10% Povidone iodine) or Bactol (N-Aklyl (40% C12, 50% C14, 10% C16)/dimethyl benzyl ammonium), a commercially available disinfectant and sanitizer.

In the holding ponds, fish are crowded from a downstream to an upstream direction to minimize stress and crowding is carried out slowly to allow the fish to adjust.

In the fish trap, chum are crowded using a seine net and are quickly transferred by hand or dip net to 8' x 4' deep holding pens. A recent innovation is to place an interim holding pen in front of the " v trap " lead in such a way that the potential broodstock are directed into the interim holding pen. They are then dip netted over to the regular holding pen. This eliminates the trauma associated with pole seine capture in the trap.
Broodstock are sorted quickly and either killed for spawning, returned to the holding pens or released immediately.

Females may be tagged if they are close to ripening, males may be tagged if they are to be re-used for stripping. Tags are selected that provide minimal impact on fish well-being, while providing clear visibility and are applied, according to the manufacturer's directions, to sedated or anaesthetized fish to minimize stress. Fish-friendly adult tags used at Snootli Creek Hatchery include: "Kurl-Lok" opercular tags, spaghetti tags, and/or opercular punch.

Fish are held at densities not exceeding 13 kg/m^2

Chum Broodstock are kept in same-sex groups to ease processing during spawning: different species are held separately. Male and female Chinook and coho are held together when brought back to the hatchery, to promote ripening.

Mortalities are reported and recorded.

4.2.1 ***Broodstock Collection***

4.2.1.1 Chum

1. Set up the weir
2. Set up the holding facilities (holding net pens) in the river above or below the weir
3. Set up the spawning equipment (buckets racks etc)
4. Enter the weir and begin to sort the fish
5. Select for females first
6. Check females for ripeness. Place females that are within 2-3 days from ripening, in the holding pens
7. Any fish that are green or more than 2-3 days away from maturation should be placed over the weir on the upstream side
8. Ripe fish are tailed, killed with a sharp blow to the head and handed to the spawning crew, then hung head down on the bleeding rack ,the gills are cut to bleed the fish. Once the blood coagulates the fish are taken off the bleeding rack and the eggs are removed . In this process the female is held tail down over the spawning basin and an incision is made from the vent towards the head to allow the eggs to fall into the spawning basin.
9. After the number of females has been determined, sort the males
10. Grasp the fish by the tail and run firm pressure along the belly to determine if it is ripe. If it is not ripe, place it over the weir on the upstream side

11. If the male is ripe, kill it with a sharp blow to the head and pass it to another staff member for milt stripping
12. Hang a small battery powered radio in the trees near the holding pen to deter bears from entering the area to protect the females being held in the holding pens

4.2.1.2 Chinook

Chinook are collected in the river using tangle nets. Keep only ripe fish. Near-ripe fish cannot be held in holding pens as they cannot be adequately protected from bears.

Since fish are not held to ripen, it is preferable to select broodstock when at least half the fish captured in a set are ripe, therefore selection is generally during peak spawning.

1. Remove the females from the nets first – remove green females and place them back into the river
2. Ensure that fish selection is random, do not select for the biggest fish
3. Remove ripe females
4. If egg takes are to take place at the river
    - Place a tailer on a ripe female
    - Kill the ripe female with a sharp blow to the head
    - Hang the females by the tailer on the rack and cut the gills to bleed
    - While females are bleeding sort and select the ripe males.
5. If fish are to be returned to the facility for spawning, place ripe fish into a holding pen until the sort is complete, then transfer unripe fish into a transport tank
6. After the females are sorted, sort the male fish
7. Grasp the fish by the tail and run firm pressure along the belly to determine if it is ripe. If it is not ripe, place it gently in the river downstream from the net and remove the tailer so the fish can swim away
8. If the fish is ripe, strip it into a Whirl-pak bag or place it into a holding tube for transfer to the hatchery

4.2.1.3 Coho

Coho are collected with tangle nets. Divers enter the water and check the nets for fish.

Generally coho are spawned at the river in the same manner as outlined above. However, ripe, or very close to ripe, fish are returned to the hatchery for holding if there is a concern of flooding.

If fish are to be transported to the hatchery for holding they are placed into a 250 gallon transport tank containing ambient water and abundant oxygenation.

Once fish are at the hatchery, sorting takes place only once per week to minimize stress. After the initial sort, males are tagged with a curl-loc tag on the jaw. Once males have been used three times, and as long as anaesthetic has not been used on them, they are returned to the river and released.

Using anaesthetic to sort coho appears to result in heavier adult losses and also seems to allow the vent to relax allowing water to enter and damage a proportion of the eggs, therefore sorting without the use of anaesthetic is preferable.

The tanks are drained to a low level (one to two feet) and the fish tend to become lethargic and easy to handle as the oxygen levels decrease. Fish are sorted and checked for ripeness quickly as they become easily handled; they are immediately put in a tub with fresh running water as soon as they are handled if they are unripe.

If a female appears close to fully ripe, she may be tagged so that she is removed first when the next sort is scheduled.

4.2.1.4 Pink

Pinks are allowed to volitionally enter the channel at the Atnarko River and spawn naturally. The channel is a completely open random distribution channel that has been "complexed" such that adults are allowed to spawn in the areas they select natural rearing is accommodated.

4.2.2 ***Sockeye***

Sockeye salmon are collected by tangle net. Procedures are as above for other species with green fish released over the net and ripe males and females killed and stripped at the field site.

Adult sockeye are brought to the hatchery facility only from the Atnarko River. These are held in quarantine in the sockeye facility.

Forms & Records:

Records are kept according to the ENPRO Adult Manual, and may include:

- Species
- Numbers caught
- Location of capture
- Method of capture
- Transport method
- Drug use (sedative, antibiotic)
- Number retained
- Sex
- Age
- Date of capture
- Tag numbers
- POHL Rivers Inlet/Smith Inlet sockeye (RISI sx)
- Comments on health condition

References:
Broodstock Treatments
Anaesthesia
Fish Handling Procedures

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.

General Principles:

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

All equipment used on broodstock should be designated for brood use only. Staff separation should occur whenever possible.

Disinfectant foot bath stations should be regularly maintained between adult holding and incubation areas. Spray bottles of Ovadine™, or other topical disinfectant solution, should 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* SOP).

Details of the Operating Procedure:

Coho are held on pathogen free well water.

Each tub has its own disinfectant bucket and dip nets and brushes which are not used in any other tub . When adults are held in the concrete raceways the same precautions apply.

All raingear is disinfected with Ovadine after spawning.

Disinfectant footbaths and/or foot mats containing Ovadine are placed at the entrance to the sockeye facility. Anyone entering or leaving the area must use these.

Ovadine disinfectant baths and footbaths are disposed of and replaced every three or four days. The solutions are disposed of to ground or to the exfiltration gallery.

Covers are used on tubs to reduce visual disturbance and stress and activities around holding containers are kept to a minimum.

Fish are routinely observed for signs of health and disease.

Broodstock are protected from predators by predator nets, buildings, and covers. (See Predator exclusion)

Mortalities are removed whenever they are discovered and the cause of death for pre-spawn mortalities is classified.

All gillnets are dedicated to specific watersheds. Those for use with other watersheds outside of the Snootli Creek system are not brought onto the hatchery facility without first being disinfected with Ovadine and rinsed with Bactol.

All sockeye culture related equipment and gear is maintained in a separate area of the facility and is cleaned, dried and stored appropriately.

All spawning buckets and related equipment are washed, disinfected and dried outside between stocks and groups on a daily basis and is allowed to dry between uses.

All eggs are fertilized in well water, spawning equipment is never exposed to stream water.

Forms & Records:
Inventory and location records

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.

General Principles:

Potential methods for carcass disposal include:

- Carcasses may be frozen and disposed of into solid waste containers and eventually removed to municipal landfill. Incineration and composting are also possible alternatives.

- Carcasses may be buried on site as a facility allows, however, this entails a risk of predator attraction. Alternating layers with sawdust and lime may be needed

- 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 *DFO Carcass Placement Guidelines*. 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.*

Details of the Operating Procedure:

The majority of carcasses are returned to the river following stripping.

Fish that have been transported to the hatchery for holding are disposed of to the river they came from or to the exfiltration gallery.

Forms & Records:
Records of numbers and species of carcasses placed in streams are kept.

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.

General Procedures:

4.5.1 ***Prior to gamete collection***

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

All necessary transport/transfer permits should be in place.

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

4.5.2 ***Female fish:***

Ripe females should be euthanized by a sharp blow to the head. The gill arches should be cut and the fish hung by the tail to bleed for 5 – 10 minutes. Blood transfer to the surrounding area may be minimized by placing paper towel inside the operculum.

Where broodstock disease screening, specific pairings or matrix spawning is planned, each fish should be assigned a number. The number should also be written on the bag into which the eggs will be collected. It is critical to track progeny location to allow for destruction of the gametes of pathogen-positive brood fish.

The fish should be handled in an inverted position until it is ready to be incised for egg removal.

After bleeding, the ventral surface of the fish should wiped down with paper towel to minimize blood, water or mucus dropping into the eggs. A disinfectant solution may be applied to the external surface of the fish as well, to reduce the risk of vertical transmission of disease.

The person cutting the fish should clean their hands or change to a new pair of gloves between females. A new spawning knife should be used for each female or the spawning knife should be disinfected between uses on different fish (see *Equipment disinfection*).

The fish should be 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.

The eggs should be collected into a labelled, clean, disinfected and dried bucket.

Any eggs with abnormal appearance, cloudy ovarian fluid or from a female with obvious signs of disease should be immediately discarded.

Eggs may be topped with oxygen and should be placed into a cool environment (e.g. on gel packs covered with paper towel or newspaper) until fertilization or transport. The eggs should not sit directly on the ice or gel pack, a layer of newspaper should be placed in between.

Samples may be collected from the female carcass for disease screening.

The person responsible for stripping the eggs from the female should wash his/her hands or change gloves and spawning knife prior to handling another female.

4.5.3 ***Male Fish:***

Male fish may or may not be euthanized for milt collection. When they are used for multiple collections, careful handling is essential and the fish should be returned to the holding unit and monitored for recovery after collection.

Ripe males may be euthanized by a sharp blow to the head. If milt collection will be repeated, the male should be anaesthetized, handled expediently and monitored during recovery.

Each fish may be assigned a number. Where fish are used for multiple collections of milt they should be clearly identifiable (e.g. pit tagged). A Whirl-pak™ bag may be labelled with the fish's number.

The ventral body wall should be wiped down with a clean paper towel to minimize water or mucus dripping into the milt being collected. A surface disinfectant may be applied to the external surface of the fish to reduce the risk of vertical transmission of disease.

Milt is collected 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 cup.

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

Milt may be stored in a plastic container topped with oxygen. The surface area of milt exposed to oxygen should be maximized. The containers of milt should be put into a cool environment (i.e. onto ice packs covered with newspaper or paper towel to maintain a cool temperature).

Milt may be checked for motility prior to use (a drop of milt plus a drop of water for sperm activation, examined under magnification within 10 seconds).

Details of the Operating Procedure:

Egg Take Equipment Checklist

- □ Clubs
- □ spawning knives
- □ buckets
- □ lids for buckets
- □ spawning bench
- □ dip net(s)
- □ ice (if warm)
- □ insulated tote with lid
- □ Ovadine (Sockeye)
- □ gloves
- □ bleeding knife
- □ tailers
- □ spawning basin
- □ paper towels
- □ holding hooks
- □ cooler
- □ sperm containers with lids or Whirl-pak bags

4.5.4 ***Female Fish***

1. Ensure all equipment required is present and properly set up.
2. Place ice inside transport containers (coolers) and place burlap on top of the ice to protect the eggs and milt.
3. Euthanize ripe females by a sharp blow to the head.
4. Cut the gill arches and hang the fish, by the tail, to bleed for approximately 10 minutes to minimize blood contamination of eggs.
    a. If spawning sockeye or Wannock Chinook, wipe the female with a sponge soaked in a disinfectant solution of Ovadine (200 ppm) or immerse her in a garbage pail of Ovadine (200 ppm) solution
5. Place paper towels inside the operculum to minimize blood contamination
6. Handle the fish in an inverted position until ready to be incised for egg removal.
7. After bleeding, wipe down the surface of the fish with clean, dry paper towel to remove any excess moisture, blood, of faeces
8. Remove a female from the rack and take her to the egg taker.
9. Turn the fish into a head up position and present it to the person cutting the fish.
10. Using a spawning knife, cut from the vent towards the head, cutting to the side of the pelvic girdle in a way that minimizes bleeding and maximizes egg extraction.
11. Collect the eggs into a stainless steel spawning pan.
12. Examine the eggs for any evidence of disease or abnormalities. Any eggs with abnormal appearance, cloudy ovarian fluid or from a female with obvious signs of disease are discarded.
13. If the eggs appear to be in good condition, decant them into plastic egg take bucket and place the lid on firmly.
14. Don't fill buckets more than ¾ full. Place the buckets into the cooler , once again ensuring that the lids are firmly sealed .
15. Extra care must be exercised to ensure that no water contacts the eggs prior to fertilization.
16. Disinfect the spawning pan with Ovadine and dry with paper towel.

17. The person cutting the fish should clean and dry their hands or change to a new pair of gloves between females.
18. Disinfect knives between females if spawning sockeye.
19. Place the egg buckets into a transport container in a cool shaded location.
20. At least 2-3 cm of headspace is provided in each transport container during transport, to allow oxygen exchange.
21. When the tote is filled, place a lid securely on it and place the tote in the vehicle for transfer to the hatchery.

4.5.5 ***Male Fish:***

1. Euthanize ripe males by a sharp blow to the head with a club.
    a. If numbers are low, Chinook and coho males may be marked by tag or opercular punch and retained in holding for repeated stripping, if required.
2. Wipe the ventral body wall with clean, dry paper towel to minimize water or mucus dripping into the milt being collected.
    a. Sockeye are disinfected with Ovadine (200 ppm)
3. Collect milt by cradling the fish and extending the tail while applying firm but gentle pressure on both sides of the body wall at the level of the testes.
4. At least 1 ml of milt is collected per male or the male is returned to holding to use at a later date.
5. Collect milt into an individual sterile Whirl-pak™ bag. Start the stream of milt flowing but do not collect the first portion of milt that is expelled. Once the initial stream is expelled, the catcher should put the Whirl-pak bag under the stream of milt (collect as much clean milt as possible. This could be 10 – 20 ml. from sockeye, 50 – 100 ml from chum and coho and over 100 ml from large Chinook
6. Any milt with abnormal appearance, or containing blood, bile, or feces, should be immediately discarded.
7. If collecting milt from an offsite location for transport back to the hatchery, ensure that the bags of milt are sealed in Whirl-pak™ bags that are topped with a large volume of air.
8. Lay the bags on their sides so that the surface area of milt exposed to oxygen is maximized. Provide at least 2-3 cm of head space in each bag.
9. Place the containers of milt into a cool environment (i.e. into a tote containing freezer packs that are wrapped in paper towel. The bags of milt should not come into direct contact with the ice.)
10. At least 2-3 cm of headspace is provided in each transport container during transport, to allow oxygen exchange.
11. Scan the carcasses for CWT's. If any are present, recover the heads and freeze for later submission

12. Tie carcasses to a line in the river until the egg take is complete. When the egg take is complete, release the carcasses from the line. By tying the carcasses to a line in the water, bear/people interactions are reduced
13. Transfer the tote of milt to incubation room at the hatchery for fertilization.

4.5.5.1 On Site Sorts

Fish being held at the facility are sorted on a daily basis. Anaesthetics (TMS is used to anaesthetize Chinook and coho in the circular tubs in the tank farm when necessary) may be used or the water in the tubs may be lowered enough that the oxygen levels drop enough to make the fish lethargic and easily handled.

4.5.6 ***Rejection criteria:***

Do not use females that appear unhealthy (lumpy, lesions, discolored)

Eggs and ovarian fluid are observed for signs of disease, such as cloudiness, over-ripeness or discoloration. Eggs from females with unhealthy appearing kidneys are rejected.

Hard and other abnormal eggs are discarded.

Batches containing many broken eggs are discarded.

Any milt with abnormal appearance, or containing blood, bile, or feces, should be immediately discarded.

Milt that appears questionable (watery, discolored, thick, or contaminated with water, blood or organic matter) is discarded.

4.5.7 ***Species specific notes:***

4.5.7.1 Chum

If fish are marked, take a scale sample prior to returning them to the river.

4.5.7.2 Coho

Coho are often spawned on site(whacked and hung in the tank farm area)

Milt the males prior to stripping the females. In this way, no eggs will be left without a corresponding male.

Tissue samples for BKD diagnostics are removed from the females after spawning.

4.5.7.3 Sockeye

Samples are removed for ovarian fluid analysis for IHNV

After sockeye are stripped the carcasses are placed aside for the removal of tissue samples (see Diagnostic Sampling protocols) for BKD diagnostics.

Forms & Records:

Rough data sheets used for male female takes and egg numbers for incubators
EnPro

References*:*

Equipment disinfection
Anaesthesia
Diagnostic Sampling protocols
Broodstock Handling
Egg and Milt Transport

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.

General Procedures:

All necessary permits/licences should be in place

If eyed eggs are being transferred under ITC permit to complete incubation at a new site, the eggs and transport water should be disinfected on arrival at the new site as stipulated by the transfer permit. (See the Federal-Provincial Introductions and Transfers Committee web page for further information)

If disease screening is planned, all gametes should be clearly labelled to identify the number of the doe or buck from which they originated. This is critical in ensuring that any offspring of pathogen-positive broodstock can be discarded later.

Eggs should be contained in clean plastic bags and may be topped with oxygen. The bags containing the gametes should be handled in a hygienic manner.

Milt may be contained in sterile Whirl-pak™ bags or small sterile Styrofoam cups with lids. Containers may be topped up with oxygen. The amount of air space in the bag should be at least 2/3 of the bag volume and bags should lie on their sides to maximize fluid surface area exposure to oxygen.

Gametes should be placed into insulated containers and their temperature maintained as close to the originating temperature as possible. The containers should be clean, have secure lids, and be labelled if screening or matrix spawning is planned.

The outside of the container should be disinfected prior to transport, and site and staff biosecurity protocols are followed by the staff member transporting the eggs.

Details of the Operating Procedure:

All eggs and milt are transported in clean, labeled containers with secure lids. Milt is transported in sealed plastic bags inflated with air. Eggs are contained in plastic ice bream buckets. Egg buckets and milt containers are placed inside a transport container on ice that is covered with burlap to avoid direct contact and the possibility of freezing. Eggs and milt are kept cool and in the dark, with minimal disturbance during transport.

Eggs and milt are transported unfertilized.

Coolers, raingear etc. used for sockeye spawning and spawning other species not from the Bella Coola / Atnarko watershed are disinfected with 200 ppm iodophore on arrival at the hatchery.

IHN positive sockeye eggs are transported, at the eyed stage, back to the natal stream and incubated to term in Vibert Boxes.

Footbaths containing Ovadine (200ppm) are in place at the entrance to each building in the sockeye facility.

Fish Transplant Permits are obtained from the 'Transport Review Committee' when eggs and/or milt are transported to the hatchery from outside the watershed.

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

References:
Egg Disinfection
Gamete Collection (Egg Take and Milt Collection)
Equipment disinfection
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 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. Where possible, pathogen-free water should be added to the egg/milt mixture to activate the sperm. In general, well water is considered to be the cleanest water source on most facilities.

Assuming an equal proportion of males to females, an equal number of males and females should be killed and spawnings should be on a 1:1 basis unless matrix spawning is planned.

Following fertilization and washing, eggs should be disinfected to reduce the possibility of external pathogens entering the incubation system.

Details of the Procedure:

4.7.1 *General Procedures*

Remove any blood clots from the egg pails prior to fertilization.

Matrix spawning may be used to maximize genetic diversity (RISI Sx, Wannock River Chinook, Nusatsum River Chinook, Saloompt River Chinook, Noosgulch River Chinook).

Chum and Atnarko River Chinook egg batches are combined and fertilized with a mixture of milt from different males.

Egg takes are done in as hygienic a manner as possible to prevent transmission of diseases to other broodstock or progeny.

All sockeye egg takes strictly adhere to the 'Alaskan Protocol' (McDaniel et al, 1994).

Used 'Whirl-paks' are discarded, egg collection materials (zak knives, spawning buckets) and egg transport containers are cleaned and disinfected (200 ppm iodophore) between egg takes.

Incubators are loaded at prescribed densities, depending on the container and species, which were determined from prior experience and expected conditions (Shepherd, 1984. The biological design process used in the development of federal government facilities during phase I of the salmonid enhancement program – Canadian technical report of Fisheries and Aquatic Sciences No. 1275)

4.7.2 ***Chum***

1. Eggs and milt are taken in separate, clean, dry containers
2. Transport back to hatchery and take coolers into the spawning area at the head of the keeper channels
3. Weigh buckets
4. Divide the buckets so that there will be 140000 eggs in each Atkins cell compartments
5. Stand Whirl-pak bags of milt in a small pail and open them for easy access
6. Pour the eggs from three females into a 5 gallon bucket
7. Add the milt from 6 males to the eggs from three females
8. Mix the eggs and milt gently by hand
9. Allow the gametes to rest undisturbed for approximately 15-20 seconds for fertilization to occur
10. Add clean, cool water to the bucket to cover the eggs
11. Allow to sit for one minute
12. Add additional water to rinse the eggs
13. Decant the water off to wash the eggs
14. Repeat steps 8-9 until the water runs clear and all broken eggs, blood and any other contaminants are removed
15. Gently pour the eggs into the appropriate Atkins cell. Hold a hand under the water flow to slow the momentum of the eggs so they do not receive force while dropping into the incubator
16. Take all the egg buckets into the lab and wash them with Roccal (1% : 100ml per 10L)
17. Rinse all equipment well and place on racks outside in the sunlight so they are dry and ready for the next day
18. Check the buckets every day for any damage that might damage eggs, replace with new buckets

4.7.3 ***Coho***

1. Eggs and milt are taken in separate, clean, dry containers

2. Number the Heath trays according to a planting plan so that the eggs from each female are logged and easily located in the event that diagnostics indicate the eggs are infected and they must be removed
3. Stand Whirl-pak bags of milt in a small pail and open them for easy access
4. Open the egg take bucket
5. Add the milt from up to three males to the eggs from one female
6. Mix the eggs and milt gently by hand
7. Allow the gametes to rest undisturbed for approximately 15-20 seconds for fertilization to occur
8. Add clean, cool water to the bucket to cover the eggs
9. Allow to sit for one minute
10. Add additional water to rinse the eggs
11. Decant the water off to wash the eggs
12. Repeat steps 8-9 until the water runs clear and all broken eggs, blood and any other contaminants are removed
13. Gently pour the eggs into the appropriate Heath tray. Hold a hand under the water flow to slow the momentum of the eggs so they do not receive force while dropping into the incubator
14. Take all the egg buckets into the lab and wash them with Roccal (1%: 100ml per 10L)
15. Rinse all equipment well and place on racks outside in the sunlight so they are dry and ready for the next day
16. Check the buckets every day for any defects that might damage eggs, replace with new buckets if necessary.

4.7.4 ***Sockeye***

Sockeye and Wannock Chinook eggs are fertilized using a matrix spawning program

Sockeye egg coolers are disinfected on the outside before any eggs are taken out into the spawning room. Staff separation is important to reduce the possibility of cross contamination. Sockeye eggs are handed in to staff inside the spawning room. When the eggs have been fertilized and disinfected, they are handed to a runner outside of the building. The runner transports the eggs to the incubation room and hands them to the staff within for planting. The runner does not enter either building. Staff working with sockeye do not work with any other species at the hatchery during this period. After an egg take, the sockeye spawning room is disinfected as is all of the equipment used (200 ppm Ovadine) .

1. Lay out the egg containers
2. Split the eggs into the number of matrix crosses being performed (usually two containers) keeping track of female ID numbers
3. Add milt from one male to one container of each female being crossed with that male (eggs from more than one female may be fertilized by milt from the same male)

4. Milt is poured from the " Whirl-pak " into the eggs. (The pipettes are used to remove ovarian fluid for IHN analysis.)
5. Record the crosses on the data sheets indicating which # female is spawned with milt from which # male or males.
6. Pick up each egg container and swirl gently to mix the eggs and milt
7. Move to the next container and repeat
8. Eggs and milt are left for a period that is as long as that required to mix all the other containers
9. Activate the milt by adding water, add clean water to each of the egg containers to a level that just covers the eggs
10. Decant the eggs and pass them to the runner for transfer to incubation staff
11. Fill the Heath tray with a 100 ppm solution of Ovadine
12. Pour the eggs from each female into an individual Heath tray
13. Allow the eggs to sit in the Ovadine and disinfect for 15 minutes
14. Push the tray into the stack and allow the water to flush out the Ovadine
15. The Diagnostic laboratory at PBS will forward IHNV results and infected eggs may be removed and outplanted or destroyed
16. After the eggs reach eyed stage, they may be removed from the incubation trays and pooled at standard heath tray loadings (~3kg/tray)
17. When eggs are eyed an picked, fill the trays with incubation media and pour the eggs on top
18. Set flows at 15 - 18 L/min (on hatch adjust flows to 20 L/min)

4.7.5 *Wannock Chinook*

Wannock Chinook are treated in much the same manner as sockeye with the following exceptions:

1. The incubation facility is not under the strict quarantine that the sockeye are placed under as the stock has been cultured for several decades without incident (Initial diagnostic assessment of Adult Wannock Chinook determined they were "clean"). Nevertheless, Wannock eggs and fry are segregated throughout incubation and rearing as a precautionary measure.
2. Eggs are incubated in Atkins cells until eyed.
3. Eggs are disinfected for 15 minutes in Atkins cells containing 100 ppm Ovadine. After 15 minutes fresh well water is turned on to flush out the Ovadine. Flows to the Atkins cells are set at 40 – 50 L/min. When the eggs are eyed they are picked and transferred to vertical stack incubators (Heath stacks)

4.7.6 *Incubation*

Dissolved oxygen is monitored regularly (daily or 1-2 times a week, depending on the species and stage of development) in the incubation facilities. Adjustments to incubator loads and water flow are made to compensate for low readings or biological events such as hatch or 'swim-up'.

Flow is kept low enough to avoid mechanical disturbance of eggs and all mechanical disturbance is avoided in pre-eyed eggs.

Incubation temperature is controlled by regulating the water source (well/surface) or heating the water (e.g. Wannock River Chinook) to obtain optimal development.

Eggs/alevins are incubated in the dark with minimal disturbance.

Eggs/alevins are routinely observed for signs of health and disease (e.g. fungus, gas bubble disease, white spot, etc.)

Diseased groups of eggs/alevins are quarantined to prevent spread of the infection.

Eggs diagnosed positive with disease organisms are culled from production and either destroyed (BKD) or segregated (IHN).

Disease-positive eggs are planted into their natal stream only if they are from an endangered stock and the chance of infection of the wild fish is negligible.

Incubation containers are thoroughly cleaned and disinfected with 100 ppm iodophore or 1% Bactol and dried between egg batches.

Chum and Chinook incubation containers are cleaned with 1% Bactol between egg batches to sterilize them.

Sockeye and Wannock River Chinook incubation containers are sterilized with 100 ppm iodophore between egg batches.

Forms and Records:

References:

Egg Disinfection

Snootli Genatic Management.doc

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 currently (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 (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 mL of Ovadine™ to each litre of water.

The actual volume of each incubator should be predetermined before starting.

A suitable ratio is 1 volume of eggs to 10 volumes of disinfectant solution.

Ovadine solutions will be a rusty brown colour when fresh, but as the iodine degrades, the solution will start to lighten in colour to yellow indicating a loss of activity and effectiveness. If the colour lightens before time has expired, additional Ovadine can be added and mixed gently to ensure even distribution.

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

Details of the Operating Procedure:

Ovadine disinfectant for eggs is made up at a ratio of 190 mL/5 gallons (19L)

Sockeye salmon are disinfected according to the Alaskan Protocol.

1. Fertilize eggs according to the Fertilization & Incubation SOP
2. Rinse the eggs as needed
3. Fill the egg container with a 100 ppm solution of Ovadine to cover the eggs
4. Pass the eggs to the runner and transfer them to incubation
5. Pour the eggs and Ovadine solution into the appropriate Heath tray
6. Securely attach the screen lid
7. Allow to sit undisturbed for 15 minutes
8. Push the tray in to resume water flow to the tray

Notes:

- All water from the sockeye facility exits to the infiltration gallery. It does not flow into the Snootli Creek system
- Following first pick, all eggs that have been identified as free from IHNV will be transferred such that eggs of the same size are placed in the same stacks and may be pooled to pond together

4.8.1 *Heath Trays*

1. Charge each Heath tray with 10L of Ovadine solution (100 ppm)
2. Pour eggs into the prepared tray
3. Secure the tray screen lid
4. Allow to sit undisturbed for 15-20 minutes
5. Push tray all the way into the stack to resume water flow

4.8.2 *Atkins*

Wannock Chinook are incubated and disinfected in Atkins cells

1. Turn the water flow off in incubators to be disinfected
2. Fill the Atkins cell with a 100 ppm solution of Ovadine
3. Gently pour eggs into the incubator
4. Allow to sit undisturbed for 15 minutes
5. Turn water flow back on @ 40 – 50 L/min.

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:

The Fish Health Management Team determines the fungal treatment program. Management and will be site-specific according to treatment capabilities, historical egg fungus infection rates and egg survival data.

Staff administering chemical treatments to eggs is aware of WHMIS safety information and employs appropriate personal protective equipment.

Egg batches should be 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.k.a. formalin (a liquid solution containing 37% formaldehyde), Perox-Aid™ (a 35% hydrogen peroxide solution). Formalin is generally the preferred treatment.

Parasite-S ™ a.k.a. formalin

Formalin treatments can vary in concentration from 1000 to 2000 ppm. The duration of exposure is generally 15 minutes, applied as a constant flow to incubation water supply. The scheduling can be repeated as needed to control fungal infections. **The standard treatment for eggs is 1670 ppm formalin for 15 minutes twice weekly.** Formalin should be metered in with a reliable delivery system.

Treatments can be started a day or two after fertilization and may be continued throughout incubation; however treatments should be stopped at least 5 days before anticipated hatch to reduce the risk of stress-induced premature hatching. Alternatively, treatments can be discontinued after shocking, if egg picking alone can prevent fungal infections from developing.

When calculating the treatment dose of Parasite-S, the product is considered 100% active. 1670 ppm (or 1.67 ml/L) is the equivalent of a 1:600 dilution. This can be calculated as:

1000 ml/600 = 1.67ml/L

Formalin effluent restrictions: Depending on temperature and species, concentrations of formalin > 200 ppm can be toxic to fish. Effluent target concentration is < 25 ppm formalin; this dilution should be achieved by combining incubation flows with the discharge from other rearing units prior to release into a natural watercourse.

Staff should review WHMIS information prior to handling this product and employ appropriate personal protective equipment. 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.

Perox-Aid ™

Hydrogen peroxide treatments can vary from 250 – 500 ppm. **The standard treatment regime to prevent fungal infections of eggs is 500 ppm for 15 minutes every other day.** To treat existing fungal infections, 500 ppm for 60 minutes every other day may be used. However, existing fungal infections will be better controlled with Parasite-S.

PeroxAid volume calculations are based on a 35% active ingredient (hydrogen peroxide concentration). So to obtain a final concentration of 500 ppm:

$$\text{Volume of PeroxAid per litre} = \frac{\text{recommended dose}}{\text{Active ingredient}}$$

$$= \frac{500 \text{ ml/L}}{35 \text{ \% or } 100/35}$$

$$= 143 \text{ ml PeroxAid per litre}$$

In its concentrated form, Perox-Aid is a strong oxidizer that can burn skin or membranes. Staff should review WHMIS information and use appropriate personal protective equipment when handling this product.

Pyceze ™ (Bronopol)

Pyceze™ is an antimicrobial agent only available through veterinary prescription and Health Canada's Emergency Drug Release Program for antifungal treatment of salmonid eggs.

Salt

Sodium chloride has historically been used for egg fungal control, however this use is not approved by Health Canada.

Details of the Operating Procedure:

Egg fungal treatments are not performed at Snootli Creek Hatchery. Through proper management of the incubation environment, and the timely removal of eggs/alevins with fungus present, disease treatments are not necessary for egg/alevins.

References:

Parasiticides and Fungicides: http://www.syndel.com/d_p_f_s/parasiticides_fungicides.html
Perox-aid™ data sheet: http://www.syndel.com/d_p_f_s/perox-aid_info_sheet.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:

Egg batches are observed on a routine and frequent basis for mortalities. 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.

Pre-eyed picks are only attempted if mortalities are very high. High mortalities are defined as when a great number of dead (white) eggs are visually observed during the fertilization process. Extra care must be taken to avoid disturbing live eggs while picking out dead eggs.

Eggs may be picked by hand using modified tweezers. 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:

Eggs are picked at the eyed stage. A second pick is performed post hatch to maintain low levels of fungus in the trays

If a tray is particularly bad it may be placed at the bottom of a stack to reduce the flow of fungus through the stack

Unusually high mortalities are recorded and reported to the Veterinarian.

Chinook, coho and sockeye eggs are picked by hand using modified tweezers with blunt rounded edges.

Cumulative mortalities for each incubation container are recorded in ENPRO.

The first pick of mortalities after ponding is the last pick from the incubation room.

4.10.1 ***Atkins cells***

1. When the eggs are eyed, a subsample of the eggs is removed with a net to allow excess water to drain off
2. These eggs are weighed and counted to determine average individual weight which is recorded in the incubation records
3. Place a large bucket near the Atkins cell
4. Add several of water into the bottom of the bucket. The bucket has holes around the top edge to prevent eggs and water from spilling over during the siphoning operation.
5. All of the eggs are then removed from the cells by siphon, water is allowed to drain off of the eggs and they are weighed in a 5 gallon bucket (that has been tared) on a scale. Data are recorded in the incubation records.
    a. Chum
        i. Carry the buckets of eggs to the keeper channels and pour them onto the hatching screens, starting from the bottom of the channel
        ii. Gently spread the eggs evenly over the entire screen
        iii. Following hatch, the eggs screens are removed with the dead eggs on them
        iv. The screens are emptied onto a tarp to collect all of the dead eggs which are then removed from the tarp and placed into a bucket following which the eggs are sub-sampled for dead egg enumeration
        v. Subtract the dead egg inventory from the live inventory
        vi. Discard dead eggs into the infiltration gallery
    b. Chinook
        i. Return eggs to the Atkins cell and allow to rest for 24 hours
        ii. Remove eggs from the Atkin's cell (once again by siphoning) and pour onto the egg picking table
        iii. Manually remove all dead (white) eggs
        iv. Weigh subsamples of live eggs into ice cream pails (1 kg) and pour into Heath trays (approx 5000 eggs per tray)
        v. Weigh the dead eggs and perform subsample counts to estimate loss
        vi. Subtract the dead egg estimate from the live egg inventory to determine the working inventory
        vii. Perform a second pick post hatch, prior to ponding

Note:

- All dead eggs from the Snootli Creek water system are disposed of to the infiltration gallery
- All dead eggs from other watersheds are disinfected (with bleach) and disposed of to the septic system

4.10.2 ***Egg Picking:***

All egg picking is manual, no automatic egg pickers are used at Snootli Creek Hatchery

4.10.3 *Egg Grading (Sockeye)*

Sockeye eggs are graded to allow incubation of similar sized eggs and to ensure that fry are of similar size at ponding.

1. Remove a subsample of eggs
2. Place a small beaker on a scale
3. Tare the scale
4. Slowly pour the eggs into the beaker until a 100 g sample is in the beaker
5. Pour the eggs onto a smooth surface and count out the number of eggs in the 100 g subsample
6. Repeat three times for each batch of eggs
7. Determine the average egg size for each batch
8. Place similar sized eggs in the same tray . Do not exceed recommended maximum per tray.

Forms & Records:
Rough data sheets – go to brood year files
Egg inventory sheets
EnPro

References:

Equipment disinfection


Shock sensitivity in eggs.pdf

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

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 risk 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 ***Ponding Timing***

- Chum eggs are transferred to Keeper Channels at the "eyed" stage.
- Atnarko River Chinook and Wannock River Chinook are transferred at the eyed stage of development from the Atkins Cells to 8 tray high Heath Stacks.
- All other eggs are planted directly into Heath Trays immediately after fertilization.
- Fry are ponded when they reach the swim-up stage (when at least 80% of them have reached the button-up stage wherein there is 1mm or less of yolk showing ventrally)

4.11.2 ***Ponding Methods***

- Sockeye, coho and Chinook fry are ponded into water of similar temperature to the incubation temperature.
- Incubators are emptied into rearing containers with great care not to damage the fry.
- Swim-up chum fry migrate volitionally downstream to the rearing ponds.
- Throughout incubation, until swim-up the Keeper Channels are covered to protect the eggs from sunlight and predators.

4.11.3 ***Keeper Channels***

Chum are ponded directly from the keeper channels.

1. Monitor the ATU's to determine the stage of development
2. Check development of fry by removing small samples of fry with a small dip net and viewing them in a small glass beaker so as to determine amount of yolk showing / how close they are from " button up "

3. When the fry begin to swim up and there is less than 1 mm of yolk visible, begin to remove the screens from the bottom and moving towards the top of the channel
4. Prepare the appropriate pond for the fry to swim to
5. Install a shorter stop log at the outflow to allow fry to move out of the channel and into the pond
6. Allow the fry approximately 1 week to move out of the channel (approximately 90% will have migrated by this time)
7. Turn down the flow to encourage stragglers to move out into the pond
8. Remove the stop log at the bottom end of the channel
9. Make a channel down the middle of the medium and manipulate the flows up and down to encourage the last fish to move out of the channel
10. With a dipnet and a bucket of water, remove the remaining fry and move them manually to the pond
11. Once all the fry are out of the channel, turn off the water and leave the channel to dry for the remainder of the season

4.11.4 **Heath trays (Chinook and Coho)**

- Monitor the ATUs to follow the development of the fry
- At hatch, perform a second pick to remove dead eggs and alevins
- When it is determined from the ATUs that fry should be ready for ponding, pull the appropriate Heath out
- Remove a small sample of fry in a small glass beaker
- Hold the beaker up to the light and examine the ventral surface of the fry to determine the degree of buttoning up
- If there is less than 1mm yolk then the fry are prepared for ponding
- Remove one or two trays of fry and carry them to the appropriate container
- Gently pour the fry from the trays into the container and examine their behaviour. They should swim up within 15-20 minutes
- If the fry swim up successfully, transfer the remaining ready fry into the rearing container
- In the tank farm walk the individual trays to the rearing containers.
- In other areas, fill the transport tank with water and bubble oxygen into the water.
- Pour the trays of fry into the transport tank (50-60,000 fry)
- Note : always situate the transport tank as close as possible to the rearing container
- Install a hose on the outflow and place the outflow into the rearing container
- Open the valve and let the fish move out into the rearing container

4.11.5 *Heath trays (Sockeye)*

Sockeye are incubated with substrate (biosaddles) in the Heath trays

1. Remove the tray to be ponded and carry it to the pond that the fry will be ponded into
2. Place a ponding tray (a second tray that contains large mesh on the bottom to capture the bio rings while allowing the fry to swim into the rearing container) into the pond
3. Remove the screen cover from the tray containing the fry
4. Lift the basket and pour the fry into the ponding basket
5. Shake fry out of the ponding basket straight into the pond
6. Disinfect the substrate and the tray after use
7. Pressure wash all equipment used
8. Dry and bag the biosaddles for the following year

Forms & Records:

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.

General Rearing Notes:

1. Rearing Conditions

    a. Fish are kept at densities not exceeding 20 kg/m^3

b. Fish are kept at densities not exceeding 10 kg/m^2

c. Fish are kept at densities not exceeding 1.2 kg/L/min

d. A minimum exchange rate of 1 x per hour is maintained

e. Oxygen levels are checked daily and flows are adjusted to compensate for low readings

f. Disturbance of rearing fish is kept to a minimum by reducing foot traffic in the rearing areas, reducing feeding frequency and always approaching the rearing containers slowly

g. Predators are kept out of rearing ponds (see Predator Control section).

2. Cleaning

a. Troughs are not cleaned for the first several days after ponding.

b. Rearing troughs are cleaned by gently tilting the standpipe, or when the fish are larger by pulling the standpipe to allow feces and uneaten food to be drawn from the bottom of the container into the drain.

c. Container water level is never drained to less than 1/2 of the operating depth.

d. Rearing ponds are cleaned daily with gentle sweeping, and vacuumed every 2-3 days.

e. Water quality is maintained by removing excess feed and fecal material as often as possible without disturbing the fish.

3. Records

a. Rearing fish are sampled for lengths/weights every week (see Juvenile Handling section).

b. Changes in behavior and physical condition are reported and recorded.

c. Groups of fish are tracked from their incubation containers to their rearing containers.

d. Biological sampling includes: species, stock, length, weight, condition, and comments on appearance.

e. The 'Fish Health Assessment' (ENPRO) procedure is used to monitor general health condition of the fish by recording detailed observations of internal and external morphology.

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.

General Principles:

4.12.1 ***Feed Storage***

Feed should be stored in secure buildings (i.e. freezer) 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%.

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***

Feed should be obtained from a feed mill that has been inspected by the CFIA. (EWOS and Skretting)

Feed bags should be labelled with the date of manufacture and guaranteed analysis information.

Feed should be rotated so that newer lots of feed on site are fed out last and any spilled feed is cleaned up immediately.

Feed buckets should be cleaned, disinfected and put away after use.

Medicated feed must to be clearly identified and used immediately. (See *Medicated Feed: Storage, Handling, and Feeding*)

4.12.3 ***Feeding Practices***

Fish should be fed at appropriate intervals with a nutritionally adequate feed. Feeding and feed size-sorting should be optimized to ensure all fish have the opportunity to feed.

Fish should be 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.

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

When automated feeders are used, the equipment should be serviced regularly and the rate of intake of the fish checked frequently.

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.

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

Details of the Operating Procedure:

4.12.4 **Juvenile Feeding**

4.12.4.1 Start-up Feeding

Offer newly ponded fry first feed as soon as they start to swim up.

Use a small starter diet that floats for a short time to entice fry to feed.

Once feeding has begun, lightly dust the water surface with food every 30 to 45 minutes, depending on how aggressively the fish are feeding.

Direct food to where the fish are congregated if distribution of fish is uneven (feed the fish, not the pond)

4.12.4.2 Feed Rates

Feed rates (timing and amount) are determined from prior hatchery experience, including consideration of goals for growth rates, feed conversion efficiency and target release size.

Select feed type and size following the manufacturer's guidelines, program goals, and past experience.

Deliver medicated feed to the fish in accordance with the Veterinarian’s instructions.

Feed newly ponded fry approximately every 30 minutes from 8 am until 4 pm. do not feed outside fish when the sun is high and hot. Feed the majority of the food in the morning or late afternoon on bright sunny days.

Take care to avoid overfeeding fry. The manufacturers feeding tables are not calculated down to the temperatures often encountered at Snootli Creek hatchery. Adjust the feed tables accordingly and feed at rations of approximately 50% until temperatures increase.

Adjust feed rations weekly as necessitated by the results of the weekly bulk weight samples. Rations may be increased or decreased according to the feed conversion rates.

If fish are to be handled or transported, starve them for 24-48 hours

4.12.4.3 Delivery Methods

Measure out feed each day on the morning that it is to be fed. Measure feed in the feed shed and place lid on each bucket to protect it. Place containers under the snow shed at the end of the keeper buildings to protect them.

Label feed buckets for individual rearing containers.

Ensure that all of the scheduled feed is distributed during the course of the day.

Continue each feeding session until all the fish are satiated. This will help in avoiding pin-heading and dropout.

Record unfed food (leftovers).

Protect feed from sun and rain before and during feeding, feed buckets must have secure lids if left in rearing areas.

All feeding is by hand. Hand feeding methods are preferred to provide optimal feed delivery.

Ensure that all feed buckets are washed, disinfected with 1% Roccal, rinsed and left to dry for use the next day. The same bucket is used for the same group of fish all the way through rearing unless a larger bucket is required or the bucket needs replacing.

Spilled feed is to be cleaned up immediately from around rearing containers and disposed of in the dumpster adjacent to the maintenance office.

Drop feeding down to as little as 50% ration every other day if it is particularly cold during the winter (water temperature less than 3 degrees Celsius)

4.12.4.4 Observation

Observe fish during feeding for unusual behaviour. Take notice of fish not feeding as usual. This may be an indicator of disease, stress or poor water quality. If fish are suspected to have contracted a disease, suspend feeding.

If water quality deteriorates, suspend feeding until water quality is restored.

If feed is visible on the bottom fish are being fed too fast or they are not feeding. If the fish cease feeding, stop applying feed to the container. Reduce feeding rates and observe the behaviour of the fish and check for flow or oxygen problems. Inform other hatchery staff of the possible problem. Look for signs of predators (tracks, fish heads and tails, scat, etc). Check the mortality records and investigate any patterns in mortality rates. Send samples to the pathology laboratory if no obvious reasons for the cessation of feeding are found.

Record all mortalities in the feed book

4.12.5 **Feed Storage and Handling**

4.12.5.1 Storage

Store feeds according to the manufacturer's recommendations; generally 2-3 degrees C.

Move older feed to the front and newer feed to the back of the cooler.

Maintain an inventory of feed.

Order feed as the program progresses (several times per year).

Discard of feeds according to the shelf life expiration date listed on the feed bag.

Protect feeds from extremes of heat, light and humidity.

Store feed in a clean, dry area that is free of scavengers.

Ensure that feed buckets have secure lids that exclude rain and pests.

4.12.5.2 Handling

Only order food from mills that have been inspected by CFIA.

Order feed 3-4 times per year as required by the programs underway.

Remove only the number of bags and size of food needed for that day's feeding from the food storage area.

Mark feed buckets by pond/species/size and make sure the right size food goes in the right bucket.

Check for sawdust/clumping/other abnormalities as the food is put into the buckets, and discard suspect food.

Use EnPro to track the feed inventory. As feed is fed out it is entered and is removed from the inventory. At least once per month a manual inventory is taken to crosscheck the remaining feed supply.

In the event that some feed is left over from a program, mix it 50:50 with feed for larger production groups.

4.12.5.3 Records

The following information should be entered into permanent site logs:

- Date feed arrives on site, amount and size, and expiry date.
- Area where the feed is stored.
- Daily amount used or taken for use off site.
- Weekly inventory of the amount/size remaining.

- Daily inventory records are kept of all feed fed to the fish.

Forms & Records:
Feed book
Feed record sheets
Feed conversion sheets developed from sampling

References:
Medicated Feed: Storage, Handling, and Feeding
EWOS Food Size Guidelines

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 once per week for determination of appropriate feeding rates and feed sizes.

Equipment list:

Person/equipment to crowd fish
Person to remove fish from crowder for sampling
Large sample dipnet
Smaller sub-sample net
Balance
One appropriate sized tote supplied with oxygen for post sampling recovery
Sample pails (~5L)
Notepad with waterproof paper and pencil

1. Fish may be crowded using a small pole seine or randomly dip netted from the containers
2. Set up sampling area with all required equipment
3. Place water into two 5 gallon buckets. One bucket will be used for collection and holding, the other for counting into
4. Insert an air stone into the water and ensure that it the oxygen or air is flowing freely
5. Using a dip net, make four or five random dips into the population of fish and collect approximately 3-4 Kg of fish
6. Place the collected fish into 5 gallon bucket
7. Take the fish to be sampled into the Tank Farm
8. Place a square basin with water onto a scale
9. Tare the scale
10. Net a sample of fish out of the collection bucket and allow to drain briefly
11. Pour the fish into a basin containing an appropriate amount of water. Add fish to a predetermined weight (approximately 1-2 kg depending on fish size).
12. Record the weight
13. Using a small dipnet, count the fish out of the basin into the recovery bucket
14. Repeat steps 9-13 three times (depending on the size of the fish, the target is 80 – 100 fish per sample)
15. Return fish to their rearing container when the sampling is complete.

$$\textbf{Mean Weight} = \frac{\textbf{Total Weight of Sample}}{\textbf{Number of Juveniles}}$$

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. Length and weight sampling is performed at ponding and prior to release. It may also be used prior to marking to determine if grading is necessary.

Equipment list:

- Person/equipment to crowd fish
- Person to remove fish from crowder and help sample fish
- Large sample dip-net and tote
- Smaller sub-sample net and labelled sample pails (5L)
- Anaesthetic equipment (drug, buffer, airstones, dedicated basin, thermometer, etc.)
- Balance
- Measuring board or ruler
- Gloves
- Notepad with waterproof paper and pencil or computer

1. Collect all sampling equipment
2. Rinse all equipment thoroughly to ensure any residual Bactol from earlier cleanings has been removed
3. Set up the scale, the measuring ruler, an aerated anaesthetic bath and an aerated recovery bucket
4. Either crowd the fish up using a small pole seine and randomly dipnet from the crowded fish or randomly dipnet directly from the container
5. Dip net out a random sample of fish (50-100)
6. Place the fish into a bucket containing water
7. Bring bucket into the wet lab in the tank farm
8. Dip a few fish out of the collection bucket and place them into the anaesthetic bath
9. Ensure the dose of anaesthetic is appropriate. The fish should succumb in 60 to 90 seconds and recover in the same time when placed in the recovery bucket.
10. If the dose is correct, add more fish to the anaesthetic basin
11. Remove the fish from the anaesthetic bath as they become easily handled
12. Briefly drain the fish of excess water and place on the measuring ruler
13. Record the length in the data sheets
14. Tare the scale
15. Place the fish on the tared scale and record the weight on the data sheets
16. Place the fish into the recovery bucket

17. When the fish have recovered, return them to the appropriate tank/rearing container
18. Repeat sampling three times measuring 100-200 fish at each replicate

Notes:

- Lengths and weights of juvenile fish from stocks that are not cultured frequently may be taken at ponding
- Clean all equipment with 1% Bactol after completing sampling and ensure that all equipment is well rinsed prior to using it as TMS combines with Bactol to form toxic compounds.

Forms & Records:
Length weight sheets
Bulk sampling sheets
EnPro

References:
Fish Handling Procedures
Anaesthesia
Equipment disinfection
Growth prediction tables should 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 *2.1.3* 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 (if expected to survive the procedure) which can damage the vertebrae.

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™) can 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) should be 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 should be 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 ***Juvenile Handling***

All handling is conducted to minimize injury to the fish. When fish are handled out of water, any surface that they touch is kept wet to minimize abrasions and loss of mucus.
Fish are handled in as stress-free a manner as possible at all times. Exposure of fish to stressful events such as crowding and out-of-water events (i.e. handling, counting, grading, tagging, injecting) is minimized.

Dip net loads are kept to a volume that does not crush the fish on the bottom.

4.14.2 ***Equipment***

All fish handling equipment is inspected before each use to ensure that there are no sharp edges or projections that might cause damage to fish skin. If any such problems are noted, the equipment is repaired prior to use with fish.

Fish-friendly nets (knotless nylon) are used to minimize skin abrasion.

Handling equipment is cleaned thoroughly between operations and is disinfected with 100 ppm Ovadine or 1% Bactol between uses with different groups of fish. Portable handling equipment (nets, basins, etc.) is similarly sterilized between uses.

4.14.3 ***Anaesthetic Use***

TMS (at a concentration of 40 – 50 ppm) is used for anaesthesia of fish prior to fin clipping and coded-wire tagging.

Fish are starved for 24 hr prior to being anaesthetized.

Anaesthetics are applied according to the manufacturer's recommendations but they are tested on small groups of fish to evaluate potency prior to use.

Anaesthetic concentration is adjusted to give an induction time of 1-2 minutes. The amount of time the fish are held under anaesthetic is minimized to provide as gentle a recovery as possible. Exposure to anaesthetic is minimized while ensuring the anaesthetic level is adequate for the procedure.

The anaesthetic bath is kept cool and well oxygenated. It is also changed frequently.

Anaesthetized fish are monitored carefully during and after exposure.

Netting of fish prior to anaesthesia is done in as stress-free a manner as possible.

Anaesthetic baths are disposed of in accordance with the Waste Management Act, Land Based Fin Fish Waste Control Regulation (B.C. Reg 68/94 O.C. 276/94), specifically it is poured into the exfiltration gallery as we know it does not get into the environment from there (Bonny Antcliff did dye tests prior to the

startup of the sockeye complex. A report summarizing her findings is available on request from Hatchery Staff)

4.14.4 *Grading procedures*

Sockeye eggs are graded to ensure relatively equal fry size at ponding.

Smaller coho and Chinook are graded out during CWT marking. Generally grading is only performed because the head mould size must be adjusted for different sized fish.

If there is a particularly large size disparity, coho and Chinook may be crowded and graded by hand so that they can be fed according to their size which enhances growth and reduces food waste.

4.14.5 *Seining procedures*

Seining of juveniles may occur after release (depending on funding and staff availability) in the estuary to compare the change in growth over time between hatchery and wild fish. Under such circumstances, a light dose of anaesthetic (40-50 mg/L) will be prepared in a small basin. Fish will be sedated and length will be recorded. Fish will be placed into a recovery bucket and returned to the system when they have recovered.

Seining may take place in the Atnarko rearing channels in order to crowd fish for sample collection. At the time of seining for sampling, pin retention checks may be carried out if the fish have been coded wire tagged .

4.14.6 *Handling procedures during marking*

See Marking Fish

4.14.7 *Collection for Sampling*

See Individual Length/Weight and Bulk Weight Sampling Protocols

References:

http://www.syndel.com/handling/vidalife_info_sheet.html
Anaesthesia

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 should be minimized and equipment used to handle fish should have smooth surfaces and be 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 to avoid crushing fish at the bottom of the load.

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

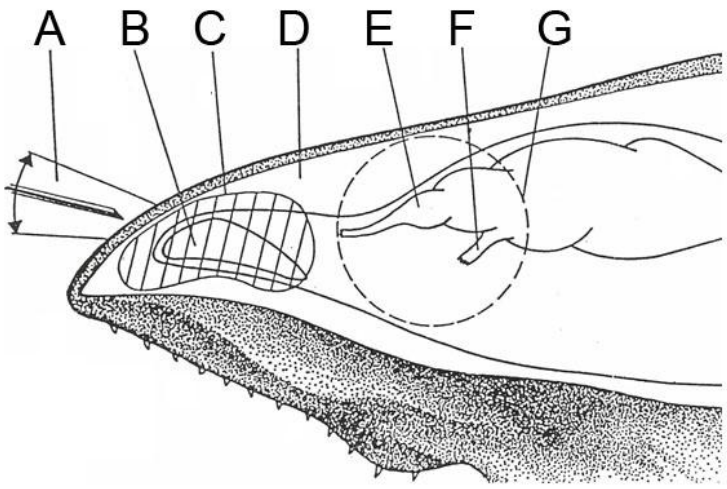
Fish should be anaesthetized for marking procedures (see *Anaesthesia*).

All equipment used for marking procedures should be cleaned and disinfected prior to use and between groups of fish (defined units). This will decrease the risk of pathogen spread between fish (see *Equipment disinfection*).

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

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

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



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

Otolith marking is performed during incubation by varying the temperatures that the fertilized eggs or alevins are exposed to. A specified temperature change over a predetermined amount of time creates a life-long mark with no known adverse effects on hatching success or subsequent fish survival, health, behaviour or social interactions. However, this mark can only be judged through lethal means and is therefore more of a tool for stock assessment purposes. 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.

Details of the Operating Procedure:

At Snootli Creek Hatchery, a proportion of juveniles are marked prior to release to determine the survival of hatchery reared fish after release. Marking fish is performed by staff or contractors who are trained in the appropriate procedures and is carried out, on anaesthetized fish, in a manner to cause minimal injury and stress to the fish.

4.15.1 **Otolith Marking**

By manipulating temperature plus or minus two degrees Celsius after the eyed stage of development, dark and light bands can be imposed on the developing otolith (Hagen, 2000). Snootli Creek Hatchery has the capability to perform otolith marking and have carried the procedure out in the past. However, otolith marking is not currently utilized. The basic procedural practice is outlined below for reference.

1. Select an appropriate mark for the species/stack to be marked.
2. When the temperature of the surface supply is 2 degrees Celsius lower than the hatchery well supply, switch to the surface supply.
3. If the surface water is more than 2 degrees Celsius lower than well water, allow mixing to keep the temperature difference near 2 degrees to avoid temperature shock.
4. After 24 hours return to the well water supply. Repeat, until the desired number of otolith bands has been applied.
5. Prior to release, euthanize a sufficient number of fish to determine is the otolith bands have been applied as intended, and are clearly visible.

4.15.2 **Fin clipping and Coded Wire Tagging**

1. Withhold feed for 24 hours from fish that are to be clipped
2. Determine which fin (left/right pelvic, adipose) is to be clipped.
3. Each morning collect the required number of fish for the clippers
4. Fish may or may not be seined depending on the rearing container. Where seining is not used, scare fish to one side of the enclosure (usually simply walking up to the side of the rearing container will elicit an escape reaction where the fish all move away) to ball them up for easier collection
5. Randomly dip fish out of the rearing container and place them into a large garbage bucket with a screen lid
6. Move the bucket of fish to the clippers
7. Pour the fish into the aluminum holding box in the clipping room
8. Dip net fish from the culture unit and place in an anaesthetic bath until properly sedated.
9. When the fish are sufficiently sedated to allow handling, they are distributed to the clippers as required
10. Dip net fish from the anaesthetic bath and place in suspended mesh baskets on the marking table (process only 10 – 12 fish at a time to prevent recovery from anaesthetic prior to marking).
11. Gently pick up fish and remove the desired fin using iris scissors which have been sterilized with 70% Isopropyl Alcohol.
12. Swiftly and gently place fish in a recovery bath. Once recovered, return the fish to the culture unit.
13. Check a portion of the fish in the recovery bath for fin clip accuracy prior to returning them to the culture unit.
14. Monitor mortalities in the culture unit up to the time of release, subtracting the 'marked mortalities' from the 'total marks released'

4.15.3 **Coded Wire Tagging**

15. If coded wire tagging is to be done, it is performed following adipose clipping and using coded wire tagging machines.
16. Ensure that the coded-wire tag (cwt) to be applied is appropriate for the species and marking group.
17. Following marking (as outlined above) pass the fish to the tagger by placing the fish into the suspended basket adjacent to the CWT machine from which the tagger can grab the fish and inject the CWT.
18. 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.
19. If the tag is in place the machine will direct the fish back into a series of tubes and hoses that lead to the appropriate rearing channel or recovery bucket.
20. If the tag is not in place, fish will be directed to a small `reject' net submerged in a water filled bucket and held until the fish can be retagged.
21. Fish are placed through the QCD to recheck that there is not a tag in place prior to retagging them.
22. Periodically euthanize a fish in the recovery bath to check for tag placement.
23. Every break transfer fish out to the pond and place in a 4x8 marquisette pen to keep them separate from the general population.
24. Monitor mortalities in the culture unit until the time of release, subtracting 'marked mortalities' from 'total marks released'.
25. The following day, remove a sample of fish from the marquisette holding pen and check the 24 hour pin retention. If fish are to be released soon after marking and tagging, a one or two week tag retention check may also be performed. Anaesthetize a representative sample of marked fish and run them through the QCD to check for tag retention
26. The yearling Chinook are checked for one year tag retention during length weight sampling, It may be necessary to sort through a large number of fish to locate a representative sample of marked fish to check

Notes:

- If the anaesthetic appears to be diluted or the fish are not succumbing in a reasonable time period (1 – 2 minutes), a few mL of anaesthetic stock solution may be added to the anaesthetic bath to maintain the dose
- Change the anaesthetic bath every 90 minutes
- A 5 – 6 person crew can generally clip and tag between 10-15,000 fish per day
- The ventral pelvic fins are alternated each three years to differentiate different year classes (scale samples are collected to determine age class fish)

- Only Snootli Creek chums are marked at this time. Survival of the other chum stocks is implied from the survival of the Snootli fish.
- Atnarko Chinook are brought to the hatchery for marking and then returned to the originating facility by truck at the end of the day or early the next morning .
- Marking equipment is disinfected after each batch of fish/day of operation
- Mark Types:
    - Adipose clips, (sockeye)
    - Swim-fin clips, (Chum)
    - Coded-wire injection, (Chinook)
    - Physiological tags (thermal marks on otolith of sockeye)

Forms & Records:

The release report is to include:

- Date marked
- Number marked
- Mark type or cwt #
- Total number (marked/unmarked) released
- Release date

References:

Equipment disinfection
Anaesthesia
Fish Handling Procedures

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.

General Principles:

Fish are observed daily for signs of health, injury and disease.

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 and recorded. Any change should be investigated and the causes identified and corrected.

Groups of fish are tracked from their incubation containers to their rearing containers using the ENPRO Juvenile Manual.

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

Groups of fish suspected of having a disease are sampled according to the Veterinarian's instructions for lab analysis.

Details of the Operating Procedure:

Fish are routinely observed for signs of health, injury and disease during feeding, cleaning and sampling. Groups of fish suspected of having a disease are sampled for lab analysis, according to the Veterinarian's instructions.

Observations are generally carried out during the day during feeding and during mort picking and cleaning.

Trichodina is a relatively common health problem at Snootli Rive Hatchery when fish are reared on surface water. The parasite tends to affect small coho chum and Chinook (0.4-0.6 g). A bluish slime coating on the surface of the fish is an indicator of the presence of the parasite as are flashing and increased mortality.

Low levels of *Phoma* are also present on occasion.

If mortalities are higher than they should be for the stage of development, investigate the problem and check the water supplies and conditions. If fish have stopped feeding or if excess feed is observed on the bottom of the rearing enclosure, cease feeding and investigate the problem. If no obvious source for the problem can be found, contact the Veterinarian.

Forms & Records:
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.

General Principles:

With a long-standing established program involving annual fish transfers between two sites, with appropriate surveillance data collected and with historical knowledge in endemic disease issues in the two populations, the disease risk assessment may be relatively informal. Any such transfer program should be reviewed during the facility annual production planning process.

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

Where new programs are developed 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.

Assessment:

For each proposed transfer of fish the Fish Health Management Team should 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

Details of the Operating Procedure:

Prior to release, a disease assessment may be carried out if a problem is suspected. Contact the Veterinarian or Mark Higgins (at PBS) to seek advice on samples to forward to the laboratory.

If fish are considered to be unhealthy they will be held until the condition has been dealt with.

Before loading and transporting fish, a site check will be carried out to ensure that there is sufficient access to the release site and to evaluate the water conditions.

Forms & Records

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:

4.18.1 ***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 necessary permits/licenses should be in place

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.

Fish should be taken off feed for at least 24 hrs prior to transportation.

All required equipment should be available and functioning.

Water used for transportation should be whichever available source poses the lowest risk for pathogen transfer. In freshwater sites, well water is preferable.

Fish should be crowded for the minimum time possible to allow collection into transport vessels via pumps or nets. Dip nets should not contain too many fish and pipes used for pumping fish should have smooth surfaces and minimal bends. Water flow during fish pumping must be neither excessive nor inadequate.

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 should be kept wet to minimize trauma.

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™ - not to be used when fish are to be released due to mandatory withdrawal period).

4.18.2 ***During Transport***

Water quality must be maintained at all times during transportation. Transport vessels should be 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, as a generality, oxygen should be measured every 30 minutes. Fish should be visually monitored regularly (every 30 minutes) during transport to ensure they are behaving in an expected manner.

Other water quality parameters which may be measured include temperature, pH and ammonia. The parameter measured and the frequency should be determined by the duration of the transport.

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 ideally not differ by more than $2^{o}C$ and dissolved oxygen levels should be equivalent so that gill tissue is not damaged.

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

4.18.3 ***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 should be monitored closely after transportation for signs of illness or trauma. Mortality rates should be calculated at least twice weekly after transport and all fresh mortalities should be examined for the next two weeks to ensure that a pathogen has not been brought unintentionally onto the site. .

Details of the Operating Procedure:

4.18.4 **Juvenile Transport**

4.18.4.1 Preparation

1. Go over the transport checklist several weeks prior to any planned transfers
2. Obtain a license to import/transfer live fish into or within British Columbia from the Fish Introductions and Transfers Committee
3. Where fish are being transferred to another facility for short term holding, the receiving sites must make arrangements for isolating the newly arriving fish
4. Proper hygiene and disinfection are adhered to at the sending and receiving site
5. Starve fish for at least 24 hours prior to transport
6. Evaluate fish health before transport loading proceeds

4.18.4.2 Transport Conditions

1. Transport all fish in cool, clean, pathogen-free well water
2. Fill the transport tanks to the brim to avoid sloshing which can lead harm the fish
3. Frequently monitor and maintain water quality during transport

4.18.4.3 Loading Transport Tanks

1. Minimize crowding time to reduce stress
2. Load tanks so as not to exceed 50 kg/m^3
3. If transport tanks are loaded using a fish pump (pescalator), brief and orientate the crew as per the S.T.E.P.s for 'Fish Transportation System-Large Unit' and 'Neilson Fish Pump' (Fisheries and Oceans Canada)
4. If fish are to be transported by helicopter, crew must be briefed and orientated as per WCB Directive 5M 03/91 PH 37 ('Safety around Helicopters') (Fisheries and Oceans Canada)
5. Transfer fish to the transport tanks in water filled buckets
6. When small groups of fish are being transported, load transport tanks using dipnets

4.18.4.4 Tank Transport

1. Maintain dissolved oxygen levels are maintained at or near saturation using aeration stones fed from compressed oxygen tanks throughout the transport. Monitor the dissolved oxygen levels in the tank using a meter in the back of the transport vehicle.
2. Loading rates are determined according to Shepherd, 1984. (The biological design process used in the development of federal government facilities during phase I of the salmonid enhancement program – Canadian technical report of Fisheries and Aquatic Sciences No. 1275)
3. If using a transport tank:
    a. Fill the tank to the first mark inside the lip
    b. Add fish until the volume of fish raises the water level to the second chosen indicator mark. (Typically 500 Kg of fish are added to the 850 gallon (3200L) transport tank)

4. If using transport buckets
    a. Charge the water in the buckets with oxygen prior to loading fish
    b. Weight the bucket of water
    c. Add fish and record weight change to determine weight of fish being transported
5. Measure dissolved oxygen prior to leaving the hatchery site
6. Do not leave the facility until the dissolved oxygen level is appropriate and is holding at the desired level
7. After 15-20 minutes of travel, stop and check the DO levels again (target is between 10-15 ppm). Visually check on the fish in the containers to ensure there are no problems
8. Keep transport containers fully covered (dark) to minimize stress
9. Keep travel time in the transport tanks to a minimum
10. Drive transport trucks in a manner to minimize tank disturbance (jostling)
11. Ensure that a contingency plan is in place in the event of breakdowns during transport. This includes provision for extra oxygen bottles, alternative means of aeration, methods for cooling the transport water, and if all else fails, alternate release sites
12. Following each transfer (different stocks or species of fish) clean and disinfect the transport tanks and all associated equipment (air stones, nets, hoses etc) using Bactol. Ensure that all equipment is well rinsed and allowed to dry fully
13. When arriving at the release location, position the truck as close as is practical to the release site
14. Connect and roll out the release hoses and attach any adapters if necessary
15. Attach the hose to the transport tank outlet
16. Fill a couple of buckets with water
17. Open the release valve and allow the fish to flow through the hose
18. Hold the hose so it is approximately level to the bottom of the tank to allow the fish to come out more gently. If possible, raise the hose above the level of the tank can let the fish out slowly, angle the hose to release gently
19. Do not release fish into fast moving water, make every attempt to release them to deep pools such that they may recover from the transport
20. Record the temperature and DO of the receiving water
21. Collect all equipment, disinfect it on return to the hatchery and store it in the appropriate location.

4.18.4.5 Float Plane and Helicopter Transports

1. Fill large garbage buckets with well water
2. Charge the water in the buckets with oxygen

3. Load the fish into the buckets at a density of between 150 – 300 g/L depending on the duration of the planned transport
4. Load the buckets onto the truck and drive the fish to the float plane
5. Load the buckets into the plane and install the oxygen manifold system (A Beaver can carry 6 buckets tot eh sea pens at a time)
6. Reduce the oxygen during transport and monitor it closely
7. During air transport – visually check the fish and move the oxygen meter from bucket to bucket to check that they are all at an appropriate oxygen level
8. On arrival at the seapen site, gently pour the fish into the pen
9. Hold the fish in the seapens for between 24 hours and two weeks
22. Release the fish to the environment in the late afternoon or evening to reduce predation
23. Record the temperature and DO of the receiving water
24. Collect all equipment, disinfect it on return to the hatchery and store it in the appropriate location.

Notes:

- Ensure that spare tanks, airstones, tools, nets, buckets, hoses etc. are in the transport vehicle
- When loading large groups of fish (greater than 500 kg), use the fish pump and the large (850 gallon) transport tank
- When moving smaller groups of fish, use one or both of the 250 gallon transport tanks
- Chinook are moved to the Atnarko River channels in April, reared for6 -8 weeks, then transported to the release site (s) to coincide with the wild 90 day smolt migration.

Forms & Records
Transport Checklist

References:
Pre-Release or Transfer Disease Risk Assessment

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* 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 should be returned to their natal streams. Release sites and rivers should be checked for adequate flow, level and temperature, prior to release. Fish should not be released if there is a potential for extreme conditions in the river.

Other watershed users should be made aware of the time and date of the fish release if appropriate

Fish may be given a salt-water challenge test before release to determine smolt readiness.

Fish designated for the watershed should be checked for health condition prior to release.

Fish may not be fed on the release day, and may be sampled the morning of the release day. Fish that have not left within 2 weeks of screen removal may be forced to leave.

All equipment (tanks, pumps, hoses, aerator, air stones, etc) should be pre-checked to ensure good working order.

Details of the Operating Procedure:

All fish are returned to their natal streams

Target numbers, weights and dates for release are determined according to stocking guidelines that are meant to maximize survival rates.

Release sites and rivers are checked for adequate flow, level and temperature, prior to release and every attempt is made to ensure that fish are released at the peak of the wild migration.

Other watershed users are made aware of the time and date of the fish release. The local First Nations may be fishing for oolichan and the nets would interfere with the juvenile salmon migrating through the system.

Fish designated for the watershed are checked for health condition prior to release.

Fish are not released if there is a potential for extreme conditions in the river.

Fish are not fed on the release day.

Lower Atnarko River Chinook are released by removing the screens and allowing them to leave at will. Snootli Creek chum are also released this way. Prior to volitional release, walk the creek to ensure that there are no restrictions. Slowly lower the pond levels before lifting the screen. The fish will move from the rearing channels into the release channel behind the ponds which drains into a release channel that goes into Snootli Creek. The fish exit the ponds over the course of one to two days. After approximately 2 days, lower the level of the water so the remaining fish are forced out into the back channel. Determination of release timing is made by observations of the behaviour and appearance of the fish as well as by the movement of the fish in the wild. If wild fish are not seen to be moving through the system, hatchery reared fish may be held back.

Fish are sampled (individual lengths and weights from a representative sample) the morning of the release day.

Slow acclimation to the water at the release site may be necessary to orient the juveniles and ensure the water temperature between the transport water and the water at the release site does not differ by more than 3 degrees Celsius.

All equipment used for transport must be cleaned (pressure washed) and/or disinfected with Bactol before it is used again. If disinfecting with Bactol, ensure that the equipment has been thoroughly rinsed prior to reuse.

Forms & Records:
Fish transport and release information is recorded according to the ENPRO Juvenile Manual. A back-up copy of this information is retained in Excel.

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

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 should 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 should have its own equipment (nets and buckets) for mortality removal. Equipment used to remove mortalities should be cleaned, disinfected and dried between uses.

All dead and moribund fish should be removed from holding units on a daily basis. Moribund fish should be humanely euthanized prior to disposal (see *Euthanasia*).

Where feasible, separation of staff occurs so that staff picking mortalities are not feeding fish or cleaning holding units on the same day. Footbaths and hand wash stations should be used prior to returning to fish holding areas.

Mortalities should be 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)

Buckets used to collect mortalities should have secure tight fitting lids that will exclude predators and scavengers. Buckets should be cleaned and disinfected before being returned to the fish rearing area.

After mortalities have been collected they should be stored (they may be frozen) in a central location away from the fish rearing area until they can be removed from the site.

Details of the Operating Procedure:

Concrete ponds are vacuumed regularly. Fish that are collected in the vacuuming process are counted as they are taken up and are sent to the exfiltration pit. Mortalities are picked from the outflow screens and counted manually.

Rearing containers are picked daily, or as necessary.

Sockeye mortalities and any mortalities in the tubs are removed and placed into a bucket containing disinfectant (Bactol solution). After collection, these mortalities are disposed of to the septic system. Sockeye egg mortalities are also disposed of in this manner.

Mortalities are collected using dedicated mort nets for stocks that are not native to the same watershed. If groups of fish are from the same watershed, the same nets and brushes may be used after disinfection between containers.

Mortalities are collected in the latter part of the day, after feeding has been completed and some may be brought up to the main lab in the office building for examination.

Each stock has its own mort collection equipment that is identified by writing on the handles of brushes, nets and buckets. All tanks are identified and mort buckets are clearly marked as such.

Vacuuming equipment is not disinfected between containers so it is not used with different stocks on the same day. It is dried and stored between uses.

Feed buckets are labelled rearing containers.

Fish that are suspected of being diseased (dark, deformed, pin-head, obvious fungus) are removed from the rearing containers and euthanized if necessary.

The mortality storage area is distant from the rearing containers to minimize the spread of disease.

Raingear is disinfected between mortality collection and fish feeding operations.

Forms & Records

Daily books - info is entered into them – the feed book – then entered into EnPro
(feed fed, mortalities, daily temps etc...)

References:

Outbreak Response
Outbreak – Disinfection Protocols
Mortality Collection and Disposal
Mortality Classification
Euthanasia
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 should be initiated.

Standard mortality classifications may include:

Background Mortality (expected background losses)
Systems related (systems or equipment failure)
Environmental (water quality, plankton)
Fresh (fresh, unexpected apparently healthy losses or disease mortalities)
Handling/transport (losses related to handling or transport)
Matures (fish that have matured and died)
Old (mortalities are too old and decomposed to determine cause of death)
Predators (fish killed or injured by predators)
Culls/Quality Control/Poor Performers (fish intentionally removed from the population

Details of the Operating Procedure:

Only basic classification information is recorded.

- Record pinhead dropouts as an approximate percentage
- Note pale gills
- Note swollen belly

A historical mortality level is assumed, if the levels increase dramatically more detailed observations will be recorded

Forms & Records:
EnPro
Mort records
References:

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 section *2.3.4* 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.

General Principles:

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

4.21.1 ***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*)

During an outbreak:

Visitors and non-essential staff should not be allowed on site unless previously authorized by the Fish Health Management Team

Hatchery management must notify other fish rearing facilities in the geographic area of the outbreak

Any suspected infected population should be quarantined/isolated from the healthy population, as are the items they may have contaminated (nets, buckets, siphons, etc). Fish should not be handled any further and any movement of fish on/off and within the site should be halted.

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

Where possible, separate equipment should be designated for the affected unit. All equipment, surfaces and clothing that come in contact with infected fish or infected material should be thoroughly disinfected after use to avoid potential transfer.

4.21.2 ***Assessment***

The Veterinarian must be sent all records 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, vaccination, 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 should be observed frequently and monitoring should 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 should be monitored and water and feed samples are to be taken if requested.

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

Disinfection procedures (below) should 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. Spatial distribution is assessed by conducting health checks on apparently healthy fish throughout the facility. 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.

4.21.3 ***Outbreak – Disinfection Protocols***

4.21.3.1 Personnel and Equipment

In the event of an outbreak, foot baths are to be used by all personnel before entering and leaving the facility. In the case of a diagnosed viral outbreak a 2% solution of Virkon™ is used in the foot bath. A 1% solution of Virkon™ should be used for dip net disinfection.

Foot baths should 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.

4.21.3.2 Mortalities

Mort collection equipment should be disinfected after use, especially during any incidence of pathogenic outbreak.

Dissection of fish for examination and/or samples must be conducted in a contained area to prevent the spread of disease within the facility.

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

Details of the Operating Procedure:

In the event of an unusual, unexplained or unexpected mortality rate the affected containers are quarantined and samples are forwarded to the pathology laboratory at the Pacific Biological Station. Staff separation is implemented to quarantine the area and footpaths and hand sanitizers will be placed in appropriate locations to reduce potential for pathogen spread.

Any suspected infected population is quarantined from the healthy population, as are the items they may have contaminated. Fish will not be handled further and all transfers on and off site will be cancelled.

Mortality collection will be increased to ensure prompt removal of carcasses and affected tanks are picked last with staff adhering to disinfection procedures between tanks and rearing units.

Where possible, separate equipment is designated for the affected unit. All equipment, surfaces and clothing that come in contact with infected fish or infected material are thoroughly disinfected after use.

When a serious infectious disease problem is suspected, the Veterinarian is immediately notified and is sent all records and appropriate sampling information to determine the cause of the outbreak and the best course of action. The Veterinarian will provide instructions for proper sampling and samples will be sent to the pathology laboratory for diagnostic workup. Samples are properly handled, properly stored and promptly shipped as per the Veterinarian or Fish Health Management's instructions. Monitoring will continue after the initial workup to determine the course of the outbreak and to assess whether treatment and/or management measure are being effective.

Fish will be observed frequently and feeding response and water quality will be monitored. Where numbers of personnel are sufficient, there will be a separation of staff working on sick and healthy fish. Where numbers of staff are insufficient the healthy fish are cared for first and personnel disinfect themselves between handling groups.

Forms & 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

4.22 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* 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

General Principles:

In the event of a diagnosed pathogenic outbreak:

4.22.1 ***Securing the Site***

Affected hatcheries should be quarantined/isolated; facilities locked down. Gates to the facility should be closed and only essential personnel admitted.

Disinfection procedures should be 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 should be immediately halted.

4.22.2 ***Isolation of Infected Group***

The affected fish rearing containers should be isolated, movement of fish into and out of these containers stopped.

If possible, effluent is trapped and treated prior to discharge to the environment.

4.22.3 ***Mortality Removal***

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

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

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

Details of the Operating Procedure:

Tours may still be conducted as all tours are under strict supervision. However, any tours would be conducted well away from any affected areas of the site.

Any planned releases will be delayed until diagnostic results are obtained from the pathology laboratory.

Forms & Records

References:
Outbreak Response

Outbreak – Disinfection Protocols

4.23 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 *2.1.3.10* 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 should be held off food for 24 – 72 hours prior to treatment. This serves to reduce fecal fouling of the tank and lower the metabolic demands of the fish.

Tanks should 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 e 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:

4.23.1 ***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 protozoan *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 mL 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.

4.23.1.1 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.

4.23.2 *Bella Coola River Chum/Atnarko River Chinook*

Since the Snootli Creek Hatchery supplements the Bella Coola River chum and Atnarko River Chinook rearing water with surface water from Snootli Creek, these fish are exposed to *Trichodina*. When fish are observed "flashing" and pond mortality exceeds 100 fish/day, mortalities are examined under the

microscope for the presence/absence of this parasite. If the parasite is found on more than 2% of the fish, treatment with Parasite-S is initiated.

4.23.2.1 Preparation

1. Starve fish for 24 hours prior to treatment.
2. Store and handle Parasite-S as per the MSDS
3. Determine the flow rate in the rearing container
4. At that flow rate, determine the volume of Parasite-S required to reach a concentration of 170 ppm in a stock solution of 12 L with a delivery rate of 200 ml/min for 1 hour.

Example calculation

- Pond flow = 60 L/min
- Pump flow = 200 ml/min
- Stock solution volume required = 12L
- Volume of Parasite-S to dilute into 12 L = 0.61 L

5. Use appropriate face shield, respirator (NIOSH/MSHA TC-23C – 1350/52 approved cartridges), and gloves when decanting Parasite-S from the 200 L drum into a smaller container.
6. Decant calculated volume of Parasite-S out of the storage container. Do this only in a well-ventilated area using a propylene lever drum pump.
7. Label decanted Parasite-S as per MSDS.
8. Parasite S (http://www.syndel.com/dpfs/parasite-sinfosheet.html) is introduced to the pond, using a Veristaltic pump, at a concentration of 250 ppm for 1 hour.
9. Mortalities are picked immediately after treatment. The next day, if mortalities exceed 150 per pond, treatment is repeated.
10. Take it out in a bucket to the pond
11. Place the intake hose into the bucket
12. Turn the pump on and adjust the flow
13. Take a 100 ml beaker and measure for 30 s set pump to = 200 ml/min
14. Begin treatment delivery
15. Observe the fish during treatment to watch for any odd behaviour
16. Monitor oxygen during the treatment
17. Treat for 1 hour
18. Turn off
19. Clean equipment

20. Vacuum pond – remove all visible parasites that have fallen to the bottom
21. Pick mortalities the next morning
22. If parasites are still visible, treat again

Note: do not feed fish during the treatment. You may feed them a portion of the ration later in the day several hours after the treatment is complete.

4.23.2.2 Disease Treatment

4.23.2.2.1 Bacterial Gill Disease

- Most epizooties are stress related. In recent years, by reducing crowding and increasing the turnover rate in ponds/troughs/tubs to at least 1 time per hour, the Snootli Creek Hatchery has avoided this problem.
- In past years, on instruction from the Veterinarian, after receiving a BVD release, fish suffering from BGD have been treated:
  - With Oxytetracyclin @ 55mg/kg of fish, added to the food for 10 days.
  - Sulfamerazine @ 264mg/kg of fish, added to the food for 3 days.
  - Chloramine T @ 8.5mg/l for one hour on 2 consecutive days (DFO 'Info Memo' 120, August 1985).

4.23.2.3 Records

- All treatments and management changes are noted as they occur.

Forms & Records:
EnPro

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

4.24 Broodstock Treatments

No Broodstock treatments are currently in use at Snootli River Hatchery.
The following is for informational purposes only

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:

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.

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 must be made in consultation with the Fish Health Veterinarian. Antibiotics must 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.

Spawning synchronization

Manipulating environmental cues such as temperature, photoperiod, nutrition, holding density, etc., is critical for the maintenance of natural reproduction rhythms. Captive brood programs experience unique challenges in terms of the synchronization of spawning readiness. Under veterinary prescription and supervision, hormonal injections (e.g. Ovaplant™, Ovaprim™) may be given to broodfish to help synchronize the timing of spawning.

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 should 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.

4.24.1.1 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.

4.24.2 *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 mL 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.

4.24.3 ***Salt***

Common salt, sodium chloride, is a general purpose supportive therapy for freshwater fish. It may be valuable in a variety of situations including:

- Reducing osmotic stress of fish with gill, kidney or skin lesions
- Reducing over-production of mucus during bacterial gill disease (aiding respiration)
- Supportive care during handling and transport (protection against lowering of blood pH)
- Lowering incidence of opportunistic infections, fungal and/or bacterial, in weakened fish.

Standard dosing for supportive care is 0.3% w/v (equivalent to 3 g/L) for as long as supportive care is required.

Cautions:
Commercially available types of salt can contain additives that are toxic to fish. Forms that are safe for use in fish culture include:

- Any intended for human consumption, except iodized salt
- Any intended for animal consumption which does not contain added minerals
- Salt intended for recharging water softeners
- Artificial sea salts

References:
Egg Fungal Treatments
Anaesthesia
Fish Handling Procedures

4.25 Top-Coating Medicated Feed

No medicated feed is used at Snootli River Hatchery.
The following is for informational purposes only

Rationale: Small volumes of medicated feed are required at sites with lower production numbers. At these sites, medication may be top-coated unto 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.

General Procedures:

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

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

References:

4.26 Medicated Feed: Storage, Handling, and Feeding

Medicated feed is not used at Snootli Creek Hatchery.
The following is for informational purposes only

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 should 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. Ensure that appropriate information has been forwarded to the veterinarian to ensure proper prescription. 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 should 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.) should be carried out. ***Once medicated feeding is initiated, it must 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.

References:

4.27 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.

General Principles:

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 must be 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.

Details of the Operating Procedure:

All sockeye stocks are sampled for IHNV and BKD. Ovarian fluid and kidney tissue are collected for laboratory analysis. All eggs are kept in segregated incubation units until diagnostics come back.

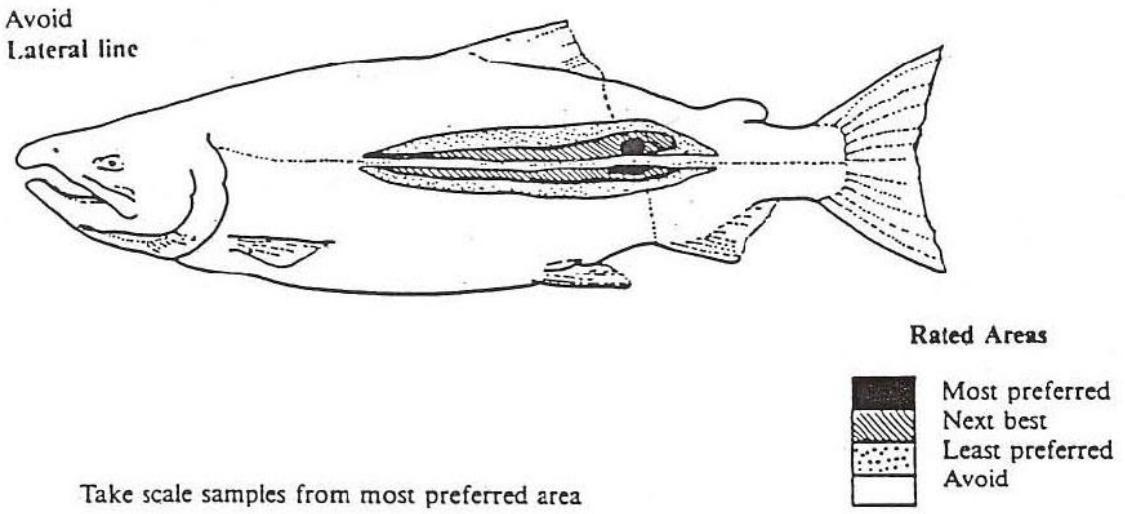
Ovarian Fluid sampling protocols are outlined in the Appendices.

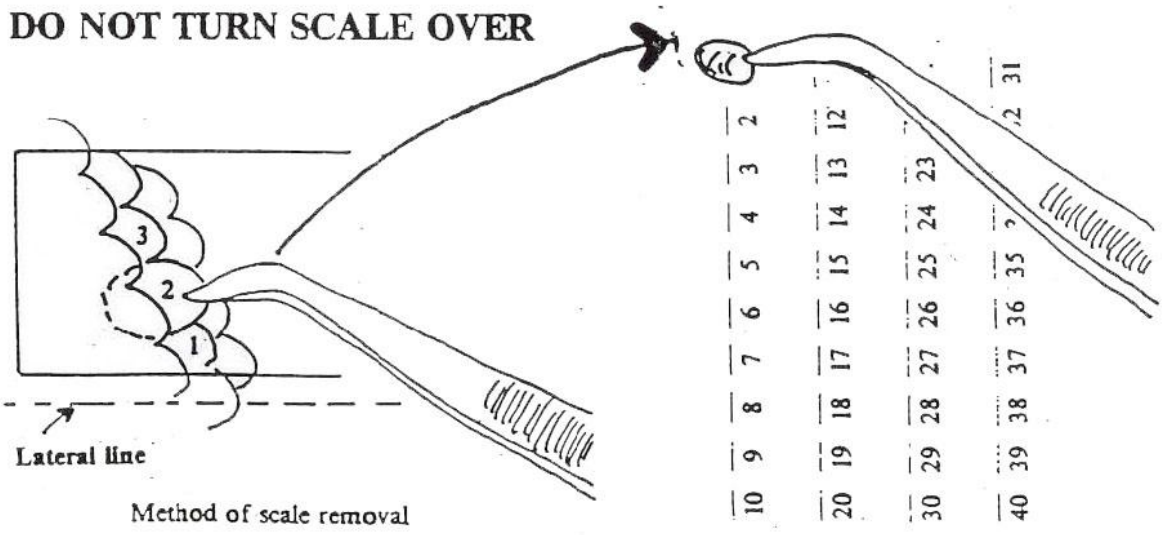
BKD sampling protocols are located in the Appendices.

4.27.1 *Scale Sampling*

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 arid pulling.
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. 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.





Forms:

References:

Euthanasia

BKD sampling procedure (revised 2006)

BKD Diagnostics, Interpretation of Results, and Procedures

4.28 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 (e.g.. pop-eye 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, a sample of the affected fish should be transported to the Fish Pathology Laboratory at the Pacific Biological Station.

Equipment List:

- □ Shipping container
- □ Elastic bands
- □ Packing tape
- □ Ice or freezer packs
- □ Ziploc bags
- □ Disinfectant
- □ Heavy duty plastic bags
- □ Oxygen supply
- □ Submission form
- □ Newspaper
- □ Waterproof labels
- □ Waterproof marker

Details of the Procedure:

4.28.1 ***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.

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.

4.28.2 ***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.

Freshly captured, live fish that display signs of the problem are the ideal samples to collect for submission.

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

4.28.3 ***Shipping live fish:***

1. Prearrange the flight bookings. Samples are shipped to Vancouver in the afternoon and then forwarded to the Pathology lab in Nanaimo via Harbour Air the following morning. Prepare the shipment just prior to the time that the plane is due to depart (just prior to lunch time) to reduce the amount of time the fish are in the containers.

2. Wrap ice packs in newspaper and place into the bottom of the hard sided box or cooler that is to be used for shipping. Alternatively, ice may be double bagged in sealed zip-lock bags and placed in the bottom of the container. Newspaper should be placed on top of the bags of ice.

3. Place the fish and water in heavy duty Ziploc bags. Use separate, labelled bags for moribund and apparently healthy fish.

4. Top the bag with a volume of oxygen that equals or exceeds the volume of water.

5. Seal the bags tightly and label clearly.

6. Place the bags into a large Styrofoam cooler.

7. Secure the container with duct tape to prevent accidental spillage. Spray or wipe down the outside of the container with an appropriate surface disinfectant.

8. Clearly label the shipment container with the names and telephone numbers of couriers and the diagnostic facilities.

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

10. Email the case information to the laboratory.

4.28.4 ***Shipping fresh dead fish:***

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

If fish are too large to realistically send alive, freshly euthanized fish may be sent for diagnostics.

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

4.28.5 ***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 labelled. Place double bagged samples in a cooler as described above and ship to the diagnostic laboratory.

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.

Histopathology samples must be treated as dangerous goods due to the fixatives used to preserve them. Nalgene bottles with tight fitting lids should be used to contain the samples. These should be placed in sealed bags for shipment to minimize risk of leakage. Ship histopathology samples as dangerous goods.

4.28.6 ***Following Transport:***

Follow up with diagnostics laboratory to ensure that they are aware of what flight the samples should be arriving on and 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)

Daily mortalities for each rearing group, live balance and suspected source of mortality are entered into field note books daily and into an Excel spreadsheet (see Brood Summary section) after release. This is later transferred to the ENPRO database (time permitting, and if the hatchery server or ENPRO program is not down).

References:

Diagnostic Sampling protocols

BKD sampling procedure (revised 2006)

BKD Diagnostics, Interpretation of Results, and Procedures

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

Ovadine® is used as a fish egg disinfectant and as a disinfectant for equipment and culture related gear.

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

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

4.29 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 should be reviewed by fish health staff and the Veterinarian prior to procedure. All staff handling anaesthetics must be aware of WHMIS information.

Fish should be taken off feed for 24 to 72 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 should be 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.

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 safety/splash glasses, dust mask, latex or nitrile gloves and rubber boots.

Fish should be handled gently using nets with smooth surfaces. Larger fish should be supported ventrally when handled by hand; smaller fish should be handled with a dip net. Any dropped fish or jumpers should 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*).

A few fish should be 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, should be monitored during the procedure. The temperature of the rearing unit and the anaesthetic and recovery baths should not differ by more than two degrees.

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

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

Fish should never be 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 (D.O. < 5 mg/L and/or temperature changes > 2 degrees) the anaesthetic bath should be renewed.

Following Anaesthesia:

After the procedure, fish should be recovered in a separate container prior to being gently returned to their rearing unit. Fish are monitored for recovery.

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

Fish populations should be monitored closely after all handling events. Mortality and morbidity should be assessed twice daily and all mortalities classified.

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

Details of the Operating Procedure:

4.29.1 ***TMS Anaesthesia:***

Equipment List

- Plastic tubs of appropriate size
- 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

The dose for TMS anaesthesia is 40 – 50 ppm.

Prepare a stock solution of TMS by weighing out 30 g of TMS and dissolving it in a volume of 250 mL of water. Sodium bicarbonate is not added to the bath.

Use 10 mL of this solution per 4 L (1 gallon) for marking and sampling fish. Test the anaesthetic bath with a few fish prior to undertaking the full procedure. If the fish are succumbing in less than 30 s the dose is too concentrated and should be diluted. If the fish are not succumbing within 3 minutes, the dose is too dilute. TMS anaesthesia is affected by temperature therefore once the appropriate dosage has been determined every effort is taken to maintain a constant water temperature (i.e. add ice, mix up new batches o anaesthetic and water as required)

Caution: Ensure that any container that may have been disinfected with Bactol has been thoroughly rinsed prior to use with a TMS anaesthetic bath. There is evidence that Bactol and TMS may combine in a toxic manner.

When anaesthetizing fish using TMS, set up several nets in the basin so that several smaller batches of fish may be run rather than larger batches which may lead to excessive time in the anaesthetic. It is preferable to not have to recover and re-anaesthetize fish.

Aeration is supplied to both anaesthetic and recovery baths. At the outset of the operation oxygen is measured at various flows and the flow set accordingly. The only time it would be checked after that is if there was a problem with fish recovery.

he maximum safe exposure time to TMS is 30 minutes.

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.

4.29.1.1 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.

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.

Forms & Records:
EnPro

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%20Anaesthetics%20-%20ENG.pdf)
http://www.syndel.com/anaesthetics/anaesthetics.html
http://www.syndel.com/anaesthetics/aquacalm_info_sheet.html
http://www.syndel.com/anaesthetics/tms_info_sheet.html
Fish Handling Procedures

4.30 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.*

Fish handling should occur in a humane and stress free a manner. (See *Fish Handling Procedures*). All fish culturists and fish health staff are required to know how to euthanize fish in a humane manner.

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 should 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:

Adult moribunds are euthanized by a sharp blow to the head

Juvenile moribunds are euthanized by bucket suffocation

Eggs that are diagnosed as BKD or IHNV positive and are to be destroyed are euthanized by immersion in a bleach solution

Forms & Records:

References:
Anaesthesia
Fish Handling Procedures

4.31 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:

All staff handling chemicals must be aware of WHMIS requirements.

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

Chemicals should be stored as recommended by the manufacturer. Provisions should 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 should be disposed of according to manufacturer's directions in compliance with local waste management regulations.

Disinfectants must be used as recommended by the manufacturer and stored in a manner to ensure worker safety and prolonged efficacy.

All equipment and tanks should be cleaned prior to disinfection to ensure efficacy and to reduce the amount of chemical needed.

Disinfectant concentrations should be maintained either by checking concentration (e.g. test strips or visual inspection) or regularly scheduled renewal of the product.

Details of the Operating Procedure:

4.31.1 ***Compressed Gas Cylinders Storage***

Compressed gas cylinders are stored in a clearly identified, dry, well-ventilated storage area away from doorways, aisles, elevators, and stairs. “No smoking” signs are clearly posted in the area. Store cylinders in the upright position and secure with an insulted chain or non-conductive belt and secure the protective caps.

Compressed gas cylinders are stored on the vehicles or at the welding shop. Cylinders are kept outside and are chained to the building to keep them standing upright.

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

There is always an extra full cylinder of oxygen and CO2 on hand

The cylinder should not be “cracked” until after the regulator has been attached properly and cylinder is secured in place.

4.31.1.1 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.

4.31.2 ***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 17mLs 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 paint shop. It is dispensed, from this location, while wearing full personal protective gear (respirator, face shield, gloves) and moved to the location where it is to be prepared into a stock solution and used.

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.

4.31.2.1 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.

4.31.3 ***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 is stored under the sink in the wet lab in the main hatchery building.

4.31.3.1 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.

4.31.4 ***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 cupboard in the main lab. TMS may also be stored in working solution concentrations in the tank farm. Stock solutions are set in a tray of running water to keep them cool when in use.

4.31.4.1 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.

4.31.5 ***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 4L jugs contained within black plastic bags in a case stored in the sockeye building or the sockeye fertilization building. A bottle may also be present in the tank farm building if in use.

4.31.5.1 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.

4.31.6 ***Bactol***

Bactol is a synergistic phenolic disinfectant that contains Alkyl dimethyl benzyl ammonium chloride. It is highly-effective in low concentrations. It has a residual effect which is also maintained in the presence of organic materials (soil, blood, fat etc).

Bactol is active against a broad spectrum of microorganisms, such as pathogenic bacteria, viruses, yeasts and moulds and leaves a protective residue on surfaces and this may react with other chemicals (notably TMS) on subsequent use.

The area should be cleaned and rinsed, and then wet thoroughly with the disinfectant solution. When heavy contamination with organic matter is present, or after an episode of a disease, Bactol should be used in the highest recommended concentration.

Bactol should be stored in a cool location. At Snootli Creek Hatchery, Bactol™ is stored in the lab as well as in the areas that are actively in use during incubation and rearing.

4.31.6.1 Bactol MSDS Information

Store Bactol in tightly closed original container in a secure area inaccessible to children. Do not contaminate water, food or feed by storage and disposal.

Wastes are acutely hazardous and improper disposal of spray mixture, or rinsate can be hazardous to the environment. Rinse container thoroughly before discarding in trash.

Bactol is corrosive and causes severe eye and skin damage. Do not get into eyes, on skin or clothing. Wear goggles or face shield and rubber gloves when handling the concentrate. Harmful or fatal if swallowed. Avoid contamination of food. Wash thoroughly with soap and water after handling.

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. And seek medical attention. Remove and wash contaminated clothing before reuse. If ingested, promptly drink a large quantity of water and do not induce vomiting. Call a physician immediately.

This product is toxic to fish. Do not discharge effluent containing this product into natural water systems

4.31.7 ***Isopropyl alcohol***

Isopropyl alcohol is used for sterilizing sampling instruments in the laboratory and is stored in the laboratory cupboard

4.31.7.1 Isopropyl alcohol MSDS Information

Synonyms: 2-propanol, isopropanol, dimethylcarbinol

Isopropyl alcohol is a colourless liquid with the odour of rubbing alcohol. It has a low flash point and is extremely flammable and flames are virtually invisible. Water is generally not effective in extinguishing fires, carbon dioxide or dry chemical extinguishers are appropriate fire fighting media.

Storage is incompatible with strong oxidizing agents (nitrates, perchlorates, peroxides) which may increase the risk of fire and explosion.

At high concentrations, isopropyl alcohol may cause mild irritation of the upper respiratory tract, drowsiness, ataxia (inco-ordination) and deep narcosis. Direct eye contact can cause severe irritation, flush with water for 15 minutes and seek medical attention. Brief skin exposure is not generally irritating and absorption through the skin does not readily occur so toxic doses are unlikely. If skin contact occurs, wash with soap and water and remove contaminated clothing. Ingestion may lead to drowsiness, gastrointestinal pain, cramps, nausea, vomiting and diarrhoea. Seek medical attention. Unconsciousness and death may occur following large doses. Vomiting, by having individual drink large quantities of water, should be induced if ingested. Lethal dose for humans is approximately 130 grams.

Store in tightly closed, electrically grounded containers in a cool area and away from sources of heat, sparks or flame. The storage area should have adequate ventilation and have no source of heat or sparks. Fans and other electrical motors should be spark resistant.

Use minimal quantities in designated areas with adequate ventilation and away from sources of heat or sparks. User fire resistant containers and store closed in a grounded, fire resistant cabinet. Alcohols are incompatible with acids and strong oxidizing agents. Store separately from these.

If small amounts are to be disposed down a sink, flush with ample water to prevent the accumulation of flammable vapours.

Chemical splash goggles should be worn to protect eyes from liquid or concentrated vapours. Gloves should be worn to prevent exposure of skin.

4.31.8 ***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, and then the excess may be wiped off with a paper towel.

Ethanol is stored in the laboratory cupboard. Quantities greater than 1 L of ethanol are not generally stored onsite and are forwarded to the facility when specific sampling requirements are requested.

4.31.8.1 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:
Chemical inventory sheet on excel

References:
WHMIS Material Safety Data Sheets
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

4.32 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: 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 Procedural Details:

4.32.1 ***Between sites:***

Each site should have designated equipment that should not be shared with other sites.

On the rare occasion when equipment must be shared with other sites it should be cleaned, disinfected and dried prior to leaving the site and prior to returning to the originating site.

Each site should have designated raingear that is not to be transferred between sites.

Vehicles and vessels used between multiple sites should be cleaned and disinfected prior to use at another site. Acceptable methods include 'fallowing', drying, and ultraviolet light and chemical disinfectants.

When collecting sockeye in the field, all equipment is disinfected on return to the hatchery and everything is stored away from fish. Staff separation is used when working with sockeye. All equipment, raingear, nets, boots etc are disinfected and hung to dry.

Anything that has been used in river systems other than Snootli Creek is disinfected between uses.

4.32.2 ***Within the site:***

Each rearing unit should have designated equipment that should not be used in other rearing units.

After use, equipment such as dip nets, buckets and feeding equipment should be cleaned, disinfected, dried and put away in the proper location.

When equipment must be shared between rearing units (for example: large objects such as grading tables), it should be cleaned, disinfected and dried between uses on different fish groups.

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.

In the freshwater environment, holding units should be cleaned, disinfected and dried between groups of fish housed in the facility. Tanks should be 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.

At all sites 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.

Within the Bella Coola system, equipment is not disinfected between groups unless one group is on surface water and the other is on well water. All equipment will be disinfected between uses with different water sources.

All equipment will be disinfected between use with fish from different water systems.

All equipment is disinfected between uses with different rearing containers of sockeye irrespective of stock.

Splash covers are installed over sockeye incubation stacks to reduce the incidence of potential cross contamination. If possible leave a break in between stacks of different stocks and disinfect between stacks when picking eggs.

Feed buckets are not disinfected between uses because individual feed containers are dedicated to individual rearing containers. Feed containers will be cleaned and disinfected with Bactol if they are soiled.

4.32.3 *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 should be made by the site management in consultation with the Veterinarian.

Products should be used according to manufacturer's directions.

Disinfectant concentrations should be 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 should be disposed of according to manufacturer directions in such a manner that meets the requirements of waste management regulations.

4.32.4 *Equipment Disinfection Protocol:*

Equipment should be cleaned and scrubbed with soap and water prior to disinfection to remove all visible organic matter.

Clean equipment should either be immersed in the 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.

Prepare a bucket with disinfectant(100ppm Ovadine or 1% Bactol and dip equipment (nets and brushes) in the bucket. Allow the equipment a contact time of 10 minutes prior to rinsing.

4.32.5 ***Tank Disinfection Protocol:***

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).

Tanks are rinsed of debris, scrubbed with Bactol (at the manufacturers recommended concentration) and allowed a 5-10 minute contact time. Tanks are then rinsed well and allowed to dry in the sun after the removal of fish and prior to the introduction of new fish.

Where possible, a fallow period of at least one week between fish groups should be allowed.

4.32.6 ***Foot Bath and Foot Mat Disinfection Protocols:***

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.

Record foot mat/bath change on the footbath log.

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.

Ovadine footbaths (200 ppm) are used in incubation and in the rearing areas for sockeye. Footbaths are recharged every 2-3 days or more frequently if freezing conditions are encountered. Footbaths may be changed daily in incubation depending on traffic. Solutions are changed when the colour starts to fade or when it is obviously soiled.

4.32.7 ***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.

4.32.8 *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 mL 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.

4.32.9 *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:

References:

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

4.33 Vaccine handling, storage and administration

Rationale: Vaccines must be handled, stored and administered properly to be efficacious. This SOP addresses sections *2.1.3.4* and *2.3* of the General Principles of Fish Health Management. The goal of this SOP is to ensure that vaccination is carried out in a manner that is efficacious.

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 showing signs of illness should not be vaccinated and fish should not be vaccinated at water temperatures of less than 1^{o}C. Vaccination should also be avoided during smoltification and the four weeks prior to seawater entry

4.33.1 ***Vaccine Storage:***

The vaccine should be stored according to manufacturer's directions. Generally, it is kept refrigerated (2-8°C) in transport and storage and is protected from light and freezing.

Once opened, a bottle of vaccine should be used within 24 hrs. Any open vaccine older than 24 hrs must be discarded.

The vaccine should be a uniform cloudy suspension. If the vaccine appears abnormal it should not be used.

The lot number of the vaccine should be noted in the records and the expiry date checked prior to use; expired vaccine is discarded.

4.33.2 ***Before Vaccination:***

Fish should be taken off feed for a maximum of 72 hours prior to vaccination. Determination of the time off food includes consideration of fish size, diet, water temperature and existing knowledge of gut emptying times.

A risk assessment should be conducted by fish health management prior to the procedure. This will include analysis of the health status of the stock, their age and size, previous disease history, current morbidity, mortality rate and important production parameters such as feed conversion ratio. If there are any indications that the health of the fish may be compromised, the veterinarian should be consulted prior to proceeding.

Vaccination should not occur if water quality is questionable.

Once it has been determined that fish are healthy enough for vaccination, large enough to respond to the vaccine and the environmental parameters are acceptable, the process can proceed.

A checklist of required equipment should be available and checked off prior to starting fish handling.

4.33.3 ***During Vaccination:***

Vaccines are to be used according to manufacturer's directions.

In general:

Each litre of vaccine is diluted with 9 litres of clean water.

Fish should be handled gently to minimize stress (see common *Fish Handling Procedures*).

Water quality in the bath should be monitored closely for the duration of the procedure, particularly dissolved oxygen and temperature, supplemental oxygen is bubbled into the vaccine bath to maintain optimum dissolved oxygen levels.

Fish should be captured in a dip net or bucket, holding water is allowed to drain from the container (fish may be weighed at this point). Numbers of fish in the net or bucket should not be excessive; fish should be closely monitored for signs of injury during the procedure.

The fish should be immersed in the vaccine solution for 30 seconds. The fish are then removed from the dilution, drained and returned to the holding unit and monitored closely for signs of injury from handling.

This procedure is repeated until 100 kg of fish per litre of diluted vaccine have passed through the bath.

The vaccine bath must be discarded according to manufacturer recommendations and local waste management regulations. Any unused, open vaccine is discarded after 24 hours.

All equipment used should be cleaned, disinfected and put away in its proper place (see *Equipment disinfection*)

Fish should be fed the day following vaccination if their behaviour and appearance is normal. Fish should be monitored closely for two weeks following the vaccination procedure for signs of illness. Fresh mortalities should be closely examined and sampled.

4.33.4 ***Vaccination of Chinook Fingerlings:***

1. Order appropriate volume of Vibrogen several weeks prior to carrying out the procedure
2. Starve fish for a total of 3-4 days. Remove fish from feed 2 days prior to vaccination and do not feed them on the day of the treatment. Feeding can resume in the afternoon of the day following vaccination
3. Set the fish pump up to pump fish from pond to fish vaccination tote
4. Suspend a net liner in a large fish tote and run water through the tote

5. Pump fish into the tote using the dewatering part of the fish pump, pumping only enough fish to fill net-liner in tote to approximately 2/3 full
6. Prepare the vaccine at a 1:100 dilution
7. In small 68 L garbage bucket, mix 300 mL of *Vibrio anguillarum* bacterin to 29.7 L of water, for a total of 30 l of solution at a 1:100 dilution
8. Place a net liner, an oxygen supply, and an oxygen meter in the vaccine solution
9. Place the bucket on the 50 kg scale and tare it
10. Using a dip net, add 15 Kg of fish into the net liner suspended in the bucket
11. Allow the fish to remain in the solution for 20 seconds
12. Remove the liner containing the fish and let them drain for 5-10 seconds
13. Pour fish into the trough that empties into the appropriate pond
14. Repeat 20 times for a total of 300 kg fish per 30 L of diluted bacterin
15. Discard used bacterin and prepare a fresh vaccine solution before continuing to vaccinate fish
16. It may be useful to have some diluted bacterin to top up bucket (previous use has found that it was necessary to allow ½ L of bacterin concentrate per 3 bottles to top up the dipping solution)
17. Refer to manufacturer's instructions if above is not clear

Forms & Records

References:
Equipment disinfection
Fish Handling Procedures

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: 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 Procedural Details:

Predatory birds and animals are, from time to time, attracted to the Snootli Creek Hatchery and the Atnarko channels by the presence of holding adults or rearing juvenile fish. During the chum egg take, bear predation can be problematic at the adult capture fence sites.

The most obvious threat is that the predators will kill the adult broodstock and rearing juveniles. However, during rearing, predators moving from one area of the hatchery to another are a concern. We have up to 16 stocks and species rearing concurrently, some from other watersheds, all reared in segregation. By moving between rearing areas, predators have the potential to spread disease.

In general terms, predator control is based on the following strategy:

1. First choice - Avoidance. Do not do things that attract predators.
2. Second choice - Deterrence. Erect and maintain fences, nets and screens to keep predators away. Electric fences may be placed around rearing and holding areas to discourage bears.
3. Final choice - Termination. If all else fails, kill the predator.

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.

4.34.1 *Infrastructure*

The use of predator exclusion devices is critical. In the freshwater environment 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.

The Atnarko Chinook facility is fenced with electric fencing and predator netting is in place.

Coho are reared inside a secure building. Any coho reared outside are protected by mesh covered lids to protect them from otters and mink.

A large predator net is suspended around the sockeye facility and tanks are elevated off the ground.

4.34.2 ***Procedures***

4.34.2.1 General

Facilities are checked daily for signs of predators. Any damage to holding units is repaired as soon as possible. Indicators of predator presence includes water marks, nail marks, beak marks, scat etc.

Feed is stored inside and in the cooler 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.

Keep an eye out for changes in feeding and other behaviours.

Household refuse should be properly contained prior to removal from the site.

Mortalities are be examined regularly for signs of predator attack (See *Mortality Classification*).

4.34.2.2 Avoidance

Only take out as much food from the freezer as you need for the day.

Clean up all spilled or accumulated food from around every rearing container, everyday.

All empty fish food bags are to be put in the dumpster outside the Maintenance Office at the end of every
day.

Dead juveniles and eggs from non Bella Coola watershed stocks are to be disinfected in Ovadine , Bactol or Bleach and flushed down the toilet.

Dead juveniles and eggs from Bella Coola Watershed stocks are to be disposed of in the Exfiltration Gallery.

Adult carcasses are to be returned to the stream of origin.

4.34.2.3 Deterrence

Smaller groups of fish should be reared indoors (i.e. in the Capilano troughs or circular tubs in the Tank Farm or circular tubs in the Chinook Building).

When rearing outside, pond levels should be kept low enough so that blue herons cannot reach the fish, but high enough that so the herons cannot stand in the ponds.

The wire mesh covers should always be used when there are fish in the eagle troughs to keep out otter and mink.

Perimeter netting should be placed around the Sockeye Rearing Facility from the time of ponding to the time of release so that kingfishers cannot access the rearing tubs.

4.34.2.4 Termination

Under the terms of Environment Canada, Canadian Wildlife Service, Permit 59-04-0025, only migratory birds actively engaged in destroying fish stocks at the Snootli Creek Hatchery can be scared and/or killed. Non-migratory birds cannot be disturbed or destroyed. This permit must be renewed annually.

Under B.C. Trapper License RT133958, fur bearing predators can be killed, according to the regulations. The license is held by Fish Enhancement Technician, Lawrence Michalchuk, who has written authorization from the owner of the registered trap-line that includes the Snootli Creek Hatchery Site. This license must be renewed annually.

Wildlife posing a potential threat to work safety, such as bears and cougars, should be reported to the B.C. Conservation Officer Service, at (250) 982-2421.

4.34.3 ***Adult Capture Fences***

4.34.3.1 Avoidance

Clean all carcasses off the fence in the morning after spawning and in the evening after clearing the traps.

Dispose of all carcasses in the main current of the watercourse so they drift well downstream of the trap.

4.34.3.2 Deterrence

A transistor radio hung in a tree near the fence site, left playing loudly, often deters black and grizzly bears. Electric fences operated using a portable generator can be installed around the traps and holding facilities when necessary.

4.34.3.3 Termination

Termination is not an option at the fence sites

In a life or death situation, bears may be killed, provided:

Staff, have completed a “Bear Awareness” course.

Staff have the current certification under the “Firearms Policy for Non Enforcement Officers”.

Staff have a valid PAL as per DFO policy.

Staff have been issued an approved weapon by the Hatchery Firearms Officer.

4.34.4 ***The Atnarko Channels***

4.34.4.1 Avoidance

As at the Snootli Creek Hatchery, only remove as much food from storage as will be needed that day.

Take all empty food bags and all other garbage to the Snootli Creek Hatchery at the end of every day and dispose of it in the dumpster beside the Maintenance Office.

4.34.4.2 Deterrence

Predator netting must be in place over the rearing channels from the time of juvenile transfer from the Snootli Creek Hatchery until the time of release.

The electric fence around the rearing ponds must be turned on whenever the staff is not at the site.

4.34.4.3 Termination

As the site is located in the South Tweedsmuir Provincial Park, predator termination is not an option.

In the event of persistent bird or mammal predation, contact the B.C. Conservation Officer Service, at (250) 982-2421 and B.C. Parks Branch, at (250) 982-2786.

4.34.5 ***Human Safety***

Traps are not placed in areas of public access.

Traps are not set during times when experienced staff are not around to deal with them.

Traps are flagged for human safety.

Traps are checked daily.

Firearms are rarely used, but when they are, the public and uninvolved staff are warned to minimize potential of staff or public injury.

Forms & Records

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.

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:

4.35.1 ***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.

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, should be limited to single sites and is to be disinfected after use.

Staff are separated between those working in the sockeye rearing and incubation and those working with other species and disinfection procedures are followed between different stocks and species.

Personnel travel to and from the other Central Coast hatcheries is minimized.

All personnel adhere to the facility hygiene and disinfection procedures.

Footbaths are used between zones in the hatchery.

Hand-wash stations are used between zones in the hatchery.

Staff does not cross-contaminate different zones of the hatchery (e.g. adult holding and incubation or rearing).

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 unto 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. On arrival, visitors are directed to the main office where a guided tour will be scheduled. No visitors are permitted to tour the facility unattended.

Footbaths and hand wash stations should be placed at critical locations throughout the site and visitors should be expected to use them.

Visitors should be informed not to handle feed, fish or equipment and should be advised to not visit another fish rearing facility within 24 hrs.

Areas holding critical life stages (i.e. incubation rooms) should be off limits, as will any areas holding potentially compromised fish (i.e. broodstock, fish showing signs of illness).

Tours should be conducted following the traffic patterns established to prevent the spread of disease within the facility, i.e. moving from observing the youngest to the oldest fish

All staff and site biosecurity protocols should be followed. (See Site and Staff Disinfection SOP)

Staff and visitor parking areas are removed from fish culture areas and clearly marked with signs.

Designated sensitive areas of the hatchery are off-limits to visitors (including deliveries).

4.35.3 *Supplier Procedures*

Suppliers can transport pathogens from one site to another as they make deliveries and pickups at farm . 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 *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.

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.

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.

All deliveries are made to the front office. Facility staff will unload vehicles. No deliveries are unsupervised

4.35.4 ***Facility Maintenance:***

All rearing and holding units, tanks and other containers should be kept clean and tidy.

All floors in fish holding or rearing areas should be kept clear of non-essential equipment, fish food, dead animals, debris, etc.

Footbaths and hand wash stations should be placed at critical locations throughout the site, notably the entrance and exit points of the incubation and rearing units.

Each enhancement technician is responsible for an area of the facility.

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 by visual inspection and regular scheduled renewal of the product.

Disinfectants are disposed of to the exfiltration gallery or to ground.

Equipment is disinfected after each use and put away in its proper place.

Sodium hypochlorite, iodophor, or formalin are used to disinfect nets, egg take buckets, food pails, mort pails, sampling equipment, Heath trays and incubation baskets, rearing troughs, ponds, crowders, dividers, stop logs, etc.

Equipment is washed between uses and allowed to dry in the sun/outside.

Organic material is rinsed off before using a disinfectant solution.

Equipment is well rinsed with fresh water after it has been in the disinfectant solution.

Equipment that must be used at multiple sites is disinfected between uses.

Large rearing ponds, transport tanks, etc. are pressure washed and left to sun dry until their next use.

Where possible, equipment is not shared between sites or rearing containers.

Equipment is checked regularly for signs of wear and tear (sharp edges, holes, etc.) and repaired when necessary.

Containers are checked regularly for signs of wear and tear (sharp edges, holes, etc.) and repaired when necessary.

Containers are cleaned (power washed, scrubbed, drained, dried) between fish groups.

Screens are checked for fish-proof fit and repaired when necessary.

Forms & Records

References:

Site and staff disinfection and biosecurity
Equipment disinfection
Chemicals & Disinfectants: Supplies and Storage
Quarantine/Isolation Procedures for Suspected Disease Outbreaks
Outbreak – Disinfection Protocols
Outbreak Response
Egg Disinfection

4.36 Water quality monitoring

Rationale: Maintaining good water quality is vital to good fish health. 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: 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:

Water quality management requires the consideration 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.

Tanks are kept clean and water flows are 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 compromise (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:

Ponds are no longer painted as the paint was found to wear off and potentially degrade water quality.

Fish free surface water is used for sockeye incubation and rearing. Groundwater at the Snootli Creek Hatchery and the Atnarko site is free of fish and pathogens.

Groundwater is aerated, via packed column aerators, prior to use.

Surface water that has a natural thermal regime is used to regulate development rates during incubation and for rearing.

Plumbing and containers are flushed prior to use to ensure fresh water for the fish.

Water from different combined sources is thoroughly mixed in 'head boxes' to ensure homogeneity of temperature and quality.

Water quality and quantity are more than sufficient to support the biomass of fish to be held at all times by providing enough oxygen and removing metabolic wastes, as per Shepherd (1984).

Monitoring and recording the quality of the surface and well water only occurs if changes are suspected.

Pond Waters are vacuumed into the Exfiltration Gallery.

Water flows and water quality parameters are monitored manually.

Surface water is gravity fed from Snootli Creek in compliance with the hatchery's Water Use Permit.

Any hatchery effluent that is discharged into Snootli Creek is within the parameters of the Waste Management Act, Land Based Fin Fish Waste Regulation (B.C Reg. 68/94 O.C. 276/94).

Water discharge is screened to prevent accidental release of fish to the environment.

Effluent from the chum ponds, Chinook ponds and sockeye rearing tubs is discharged to the exfiltration gallery.

4.36.1 *Temperature*

Water temperatures are recorded continuously using Vemco temperature loggers and are also measured periodically using a calibrated Brannan England BS1704/L/75 hand held thermometer.

The head box in incubation contains a temperature logger to allow constant monitoring of ATU's and provide a complete incubation profile.

Temperature loggers are also present in the keeper channels.

A temperature recorder is submerged in the Atnarko River pink channel to record ATU's and determine approximate hatch and development stages. Channel sampling is performed when the eggs are eyed but prior to hatch (November) to determine the live eggs, green egg to eyed egg survival, then again later to check eyed egg to hatch survival (January)

4.36.2 *Dissolved oxygen*

Dissolved oxygen is measured twice per week through the use of a handheld Oxyguard meter. Measurements are made at both the inflow and the outflow in straight flow containers. Measurements are made at one location (usually immediately adjacent to the outflow standpipe) in circular tubs.

If levels fall below 8ppm they should be investigated immediately.

The D.O probe is calibrated according to manufacturer's directions prior to each use.

4.36.3 ***Other Parameters***

Flow rates are assessed continuously and are reset or adjusted as required.

pH readings are done infrequently. The Community Advisor maintains a pH meter and can be called on for testing water if it is deemed necessary.

Gas strippers are present at the older wells and also at the keeper channels. The sockeye system is also equipped with gas strippers.

Salinity is measured using a hand held salinometer at the sea pens when they are in use.

Inflow, outflow and rearing water is monitored for oxygen, nitrogen, ammonia and suspended solids.

A visual assessment of turbidity is made and recorded daily.

Form & Records:

References:
Water quality contingency plan

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: 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 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 life stages (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.

Fish should be 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.

Backup generators are on site to ensure power is available in the event of a power failure. These should be tested weekly to ensure they are functioning properly. Backup pumps must be in place and regularly tested.

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 tanks and raceways will quickly exhaust the dissolved oxygen levels in stagnate water. Each hatchery has the capacity to provide supplemental oxygen via air stones in an emergency.

Where water flows and/or supplemental oxygen capacity is limited, our sites have a last ditch option to do an emergency, early release of progeny from native broodstock, thereby freeing up resources for non-

native stocks. This option will only be exercised if the fish in question are have not been showing signs of illness, are not on medication or subject to any medication withdrawal time restrictions.

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 should be quarantined until it is determined that a disease outbreak is not occurring

Details of the Operating Procedure:

Water sources at Snootli Creek Hatchery include surface water and well water. Surface water is collected from the intake below the waterfall and funs through the entire facility as a backup water source. Surface water is also collected from an intake above the waterfall. This source is fish free and is used for sockeye rearing and otolith banding. Backup power sources and pipes can bring alternate water from the river, if needed.

The facility has ground (3.6 cfs) and surface water (5 cfs) available, multiple rearing containers and reliable fish culture experience. Nine wells are on site. These range from water pumping capacities between 50 gallons per minute and 300 gallons per minute.

All vital systems are suitably alarmed to indicate changes in water quality below predetermined set points; e.g., precipitous fall in dissolved oxygen levels.

Low water alarms are present on most containers. Where individual containers do not possess low water alarms, the water source or head tank is suitably equipped.

The head boxes in incubation are alarmed for flow changes to allow rapid water restoration in the event of a failure.

Wells are equipped with audible and visual alarms and alarms that are linked to a pager system for notification.

The Snootli Creek Hatchery Emergency Response Plan, Business Resumption Plan, located in the Maintenance Office, includes provisions to deal with acute deterioration of water quality (Anon, 1999).

If there is a system failure, all efforts are directed to restoring sufficient water for the fish.

If water flow cannot be restored or substituted, the fish may be moved to a more secure site or released into the environment.

The site has backup system(s) for keeping dissolved oxygen levels compatible with short-term life support for the fish while the system failure is being addressed. Sufficient oxygen levels are restored to support the fish by air stones, bottled oxygen, agitation or change in the water supply.

In case of complete power loss, or any other disastrous circumstance, the site will immediately activate the DFO Business Resumption Plan.

Wells are equipped with back-up power supplies at the Snootli Creek Hatchery and the Atnarko site.

Water level alarms are used to indicate low or high water levels in the rearing and incubation containers.

Backup generators are tested approximately every two weeks.

A list of stocks and stages of development is maintained at all times and updated weekly. The list is kept on the alarm panel and identifies locations of the different prioritized groups of fish. This allows staff to prioritize fish in the event of an emergency and allow efforts to be directed towards those that have the least amount of available time before serious consequences are encountered. In general, alevins in Heath trays are of highest priority as they have the smallest head boxes. Efforts must be made to return water flows to these systems quickly.

In an emergency, it may be necessary to direct surface waters to fish that would not otherwise be on it.

Two staff are on standby at any given time.

Forms & Records

References:

Outbreak Response
Euthanasia
Water quality monitoring

Anon. 1999. Business Resumption Plan Site Template for Snootli Creek Hatchery. Fisheries and Oceans Canada: 34 pp.

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 labelled 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 BKD Diagnostics, Interpretation of Results, and Procedures

Progeny segregation (keeping egg lots separate during water hardening, egg disinfection and incubation in Heath trays until testing results from individual parents are complete) and culling will be based on levels of soluble *R salmoninarum*-antigen detected using the Enzyme Linked Immunosorbant Assay (ELISA).

- Fertilized eggs/progeny from females that have an OD value less than the mean OD value (minimum of 9 wells) plus 2 standard deviations of a negative control fish kidney sample are to be reported as 'negative' and may be used for yearling programs or be eligible for transfer to another facility.

- Fertilized eggs/progeny from females with an OD value greater than the mean negative control OD value but less than 0.1 are to be reported as 'low level of detection' and are suitable for yearling programs, but should be reared separately from progeny which are 'below detectible levels' if possible.

- Fertilized eggs/progeny from females with on OD value greater or equal to 0.1 but less than 0.25 are to be reported as 'low positive' and should be released early, as unfed fry to help maintain low levels of *R salmoninarum* within the hatchery and lower the risk of horizontal transmission between fish.

- Fertilized eggs/progeny from females with an OD value greater or equal to 0.25 but less than 0.6 are currently classified as 'moderately positive' and should be outplanted as eyed eggs if suitable rearing habitat is available downstream from the water intake of the facility or buried in dry ground or in wet ground with quicklime if appropriate habitat is unavailable.

- Fertilized eggs/progeny from females with an OD value greater or equal to 0.6 are currently classified as 'high positive'. Eggs testing high positive are considered to be at an unacceptable risk of developing and spreading BKD. It is recommended that these egg lots be buried in dry ground or in wet ground with quicklime.

In situations were escapements are low, or where the escapement BKD prevalence is so high that culling will compromise production targets, or where unexpectedly high levels of incubation mortalities occur, it may be desirable to rear progeny from females testing 'low positive' for BKD by ELISA. The primary consideration will be the ability of the site to protect the progeny of females testing 'negative' and native stocks below the hatchery outflow from the potential spread of *R salmoninarum*. The disease risk assessment must be made in consultation with the DFO fish health veterinarian and site management using the following criteria:

Considerations:

- ***Physical containment***

- Separate rearing units, separate areas with appropriate staff traffic flow, separate water flow, separate nets and equipment with established disinfection protocols, separate dedicated staff, etc.

- Availability of adequate type and volume of water for the duration of proposed rearing
    - Pathogen-free water is preferable

- Effluent management and potential to divert effluent from stream discharge in the event of a disease outbreak.

- Early recognition and mitigation of a problem

    - BKD is a slowly progressing, lifelong disease. Fish infected with *R salmoninarum* will not normally show the classic clinical signs associated with BKD (pop-eye, fluid distended abdomen, white nodules within the kidney, 'rash' or small red, external skin lesions, etc.) until the fish are at least 6 – 12 months old. However the presence of the bacteria will make the fish more susceptible to other pathogens, such as *Flavobacterium psychrophilum* (Coldwater Disease) or *Aeromonas salmonicida* (Furunculosis). For these reasons, staff rearing progeny from females testing low positive will need increased vigilance with regards to early detection and reporting to site management and the veterinarian of any potential disease development.

5.3 Collection of Ovarian Fluid for IHN Virus Assay

Collection of ovarian fluids is carried out during spawning.

Using a sterile transfer pipette, withdraw 2 – 3 mL of ovarian fluid from the container into which the eggs have been spawned. Put the fluid into a sterile, non-breakable, leak proof container. Plastic screw cap test tubes are recommended.

Using a waterproof marker, write the fish number on the container.

The container into which the eggs have been spawned should be cleaned and wiped with paper towel between each fish.

Change pipettes and collect the next sample.

Collection containers (test tubes) must be kept cool at all times.

Containers are put into TWO plastic bags, securely sealed and placed on gel or freezer packs for shipment.

The samples should not be frozen unless shipment is to be delayed for more than 7 days. Keep samples in a refrigerator until shipped.

Keep the shipment cool by using ice or freezer packs.

5.4 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:

_____

_____

5.5 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.

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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 that 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.