Department of Fisheries and Oceans - Salmon Enhancement Program

Big Qualicum River Project

Fish Health Management Plan

Prepared by:
Paige Ackerman, Terry Kyte, Ian Seaton,
Christine MacWilliams and Don MacKinlay

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1 Introduction

1.1 Objective

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

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

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

1.2 Target Audience

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

1.3 Document Structure

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

Section 2 outlines the general principles of fish health management:

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

Section 3 provides a brief overview of this particular facility.

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

Note: The focus of our work is the production of juvenile Pacific salmon for stock enhancement purposes. Netpen holding is limited to a handful of our facilities, which have the infrastructure and historical evidence of improved survival following a brief period of acclimation to a semi-natural environment. Additionally, this production strategy allows imprinting to a watershed for the eventual return in support of recreational fisheries in the areas whose natural spawning and rearing habitats are compromised. Specific netpen practices should be included in the Section 4 SOPs where appropriate. Where indicated, Appendixes are included containing ancillary documents pertinent to the operation of the specific facility.

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

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

1.4 Fish Health Management Team: Personnel duties and responsibilities

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

1.4.1 *Hatchery Management*

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

1.4.2 *Hatchery Staff*

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

1.4.3 *Support Biologists/Community Advisors*

Fisheries and Oceans biological support staff is available for consultation and to serve as a liaison between 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		250-757-8412
Hatchery staff list:		
Grant Ladoucer		250-757-8357
Terry Kyte		250-752-3453
Mike Recalma		250-757-9306
Doug Reid		250-757-8728
Arnold Recalma		250-757-9396
Bryan Recalma		250-757-9632
Lorne Hepting		250-757-5992
George Stringer		250-335-2991
Les Clint		250-757-8942/3
Ian Seaton		250-390-4050
Donny Reid		250-757-8303
Barbara Dunsmore		250-757-8240
Alarm Monitoring company		
Securco		250-248-8280
	or	250-754-2667
Emergency Police, Fire Department and Ambulance		911
D.F.O. CONTACT PHONE NUMBERS		
D.F.O. Community Advisor (Dave Davies)		250-339-0431
		250-703-3270
D.F.O. Veterinarian (Dr. Christine MacWilliams)		250-729-8377
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 buffered 10% polylvinylpyrrolidone iodine (PVPI) solution in water. It may be used to disinfect equipment or fish eggs. Use on fish eggs is currently being monitored by Health Canada.

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. Saprophytes, 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 air stones

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.

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.

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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
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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
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

Big Qualicum employs a number of natural and artificial enhancement techniques to increase populations of Pacific salmon and steelhead trout. It was the first of the modern enhancement projects to be undertaken in this province and has provided a model for other developments. Research and assessment of this facility have increased the scientific data available on salmonid behaviour, life cycle and habitat requirements. And not to be forgotten is the annual landed value of over $10 million to the commercial and sport fisheries. The hatchery also provides an important source of fish for the native food-fish program and countless hours of enjoyment for the recreational fisherman.

The Big Qualicum River is a typical coastal stream. From its source at Horne Lake, the river flows approximately 11 km (7 mi) to the Strait of Georgia. All species of Pacific salmon return to Big Qualicum as do steelhead and cutthroat trout. Chum represent the highest production followed by good populations of coho and chinook.

During the fall and winter, adult salmonids returning to the Big Qualicum are counted as they pass through the fence. Their offspring are also counted as they swim downstream to the ocean in the spring. The spawning and rearing area in the river is limited, therefore the number of spawners is controlled at about 100,000 chum, 10,000 coho, and 1,000 chinook. If there are more, the fence is used to divert them. It also aids in capturing hatchery brood stock.

4 Standard Operating Procedures for the Big Qualicum Salmon Hatchery

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

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

Broodstock & Spawning

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

A female 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:

Species collected for broodstock at Big Qualicum hatchery include: pink, Chinook, coho and chum salmon, and cutthroat trout

All fish are collected via swim in, no fish are seined. Access to the pond is opened when the fish start to move into the river.

4.1.1 *Sorting fish for broodstock selection*

1. Remove V-notch weir
2. Drop the flat panel in so the crowder can be moved past it
3. Set up the sorting system
    a. Three ponds are prepared for use in sorting
    b. Pond 3 is used for initial capture. Fish are sorted out of this pond into ponds 1 and 2
    c. Fish are sorted into ponds 1 and 2 according to species and sexual maturity

4. Fill anaesthetic tank with freshwater and charge the system as outlined in the *Anaesthesia* SOP
5. Ensure all gear is in place and all equipment has been tested (counters, buckets, elevator, brailer, R9500 tested etc)
6. Using the power crowder, push the fish down towards the brailer (down flow)
7. Crowd an appropriate number of fish into the brailer
8. Lift fish into the anaesthetic bath using the brailer
9. Monitor the oxygen levels in the crowded area during sorting. If the O2 meter indicates lowering oxygen levels, slide the crowder back to allow the fish room to spread out and reduce their densities.
10. Fish are left in the bath for 2.5 – 3 minutes until they are easily handled (fish will generally succumb faster at the beginning of the sort).
11. If necessary, the CO2 delivery may be increased after one hour of sorting if the fish are succumbing too slowly.
12. CO2 levels in the bath are not monitored continuously, therefore careful observation of fish is required at all times
13. When the fish are at a stage that they may be easily handled, Raise the brailer and to the level of the sorting chute and deliver the fish to the sorting table
14. Sorters assess the fish for degree of ripeness and may be sorted into the river, into ponds 1 and 2 for brood by species and sex, into surplus for the First Nations ESSR, or killed for gamete collection

4.1.2 *Rejection of fish as broodstock*

Fish will be selected primarily based on species and sex. Jacks are not selected against and no size selection occurs. Fish with obvious signs of disease are not selected as brood stock and may be killed or returned to the river live

4.1.3 *Surplusing Decisions*

The First Nations members would like to receive a proportion of the early, bright fish. Big Qualicum will attempt to meet their surplus requests for Chinook and coho salmon whenever possible. However, if the target production is deemed unlikely to be met, fish may not be surplused. Estimates of fish numbers likely to enter the system are based on the test fisheries and on sports fishers success.

Due to timing and potential holding limitations, a large proportion of the early run Chinook are surplused to the First Nations. Most of the mid run fish are kept and much of the late run fish are also surplused. It is possible that this may have genetically eliminated a component of the early run and late run fish through these actions.

4.1.4 *Run and gamete collection timing*

Pinks: Pinks begin to arrive near the beginning of September and gamete collection will commence approximately 1 week following.

Chinook – Chinook are collected between early September and mid November. Fish are spawned and gametes collected between early October until approximately the middle of November.

Coho: The coho begin to arrive at the facility near the completion of the Chinook program and egg takes will commence when the Chinook egg takes are ending. This is roughly near the latter part of November.

Chum: Chum are the last group of fish to enter the facility and generally begin to arrive around the same time as the coho arrive. Early chum are granted access to the river and are counted into the river as they pass over the weir. When the numbers of chum increase and a large movement of fish begins, the spawning channel will be prepared and loading will commence. The appropriate diversion fence will be opened. Chum are not handled unless a special request for eggs or data such as fecundities or lengths are requested.

4.1.5 *Adult handling and sorting - oxygen injection system*

The Oxygen injector system is located at the outflow of Raceway three, adjacent to the brailer/clam/fish lift.

During sorting procedures every effort should be made to maintain oxygen at ambient levels (fresh unused river water 9 to 10 ppm).

The system consists of the following;

Point Four Systems vented pressure column complete with the following;

- Water flow gauge (G/min)
- Oxygen flow meter (L/min)
- Pressure meter (PSI)
- Water level site glass
- Ten horse-power high pressure pump (2 inch three phase)
- Control valves to regulate flow of saturated water to diffusers located at downstream end of pond and on the fish crowder
- 100 feet of two inch delivery hose (quick coupled at both ends).
- PGS -45 Liquid oxygen cylinder, c.w. flow meter & heater

Operating Procedures;

1) Start-Up

In order to prevent water from feeding back and blocking the oxygen supply, flow meter at column must be fully closed during initial start-up

1. Prime the pump
2. Connect 1.5 inch red wash down hose to quick connect at pump drain
3. Open the drain valve and prime until water flow gauge reads at least 50 GPM and all bubbles have been discharged from the system
4. Fully close the drain valve & turn pump switch to on position
5. Close valve to wash down line

6. Check to ensure that pump is functioning, if not, repeat priming procedure
7. Open flow meters at oxygen bottle and at pressure column (initial flow rate setting at between 20 and 40 L/min. Stabilization takes 10 - 15 minutes
8. Ensure that oxygen heater is functioning and pump remains primed

Balance the flows as follows;

Site glass should read between half and three-quarters full. Fine tune by adjusting oxygen flow rate as follows. Read level at site glass – to decrease level, increase oxygen flow or reduce oxygen flow to raise water level. Maintain pressure at 40 to 50 psi

Note: The above readings assumes that both diffuser supply line valves are fully open. Increasing the flow of oxygen forces a portion of the water out of the column and vice-versa. In order to function properly the column must not be filled more than three-quarters with water (one-quarter pure oxygen in top section). This reading is taken from the site glass mounted on the column.

During normal sort procedures, the person responsible for operating the fish lift and brailer should also monitor flows and levels at the oxygen injector and make any necessary adjustments.

SAFETY: When using liquid oxygen there is a risk if fire or explosion. Venting of pure oxygen at both the column and at the cylinder will occur as pressure and/or temperature increases. The general public has access to the area adjacent to the column and cylinder but do not adhere to the posted warning signs. Hatchery staff should politely request that visitors stay clear of the area and adhere to the “no open flames” posting.

2) Shut down

1. Switch pump off and open drain valve (risk of freezing temperatures).
2. Disconnect 2 inch flexible supply hoses at quick couplings.
3. Starting at one end, elevate supply hoses & allow all water to escape.
4. Close valve at liquid oxygen cylinder and flow meter at column.
5. Disconnect electric cable to oxygen heater.
6. Place cover over top of cylinder.
7. Check liquid oxygen level – order more as required.

Notes: Prior to installation of the oxygen injector system, it was not uncommon to detect oxygen levels as low as 4 or 5 ppm. at the downstream end of the pond while crowding adult salmon.

When the system is working to its full potential it is possible to elevate oxygen levels to 20 ppm and higher

The system is also useful as an aid in attracting adults into the pond. When upstream migrating adults sense a decreased oxygen level they will simply stop moving. Oxygen levels can be brought back to acceptable levels by operating the injector and diverting all outflow into the fishway, thereby triggering a fresh influx of adults into the pond.

In the event that the PGS-45 liquid oxygen cylinder runs dry and a fresh one is not immediately available, it is possible to operate the system with the standard sized bottles for a short period of time. A standard sized bottle will only last about 30 minutes while the large liquid cylinder is good for about one month of normal sorting procedures.

Forms & Records:

Big Qualicum River Adult salmon enumeration form (fence)
Big Qualicum hatchery Adult salmon enumeration form
Escapement forms
CO_2 anaesthetic bath form
Sort sheets
EnPro


ESC_SAMP.XLS

4.2 Spawning channel loading

Rationale: Adult chum are loaded into the spawning channel at densities that are determined to maximize the productivity of the channel. This SOP addresses section *2.2.9* 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. Facility 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 spawning channel should reflect the proportion in the population.

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

Details of the Operating Procedure:

The fence is installed when the chum are seen in the river. This may be as early as late September. Most of the early chum are loaded into the river for natural spawning. The channel will not be loaded until numbers are seen that indicate that the run is reaching its peak. This is because the early run tends to have a predominance of males and proportionally fewer females.

When all spawning activity has been completed, the fence is removed. In general the fence is kept in place between late September and June/July

Fish are counted at the counting shack at the most downstream section of the fence. There is another counting shack and fence downstream of where the channel and river split. Chum may be counted in at the lower structure and the fish will be allowed to go up the river at fence 280.

Alternatively, the 280 fence may be closed and the spawning channel opened. If staff is limited, count at the second channel.

The channel is divided into three sections, each with a diffuser and a divider structure. Up to 30,000 adults will be loaded into the entire channel (roughly 10,000 fish in each section is targeted)

Once the channel has been loaded, the balance of fish are allowed to enter the river to spawn naturally. This will be capped at a reasonable number – the maximum load to river is approximately 100,000.

Chinook and pinks are also counted into the river, but the spawning channel is not opened to them

Forms & Records:
Big Qualicum River Adult salmon enumeration form (fence)

4.3 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:
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 brailed out of the anaesthetic bath with the existing lift system and assessed for 'ripeness'. If antibiotics have been prescribed by the Veterinarian, they may be injected at this point.

Details of the Operating Procedure:
Fish are crowded to make brailing easier. Crowding of fish in the ponds is by a power crowder. The duration of crowding and the density is kept to the minimum amount of time possible and oxygen in monitored during crowding to ensure densities are not resulting in oxygen depletion and detrimental conditions to the broodstock. No nets are used for broodstock handling, all handling is by automatic power crowder, brailer and manual handling at sorting. Wool gloves may be used to increase the grip on fish when they are being sorted

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 anaesthesia and handling events, fish are monitored for signs of injury, morbidity and mortality. Mortalities are removed on observation.

If a fish is determined to be ripe and an egg take is in process, the fish will be euthanized by a sharp blow to the head. 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.

Depending on the species and sex of fish sorted, a proportion may be sorted to the ESSR or the river

Forms & Records:
Big Qualicum Hatchery Dead pitch form
Holding pond dead form
References:
Anaesthesia
Fish Handling Procedures

4.4 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:

Broodstock biosecurity is restricted to the following steps that are in place to reduce stress and maintain quality holding conditions

Oxygen levels are monitored in the holding ponds. If oxygen levels are lower than desirable (i.e. no lower than 7 mg/L) flow rates may be increased or the oxygen injection system may be activated (see *Adult handling and sorting - oxygen injection system)*

Flow rates in the holding ponds will be maintained between 10 cfs and 20 cfs

If any pathogenic problems appear to be on the rise (ex. *Ichthyophthirius*) temperature may be manipulated by mixing cooler water from deeper in the lake into the flow. Temperature can be reduced by 2-3 degrees if required.

Dedicated adult holding equipment is used during broodstock holding periods. This equipment is not used with any other life stages and is clearly identified for use with adults only. However, there is no

segregation of equipment between adult holding ponds. There is significant water seepage between holding ponds, thus cross contamination is always in occurrence.

The concrete ponds are used for both adult and juvenile life stages. The ponds are drained and pressure washed between life stages. After cleaning they are left empty and are disinfected via drying. The period of drying between adult and juvenile stages is approximately 2.5-3 months.
Adults are separated in the holding ponds according to species and sex and degree of maturity. More than one species may be maintained in any one pond if it is possible to sort both above and below the crowder in place in the pond.

Mortalities are removed using a gaff hook. No nets are used for adults.

Public access is restricted from holding ponds 1 and 2 to reduce stress on fish in those enclosures.

Fish will be allowed a minimum of two weeks prior to sorting. This allows the fish time to reach sexual maturity. Ripeness sorts will begin thereafter and will be performed on a weekly basis

Forms & Records:
Inventory and location records
Dead pitch form
Holding pond dead

References:
Site and staff disinfection and biosecurity

4.5 Fecundity and Egg Retention Determination

Rationale: Determination of fecundity allows an estimation of egg deposition per female. These data allow a more accurate estimation of environmental requirements of developing eggs and fry in the channel prior to out migration. The goal of this SOP is to estimate average fecundity of sockeye females.

Authority: The information contained within this SOP will only be revised by the Fish Health Management Team. Facility 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:

4.5.1 *Fecundity Determination*

1. When sorting fish, a random sample of female fish are selected for calculating fecundity
2. Randomly select 100 females of varying lengths that are representative of the population throughout the run (see the annual sampling plan for species sampling requirements)
3. Fish are killed by a sharp blow to the head
4. Measure and record post orbital hypural length for each fish
5. Once all fish have been collected and measured, cut open the belly of each female using a spawning knife
6. Remove all eggs into a plastic bucket
7. Label each egg bag with the female number and length
8. Record sample ID and fish length on data sheet
9. Dispose of carcasses to the compost pile
10. Tare an empty bucket on a scale
11. Pour the eggs from one bucket into the zeroed bucket and record the total weight
12. Weigh out a 100 g subsample of eggs from the weighed container
13. Record the 100 g subsample weight
14. Zero a hand counter
15. Pour the eggs out onto a smooth surface and count using a hand counter
16. Record the number of individual eggs in the 100 g subsample
17. Back calculate to determine the number of eggs in the female (the entire bucket of eggs)
18. Repeat for each female
19. Eggs may be placed into the production incubators or planted into the river or channel gravel to supplement production

4.5.2 *Egg Retention*

Over the period that fish are present and spawning in the channel, 125 female fresh carcasses are removed and checked for egg retention (see the annual sampling plan for exact requirements of species and numbers of fish). Egg retention will be assessed over a 2-3 week period.

1. Select up to 25 female mortalities per day from the diffusers for egg retention assessment. Females are collected equally from each of three sections of the channel.
2. Measure post orbital hypural length and record
3. Using a spawning knife, cut selected females open and remove all eggs into separate containers
4. Using the egg retention scoop (a modified coffee measure scoop with a 6" handle) remove the eggs from the container, recording how many scoops of eggs are in each container
5. If there is a greater number of eggs than can be contained in the scoop, the egg retention is calculated from historical data on the average number of eggs the scoop may contain (243 eggs per scoop)
6. If there is less than one full scoopful of eggs, manually count the individual eggs and record the number in the data sheet
7. Record these numbers in the egg retention data sheets and classify selected females as percent spawned (0%, 25%, 50%, 100%)

Forms & Records
Numbers and fish length
Fecundity data sheet
Egg retention sheets

References:
Euthanasia

4.6 Adult Carcass Disposal

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

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

Details of the Operating Procedure:

Carcasses are predominantly disposed of to a mort pile on land. Carcasses are mixed with sawdust and turned frequently with a backhoe to generate compost. The compost is provided to community residents free of charge. Users are required to check in at the office and are requested to call ahead to set up a time for compost removal.

Carcasses may also be surplused to the First Nations ESSR. The First Nations will provide totes and carcasses will be placed in them for removal by the FN.

Carcasses may be placed into their natal streams to provide nutrient enrichment according to the DFO Carcass Placement Guidelines (see Appendix). This use is permitted under the authority of the intergovernmental Introductions and Transfers Committee. Some carcass placement in stream systems within the watershed is performed by local volunteer groups as directed by the Provincial Government. All permits must be in place prior to removal of these carcasses from the site. Placement is predominantly performed with chum carcasses.

Because of drug clearance times, and the length of holding, fish previously treated with an antibiotic or anaesthetic must not be used for carcass placement. However, fish treated with external chemicals that do not require a withdrawal period (e.g. Parasite S or Chloramine T) are considered safe for placement. If in doubt, contact the Fish Pathology Program at PBS.

Forms & Records:

Dead pitch form
Holding pond dead

UPSTREAM.XLS

References:

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

4.7 Gamete Collection (Egg Take and Milt Collection)

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

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

Details of the Procedure:

4.7.1 *Prior to gamete collection*

All necessary equipment should be cleaned with warm water, and dried before and after use.

All necessary transport/transfer permits should be in place. Gametes being transported between Big and Little Qualicum do not require a permit as the populations arise from the same originating stock.

Disease screening is not common at this facility, but in the event that samples are to be forwarded to the Biological Station for analysis, Lab personnel should be contacted to ensure they know of the workload on the way and to avoid conflicts and shortage of assistance.

Egg Take Equipment Checklist

- □ Clubs
- □ spawning knives
- □ buckets
- □ lids for buckets
- □ ice packs or ice (if warm)
- □ tally counters
- □ Oxygen meter
- □ Oxygen regulator
- □ Oxygen cylinder
- □ tote for milt bags
- □ Gloves
- □ Water hose
- □ hanging rack
- □ tailers
- □ Whirl-pak bags
- □ paper towels
- □ data recording forms
- □ ice chests
- □ CO_2 cylinder and regulator
- □ Sodium bicarbonate
- □ bleeding knife

Fish are crowded into the anaesthetic tank and anaesthetized and sorted according to the Anaesthesia SOP and the Broodstock Selection SOP

4.7.2 *Female fish:*

1. Ripe females are killed by a sharp blow to the head and placed onto the pre-hang table
2. The gills are cut using a sharp knife and a tailer is placed around the fish's peduncle
3. The fish is hung on the hanging rack to bleed.

4. Fish are rinsed with water using a hose and allowed to dry of excess moisture out of the sun
5. Each bleeding rack will hold up to 40 fish. At any sort, a maximum of 80 females will be killed for spawning prior to egg removal occurring
6. A record of female numbers stripped is kept to ensure enough males are spawned for fertilization. Male and female fish are counted and checked through the R9500 counter.
7. The fish should be handled in an inverted position until it is ready to be incised for egg removal.
8. Each female is, in turn, removed from the hanging rack and turned into a head up position by the handler
9. The fish is carried to another person who is stripping the fish. This person cuts from the vent towards the head, using a disposable zak-knife, cutting to the side of the pelvic girdle
10. The eggs are collected into clean dry basin and then poured into individual clean, dry one gallon ice cream buckets
    a. Chinook eggs from one female are collected into each bucket
    b. Coho eggs from up to 3-5 females are collected into each bucket
11. Place the lid on the bucket and place out of the sun
    a. Fertilization takes place at the incubation site no more than 2 hours after the egg take). Not put into a cooler or a tote. May be put into the back of a truck under a canopy. Move to incubation sooner if the day is warm. May put them in a cooler to maintain temperature if the day is too cold and there is a risk of freezing

4.7.3 ***Rejection criteria***

Discard any eggs:

- with abnormal appearance
- from females that have cloudy ovarian fluid
- from females with obvious signs of disease
- that are water hardened
- with a heavy incidence of broken eggs
- that display obvious contaminants
- that show excessive bloodiness
- from fish with any kidney abnormalities
- from fish with any obvious internal signs of disease

4.7.4 ***Male Fish:***

During sorting, males are checked for ripeness.

Males are not euthanized for stripping and are not generally used for more than one spawning unless there is a shortfall, which may occur near the end of the season.

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 is be collected into a sterile Whirl-pak™ bag that is held away from the body to ensure that no moisture or contaminants from the external surface of the fish enters the bag.

When the bag is closed, ensure that an amount of air has been captured in the bag such that the bag is not compressed. This will ensure that the sperm has adequate oxygen.

Whirl-pak bags are placed into a cooler containing ice packs or a frozen bottle of water.

Milt from only one male will be collected in each bag

Any milt with abnormal appearance, or containing blood or feces, should be immediately discarded. Males with obvious external signs of disease will not be used for milt collection

Males used for milt collection are directed down a chute on the sorting table and are killed by suffocation in a tote (coho are counted and checked for tags using the R9500 detector).

Forms & Records:

Egg take form Incubation summary sheets

INCUBATN.XLS

References*:*

Broodstock Handling

Egg and Milt Transport

4.8 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 containers and may be topped with oxygen. The containers 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 should be followed by the staff member transporting the eggs.

Details of the Operating Procedure:

Gametes are transported within the site from the egg take area at the sorting shed to the incubation facility 7 km up a private, onsite roadway.

Gametes are also transported to Big Qualicum incubation facility from the Little Qualicum facility which does not have any incubation facilities

Eggs are transported in clean plastic ice cream buckets that are kept in the shade at all times and transported in totes in the bed of a truck under a canopy. Milt is transported in Whirl-pak bags placed in an ice chest that is kept cool and out of the sun at all times.

No disinfection protocols are employed within or between the two facilities with respect to egg and milt transport. Hygiene is maintained, but no disinfectants are utilized.

Forms & Records:

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

References:

Gamete Collection (Egg Take and Milt Collection)
Federal-Provincial Introductions and Transfers Committee web page

Incubation

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

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

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

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

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

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

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

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


Predictions for egg development.pdf

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


IncubWin:Predicting Embryonic Stages

4.9 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:

1. Buckets of eggs and Whirl-pak bags of milt are mixed on a one to one ratio on reaching the incubation facility.
2. Several buckets of eggs are laid out on a steel cart. The lids are removed from each bucket and one bag of milt is added to each and mixed gently by hand.
3. Each bucket is allowed to sit undisturbed for approximately 2 minutes (approximately the time it takes to get to the end of the buckets on the cart) Process 20 – 30 buckets of gametes in sequence then go back and deal with them in the same sequence
4. Pour the contents of each processed bucket of eggs into a larger 5 gallon pail to combine
5. The rim of the 5 gallon pail is submerged into the water in an empty bulk incubator to cover the eggs with clean fresh water.
6. The water is decanted to rinse the eggs of any foreign material, blood, mucus, broken eggs etc.

7. This is repeated until the water is clear and free of debris
8. The eggs are gently poured into the appropriate bulk incubator box
    - Large bulk boxes hold approx 500,000 Chinook eggs.
    - If a smaller lot is being processed the eggs may be placed into a smaller Atkins box which will hold approximately 150,000 chinook eggs
    - Bulk incubators should not be loaded over more than a two day period to avoid shocking the eggs unintentionally

9. Eggs are held in bulk incubators until they are shocked and picked. Following picking, eggs are enumerated into Heath trays where they are incubated until ponding. See *Egg Shocking, Picking & Egg Enumeration*

Forms and Records:

ATU development chart
Egg take forms
Incubation summary


ATU Chart.xls


INCUBATN.XLS

References:

Error! Reference source not found.

4.10 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 ***Error! Reference source not found.*** 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 fungal treatment program is determined by the Fish Health Management Team. 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 L = 1.67 mL/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.

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

$$\text{Volume of Perox-Aid per litre} = \frac{\text{recommended dose}}{\text{active ingredient}}$$

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

$$= 143 \text{ ml Perox-Aid per litre}$$

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.

Cautions: Health and first aid information - Quick reference only – see MSDS for detailed version

Inhalation – if patient is breathing, apply artificial respiration and, if qualified, administer oxygen. Keep patient warm. Call a physician immediately.

Ingestion – call a physician immediately. Wash mouth out with water. If patient is conscious give water freely to dilute chemical, induce vomiting – repeat.

Eye contact – call a physician immediately. Rinse eyes with a gentle stream of water for at least 15 minutes.

Skin contact – wash for at least 20 minutes with soap and water. Remove and wash contaminated clothing. Call a physician if irritation persists.

Conditions to avoid – heat – sparks – open flames. Freezing – high and low temperatures – exposure to direct sunlight.

Employee protection (mandatory)

Respiratory – NIOSH approved respirator.
Eye protection – chemical goggles. Eyewash and safety shower must be provided.
Protective clothing – PVC gloves and apron.

Control measures – (in case of spill) - Wear protective gear as described above. Dike with soil or absorbent material. Place sorbent in approved waste container and comply with federal disposal regulations.

Details of the Operating Procedure:

4.10.1 ***Parasite-S egg fungal treatment***

Eggs are treated for fungus while in bulk boxes. Treatment is applied three days per week (Monday, Wednesday and Friday) with Parasite-S

An enclosed system is utilized in such a manner that the chemical is never handled directly. A remote control trigger system employs an electric pump (installed on the chemical drum and enclosed in a separate room inside of a spill containment system) to deliver the chemical through via a system plumbed to a small carboy above each bulk incubator

The chemical is diluted in the same carboys by adding a known volume of water and a emitter on the bottom of each carboy delivers the treatment at a known volume over a known period to ensure a correct concentration for the duration of each application

Dose: Eggs are treated with 1667 PPM of Parasite-S for a 20 minute flow through period

Always wear appropriate personal protective equipment (gloves, respirator and full face shield) Eye wash station and a means of flushing skin must be readily available when using Parasite-S

Notes:

- Drip rates from carboys are controlled with pre-set regulators
- Check drip rate at least weekly (set timer for 20 minute duration)

Calculation

$$\frac{\text{Flow (L/min)} \times \text{concentration (1667 ppm)} \times \text{duration (20 min)}}{1{,}000{,}000} = \text{total A.I. Parasite-S (L)}$$

$$\text{Ex. } \frac{55 \text{ L/min} \times 1667 \text{ ppm} \times 20 \text{ min}}{1{,}000{,}000} = 1.834 \text{ L Parasite-S}$$

Bulk boxes – flow 55 L/min = 1.834 L Parasite-S per treatment
seven sets of boxes = 12.84 L per full treatment
two treatments per week = 25.67 L per week

Atkins cells - flow 30 L/min. = 1.002 L Parasite-S per treatment
12 sets of cells = 12.024 L per treatment
two treatments per week equals 24.048 L Per week

Combined (Atkins and bulk) per week = 49.718 L Parasite-S

Barrel of Parasite –S = 200 litres
If all incubators were loaded, barrel would last 4 weeks

Note: most facilities set their initial flows at approximately 65% less than for advanced egg development stage. At Big Qualicum we go straight to full flows as shown below. However it may

become necessary to reduce initial flows if observations indicate "tumbling" of eggs during the early development stage.

Desired concentration = 1667 ppm Duration (exposure to drip) = 20 minutes

Bulk boxes

advanced flow rate 55 L/min
1.667 x 55 = 91.685 x 20 min. = 1.834 litres A.I.

Atkins cells

a) for one pair of cells (in series)

advanced flow rate 30 L/min
1.667 x 30 = 50 x 20 min. = 1.0 litre A.I.

b) for two pairs of cells (2 pairs each in series or 4 cells)

advanced flow rate (each) 30 L/min
1.667 x 30 = 50 x 20 min. X 2 = 2.0 litre A.I.

Setting drip rate from carboys

Note: due to the location of the spigot, carboys will not completely drain. One litre will be left in container after each treatment. This is not a problem so long as residual Parasite-S is flushed with fresh water if no treatments are to be performed for more than one week. Carboy graduations are shown in litres. Delete one litre from indicated level when adding stock solution.

Setting drip rates

Drip rates are based on a 20 minute exposure
Stock solution is 50% - pre-mixed in barrel

1) Atkins cells
   Each carboy is set up to supply treatment to four cells (two pairs in series). The drip rate is split with a "y" fitting and flows are controlled with emitters. It is recommended that one valve be closed when treating just one set of cells.

   one pair of Atkins cells;
   1.0 L A.I. and 1.0L Water = 2 L Stock solution over 20 minutes
   Set drip rate at 100 mL per minute

   Two pairs of Atkins cells
   2.0L. A.I. and 2.0 L Water = 4 L Stock solution over 20 minutes
   Set drip rate at 100 mL per minute for each pair and maintain for 20 minutes

2) Bulk boxes
   Each carboy treats two boxes in series, flow is controlled in the same way as for Atkins cells.
   1.667 L A.I. and 1.667 L Water = 3.7 L of stock solution x 20 min.
   Set drip rate at 185 ml. Per minute

4.10.1.1 Pre-mixing and delivery to incubation site

1. All transfers and distribution of stock solution must be done through the use of a chemical pump designed specifically for Parasite-S
2. Use approved barrel lifting device to load barrel onto pick-up truck
3. Secure barrel to bed of truck and deliver to incubation site
4. Re-install chemical pump, hose and nozzle onto incubation site barrel
5. Ensure that all fittings are secure and drum vent is closed

4.10.1.2 Transfers to distribution system

All doors are opened to provide adequate ventilation. This procedure is performed just prior to leaving the building at the end of the day

1. Open breather valve on 40 gal. barrel of stock solution.
2. Using the remote chemical pump, control the on off switch on the Parasite-S delivery pump
3. The treatment line is hard plumbed to each of the individual carboys through a pressure reduced valve and a check valve
4. Turn spigot on bottom of each carboy to the closed position
5. The appropriate amount of chemical to be delivered into each carboy is marked by volumetric lines directly on the carboys
6. Open the filler valve to the first carboy to allow Parasite-S to enter and fill to the bottom line on the carboy. Close filler valve, and remotely turn off pump

There are two lines on each carboy for Parasite-S delivery – this is because the spigots are higher than the bottom of the carboy and some remains. Each subsequent treatment requires filling to the second line to ensure proper deliver concentration

7. Add clean water to the appropriate marked volume in each carboy (second – top – mark)
8. Repeat this set of steps for each supply carboy that must be filled (for each set of active incubators)
9. Switch chemical pump to “off” position promptly when finished filling all of the carboys
10. Wash down the floor in the treatment area
11. Open the main spigot at the base of each carboy
12. Check to ensure that the flow of chemical is reaching the incubators
13. Flows are pre-set to deliver treatments over a 9 minute period Even a small amount of debris will disrupt the flow through the special emitters. Routine flow checks should be performed at least once each week (more frequently during periods of heavy debris loads) (use a graduated cylinder and time to check flow rate) Clogged emitters must be cleaned or replaced
14. Visually inspect each carboy to ensure all drips are flowing

15. Vacate the building as soon as possible after distributing the chemical treatment
16. Store unused portion of chemical at walk in cooler at lower site
17. Repeat the treatment on Mondays, Wednesdays, and Fridays (or as directed by the Veterinarian if fungus is evident)

Forms & Records:
Treatment records
References:
Parasiticides and Fungicides: *http://www.syndel.com/d_p_f_s/parasiticides_fungicides.html*
Parasite-S™ data sheet: *http://www.syndel.com/d_p_f_s/parasite-s_info_sheet.html*

4.11 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:

4.11.1 ***Egg Shocking:***

Eggs are shocked when they are strongly eyed

1. Eggs are dipped out of the bulk incubator using a small net
2. Eggs are placed into a 5 gallon pail and carried to the shock box
3. The pail of eggs is poured through a Buzzle Box that is set above the shock box (a bulk incubator on wheels)
    - The Buzzle Box is a an early egg sorter that consists of a series of baffles the eggs bounce down. The eggs exit the box at a steep angle and each egg is known to be shocked equally through this method
4. Eggs are allowed to rest overnight (12-24 hrs) prior to being picked, enumerated and inventoried into Heath trays

4.11.2 ***Egg Picking:***

An automatic egg picker (Jensorter) is used to remove dead eggs.

Set up the egg picker according to the manual (see attached file)

If further egg picks are required, they will be carried out manually using a bulb suction picker. This will be carried out prior to transfer to Heath trays ad prior to ponding.

4.11.3 ***Egg Enumeration:***

Following picking, eggs are enumerated by subsample

1. Place a small container on the Mettler scale and zero the weight
2. Using a small, fine meshed dipnet, remove a small subsample of eggs from the live egg container and place them into a small weighboat on the scale container until the scale reads 100 g
3. Pour the eggs onto a smooth surface or the perforated plexiglass board and manually count all of the eggs in the 100 g sample
4. Record this number in the incubation summary sheet
5. Repeat steps 2 and 3 an additional two times (perform the egg weight sub-sampling a minimum of three times)
6. Return the eggs to the live egg container
7. Zero a large container on the scale and pour the eggs from the live egg container into it
8. Record the weight in the incubation summary sheet

Repeat steps 1-8 for the eggs in the dead egg container and record the number and weight of dead eggs on the dead egg sample sheet

Forms & Records:

Incubation summary
Dead egg samples sheet

JH Operating Instructions.doc

References:

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

Shock sensitivity in eggs.pdf

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

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

4.12 Ponding

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

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

Details of the Operating Procedure:

ATU's are monitored as a rough guide to determine approximate development and preparedness for ponding.

1. When the fry are assumed to be prepared for ponding, take a sample will be removed using a clear graduated beaker.
2. Hold the beaker up towards a bright light and examine the bellies of the fry to determine the degree of buttoning up.
3. Samples will be taken from several trays.
4. If approximately 90% of the fry are buttoned, they are deemed to be ready for ponding.
5. If the fry are prepared for ponding as determined above, they are moved to the lower site.
6. Position the portable Heath stack near the permanent stack of trays and place the flowing hose of water in the top
7. Remove Heath trays from the stack, starting at the bottom, and place them in the portable stack
8. Position the transport truck and tank outside the loading door
9. Fill the transport tank with water and turn on the oxygen and air flow to the container (The oxygen stone is positioned on one side and an air stone lies along the other side of the tank. This generates a water circulation)
10. When the portable stack is full, remove the water hose and roll the stack to the loading door
11. Using the forklift, lift the portable stack up to the truck and transport tank positioned outside
12. Position two people on the transport truck. One person will raise the transport Heath Stack out of the trailer while the other loads it
13. Lift each tray out of the portable stack and place it in the transport stack, starting at the bottom
14. When the transport stack is filled, lower it fully into the tank and push it to the back so that another may be positioned in front of it. (there are four racks per tank)
15. Close the lid of the tank and latch it securely

16. Fill the second truck/tank if using
17. Ensure that there are two people in each truck during the transport. One person is the driver, the second will monitor the dissolved oxygen levels in the tank during the transport. Levels should be maintained not lower than 10 ppm and not above 15 ppm
18. Drive to the lower site (7 km, approx 10 minutes)
19. On arrival at the appropriate rearing enclosure at the lower site, the driver parks as closely as possible
20. One person stands on the transport tanks and lifts one rack at a time out of the tank
21. Another 3-4 people carry trays and pond fry into the ponding tub
    a. The ponding tub is a shallow tub with smooth sides and water flowing into it. It has a pipe running out the bottom and a small short standpipe to retain some water. The fry flow from the ponding tub into the intended enclosure (raceways or channel)
    b. When all of the trays have been emptied into the ponding tub, pull the standpipe at the bottom of the tub to flush any remaining fry down the pipe and into the pond

Fry may be started in circular tanks when numbers are low and fish are more precious (i.e. coho). This reduces unaccountable loss due to predation (an expected unaccountable loss from fry to 2-3 g in earthen channels is approximately 10%). Fry are reared in these containers until they reach a density of 8 kg/m^3 (coho) of 15 kg/m^3 (Chinook) before they are thinned into Burrows ponds. Fry will be thinned once more at marking when they are relocated to the earthen channels. When marking commences, initial focus for thinning should be on those containers with the highest density.

Forms & Records:
Cumulative mortality sheets
Daily mortalities sheet

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


Containers and Loading.pdf

Big Qualicum Hatchery Rearing and transport containers, volumes and loading rates

Rearing

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

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

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

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

4.13 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

4.13.1 ***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.

4.13.2 ***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)*

4.13.3 ***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. 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:

Feed is stored in a freezer and a cooler adjacent to the warehouse. Storing it in the cool/cold environment prolongs its shelf life. If the cooler is full, any excess feed will be stored in a non-temperature controlled room adjacent to the earthen channels. Feed is used first from the non cooled building

Feed buckets are put away following use and are to be cleaned if dirty

A feed schedule is drawn up for each container, feed requirements are determined in numbers of bags per day. Bags are delivered on the back of a golf cart to the shelter at the raceways. Each bag of feed is poured into a garbage can (to keep crows, rain etc out of the feed) from where it is removed into 2.5 gallon pails for feeding out. Feed is distributed using a plastic feed scoop

Chinook : The amount of feed is determined based on the manufacturers feed schedule and from the estimated biomass as determined by bulk sampling. The feed allotment may be modified such that up to 125-150% of the schedule may be provided if fish are responding well and an accelerated weight gain is desired.

Coho : When coho are small they are fed as above. As the feed allotment increases and the water temperature increases, move to a power feeder – holds a full 20 kg bag. This will blow the feed out over the channel for better distribution and more efficient feeding. These will be filled several times per day as needed

Feed build-up in the bottom of enclosure is noted and will result in more frequent feeding of reduced ration. If fish display a reduced interest in feed, if the water is dirty or turbid, if temperatures have dropped considerably, feeding will be reduced.

If fish appear to be rejecting the feed, stop feeding and try again the next day. If they go off feed for longer and anything is suspected, send samples into the lab at PBS.

Forms & Records:

Feed record sheet

Weekly juvenile feed/mortality records


CraigCk.xls


QREAR.XLS


FEEDREC.XLS


QFEED.XLS

References:

Medicated Feed: Storage, Handling, and Feeding

EWOS Food Size Guidelines

4.14 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:

4.14.1 *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 Chinook. Coho are sampled weekly during early rearing and until marking is completed. Thereafter, coho are sampled once per month for determination of appropriate feeding rates and feed sizes.

Equipment list:

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

1. Starting at the lower end of each channel/pond and moving towards the end where the diffuser is located, a small seine net (50 foot) is used to take a sample at the top mid and bottom of each
2. The net is walked out into the channel and returned to the bank to crowd a group of fish for sampling
3. Using a dip net, remove a sample from the crowded fish and place it into a large garbage pail containing water
4. Repeat this three times
5. All three samples are mixed into a large garbage pail and the sample is taken from the bucket
6. A smaller bucket of water is zeroed on a portable scale
7. A dip net of fish is placed into the bucket (approximately 1 kg sample)
8. The fish are then counted back into the channel from this bucket at the diffuser
9. Record the number and the weight
10. Repeat this up to three times for each channel section (or raceway ponds) (not each portion of the channel) depending on workload and staff availability

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

4.14.2 ***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.

Individual length weight sampling is generally only performed one day prior to release unless there is some question regarding bulk sampling results in which case a dry length weight sample will be performed to check the bulk sampling results.

Equipment list:

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

1. Starting at the lower end of each channel/pond and moving towards the end where the diffuser is located, a small seine net (50 foot) is used to take a sample at the top mid and bottom of each
2. The net is walked out into the channel and returned to the bank to crowd a group of fish for sampling
3. Using a dip net, remove a sample from the crowded fish and place it into a garbage pail containing water
4. Repeat this three times
5. All three samples are mixed into a large garbage pail
6. Transport the garbage pail of fish into the lab building
7. Prepare a TMS anaesthetic bath according to the Anaesthesia SOP
8. Fish are anaesthetised until they are easily handled
9. Net fish out individually
10. Dry each fish slightly on a paper towel to remove excess moisture
11. Place the fish on a zeroed scale and record the weight
12. Place the fish onto a measuring board and record the length
13. Place the fish back into a freshwater recovery container
14. Repeat for a minimum of 100 fish per section

Forms & Records:

Bulk sample form

BULKWT.XLS

Juvenile length/weight data sheet
Juvenile length-weight data chart


L-WSample50.xls


L-WSheet.xls

Juvenile mortality records


CNJUVMTS.XLS


COHOMORT.XLS

Dead length or live length/weight sample form

References:

Fish Handling Procedures
Anaesthesia
Equipment disinfection
Growth prediction tables should be available for comparison

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

Time out of water should be minimized and 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.

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.

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:

4.15.1 *Seining procedures for collecting fish for marking and sampling*

Seining is used to capture fish for bulk weight sampling, for individual length weight sampling and for marking. Seining is carried out by two people.

1. Reduce the depth of the water just enough to allow workers easy access without going over the top of their waders – this is done by removing stop logs at outflow.
2. Lay the seine net out at the side of the enclosure ensuring that the lead line and the float line are not twisted
3. One individual should remain on the bank/side of the channel/pond/raceway while the other enters the enclosure
4. The individual entering the enclosure walks the net across the channel and loops back to the starting bank ensuring that the lead line is pushed to the bottom
5. Once the loop is completed, pull the lead line up to crowd the fish for sampling
6. Fish should be crowded enough that a random sample may be dipped out in one scoop of the net but they should not be overcrowded
7. Once the sample is obtained, one side of the lead line should be dropped back into the enclosure to release the fish
8. Ensure that all the fish are out of the net prior to resetting for the next collection

Forms & Records:

References:

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

4.16 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*).

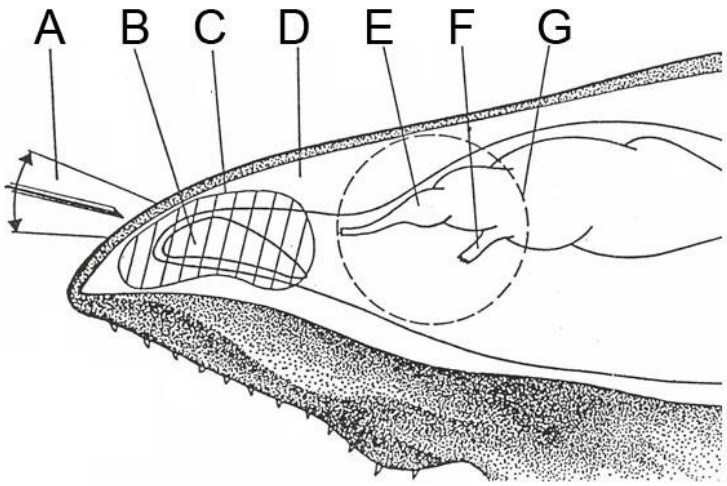
For ***adipose fin clipping***, the adipose fin is removed to serve as a quick visual identifier of hatchery origin fish. Proper removal of the adipose fin provides a life-long mark which is not considered to adversely affect the health, behaviour or social interactions of the fish.

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.

Otolith marking may be 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.



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

Details of the Operating Procedure:

4.16.1 ***Tasks to complete in preparation for marking programs***

1. Determine the exact numbers and types of marks to be applied
2. Arrange for adequate numbers of local fry markers to be available for marking period
3. Ensure that First Nations have had first opportunity for employment
4. Arrange for contract markers if additional marks are approved/required
5. Ensure total familiarization with tag machine and maintenance/set up/repair
6. Ensure adequate marker supplies (record sheets, TMS, scissors etc)
7. Contact veterinarian for approval to use TMS
8. Purchase any extra equipment or supplies required (scissors, tag cutter, TMS)
9. Run fire house out and test water supply, pumps etc

SEE DETAILED START UP, OPERATION AND SHUT DOWN REPORT, LOCATED AT EACH OF THE MARKING FACILITIES, FOR DETAILS

Notes:

- Normally chum fry receive adipose and right ventral clips. Approximately 250,000 will be clipped and marking will begin in early April and may finish as late as the end of April. Chum fry are collected in the fry samplers during the outmigration period. They are marked in the permanent marking structure located at the exit to the channel.
- Normally Chinook will receive an adipose clip in addition to a coded wire tag. Approximately 200,000 will be marked starting as early as mid April completing as late as May 15. In some years there will be an overlap where both chum and Chinook marking programs are in progress. Chinook are marked at approximately 2 g, prior to smolting. If left until they reach approximately 5 g there is a high level of scale loss
- The normal coho marking program includes approximately 40,000 fish receiving an adipose clip in addition to a coded wire tag implant. The balance of the coho will be adipose clipped only. This program will generally begin in early June and complete as late as early August depending on fish numbers
- Chinook and coho fry are marked in the portable marking trailer

Contacts:

- Keir Surgical Ltd – ph 604- 261-9596 (fin clip scissors - #810SP)
- Syndel Labs – ph 250-756-7057
- Northwest Marine Technology – 1-360-468-3375 (Washington)
- Doug Herriot – Gregg Bonnell (re marking plan)

4.16.2 ***Marking Procedure***

1. Lightly crowd the fish in the channels using a seine net set (see *Fish Handling Procedures* SOP)
2. Leave the fish in the seine net being certain to insert a hoop to keep the net open so the fish are not overcrowded while delivering fish to the markers over the course of the day
3. Dip net fish out of the seine net into a garbage can containing water that has been located on the back of the golf cart
4. When a manageable number of fish have been collected into the garbage can (Maximum weight of garbage can, water and fish should not exceed 35 kg) deliver them to the marking trailer and net them into the holding tank inside the trailer
5. Anaesthetize fish with MS-222 according to the *Anaesthesia* for marking
6. One person will monitor level of exposure of anaesthesia and distribution of fish in the anaesthesia bath and distribute them to the staff performing adipose clipping
7. Remove the adipose fin (and right ventral fin if chum) using sharp scissors (if tagging these will then be distributed to the fish taggers)
8. Place the fish gently into the ambient fresh water pipe which leads to the recovery tub outside the trailer
9. As the density of the container begins to increase fish must be moved

10. Net fish out of the recovery tub and place them into a garbage pail containing water on the cart and return them to the appropriate enclosure
    - chum go directly out into a recovery box held in the river which is opened each evening after dark to reduce predation
11. If coded wire tagging is to be carried out, it is performed following adipose clipping using coded wire tagging machines
12. Following marking (as outlined above) pass fish to the taggers via the tube that carries it to the sink adjacent to the tagging machine
13. The tagger will grasp the fish gently and place its head in the head mold
14. 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
15. If the tag is in place the QCD (Quality Control Device) machine will direct the fish back into a series of tubes and hoses that lead to the recovery tub outside the tagging trailer
16. If the tag is not in place, fish will be directed to a small `reject' container where they are held until they can be retagged. This is performed several times per day.
17. Fish are dropped through the QCD to recheck that there is not a tag in place prior to retagging them.

4.16.3 *Cleaning*

The Tagging trailer is thoroughly disinfected between tagging programs. Once per week a disinfectant solution (250 ppm) of Ovadine is used in the recirculation chiller and is flushed through the system for a 1-2 hours. The floors and all sinks are also disinfected with Ovadine (250 ppm) once per week.

4.16.4 *Pin placement assessment*

As head moulds are installed several fish will be test run through the CWT machine. These test fish will be euthanized by quickly driving a scalpel through the cranium to sever the brain stem. The head region will be dissected to ensure proper placement. If the CWT's are not being localized correctly, the head mould is readjusted and another few test fish will be tagged, euthanized and dissected.

To dissect the head, look for the mark (pin hole that may display a drop of blood on recently tagged fish) on the nose and cut just to the side of that and under a bright light examine the pin location. The pin should be properly located at the proper depth and along the centre line. (**see NMT coded wire tag project manual for details)**

4.16.5 *Pin retention assessment*

Fish that are successfully tagged with the CWT machine are directed into two circular live troughs outside the trailer. Two codes may be used per day, therefore the fish will be separated go into separate tubs. Fish are held in these tubs until the following morning and run back through the QCD. At the same time that fish are collected and re-run through the QCD, fin clip quality should be examined. This is performed daily during the clipping/tagging program.

4.16.6 ***Bismarck Brown Dye Tagging***

Note: Personal Protective Equipment (chemical gloves, dust respirator, chemical apron) should be worn at all times when carrying out this procedure

1. Fill the dedicated BBY marking garbage can with 40 liters of water
2. Place an air stone into the bucket and turn on to ensure flow is adequate
3. Using a net, place 1.25 kg of fry into the bucket of water
4. Weigh out 0.50 g of Bismarck Brown-Y powder
5. Place BBY powder into a 500 ml container
6. Add water and mix until powder is dissolved
7. Pour the dissolved BBY solution into the garbage bucket containing fish and water
8. Set a timer for four hours and leave fish undisturbed for this time
9. After four hours has elapsed, net the fry from the solution into a bucket of clean water
10. Transport the bucket of fry to the river and place into the live box
11. Dispose of the solution to drain
12. At the end of the day (when it is dark) release the fry from the live box. Releasing after dark reduces predation on the newly migrating fry

Forms & Records:

Mark quality by individual tagger
Chum salmon marking – daily totals
Mark quality
Marking summary (Ad/CWT – Pin retention)
Chum fry marking (quality control)
Marking record (Ad/CWT)
Coho salmon marking


CWTMK.XLS


CMMKING.XLS

References:

Equipment disinfection
Anaesthesia
Fish Handling Procedures


coded wire tag project manual.pdf

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

Groups of fish should be 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 should be sampled according to the Veterinarian's instructions for lab analysis.

Details of the Operating Procedure:

Big Qualicum Salmon Hatchery has a historical incidence of furunculosis. Therefore temperatures are closely monitored in the water system. The disease tends to manifest when the water temperatures rise above 15 ^{o}C so temperatures are maintained below this whenever possible by manipulating the water draw from the lake.

Fish are regularly observed for any changes in feeding behaviour.

Flashing behaviour may indicate parasite presence

The head fish culturist will be notified of changes in feeding and behaviour

During weekly sampling, fish are examined for gross physical condition

Forms & Records:

References*:*
Diagnostic Sampling protocols

Release

4.18 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:

No formal pre-release risk assessment is performed. Fish are sampled for individual length weights prior to release and examined for physical condition at this time.

The head fish culturist will be notified of any gross characteristics of concern.

Forms & Records

References:
Juvenile Release
Juveniles-Health Observations
Mortality Classification

4.19 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:

4.19.1 *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).

4.19.2 *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.

4.19.3 *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:

Adult broodstock are collected via swim in, and juveniles are released volitionally. Pre-ponded fry are transported from the incubation facility up-river.

Pre-ponded fry of Little Qualicum origin are transported back to Little Qualicum for ponding in the same manner as outlined in the *Ponding*

4.19.4 *Transport Checklist*

4.19.4.1 Vehicles

1. Wash truck
2. Check all fluid levels (oil, brake, washer)
3. Check that all lights work (head, brake, turn signals)
4. Top up fuel tank
5. Check tire pressure and tire wear

4.19.4.2 Transport Tank

1. Put on truck and secure
2. Check that any clamps are present
3. Check if the tank requires disinfection or cleaning
4. Ensure that the air stone and air hose are in good condition
5. Ensure that all lid snaps are in good working condition
6. Check the oxygen bottles, should have one full plus one full - or even half full – spare bottle
7. Ensure oxygen bottles are securely fastened to the transport tank/truck
8. If transport involves ferry travel, ensure all Dangerous Goods permits are in place for both trips (to transport site and return)
9. Ensure all gauges are in good working order – bring a spare
10. Bring a spare air stone with spare hose

4.19.4.3 Items to bring on transport

1. DO meter in good working order
2. Thermometer
3. Paper to keep track of readings
4. Buckets and nets
5. Phone number of people you are to meet
6. Wrench to change oxygen or gauges
7. Flashlight in case of poor light conditions
8. VHF radios for communication between trucks

For Ponding Transport, see the *Ponding*

Forms & Records

TANKLOAD.XLS

Tank loading calculation spreadsheet

References:

Pre-Release or Transfer Disease Risk Assessment

Ponding

4.20 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:

Juvenile sampling will precede release. See *Individual Length/Weight and Bulk Weight Sampling Protocols*

No specific health checks precede release

All juveniles released at this facility are by volitional release. A small opening is placed in the outflow diffuser (approximately 6" x 6") to allow juveniles the opportunity to migrate out. If it appears that the juveniles are migrating out in great numbers, the grate will be removed and the fry will be allowed to leave.

Fish remaining a week following general release will be forced to vacate the enclosure by lowering the water level and increasing the water flow.

To determine preparedness for release, 24 smolts are held in a bio-assay cage at Deep Bay at least one day prior to release. Overnight survival is expected to be 100% if smolts are prepared for release.

Release is generally planned to coincide with peak wild migration timing of wild smolts of the same species as indicated by downstream enumerations

Forms & Records:

References*:*
Pre-Release or Transfer Disease Risk Assessment
Transporting Fish
Individual Length/Weight and Bulk Weight Sampling Protocols

4.21 Fry Sampling

Rationale: Enumeration of out-migrating fry allows the determination of expected returns. Fry in spawning channels are difficult to capture and therefore methods to passively collect a known proportion of migrating fry allow a determination of spawning success.

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:

Downstream fry are collected using an incline plane trap at the bottom of spawning channel hub 280 fence (adjacent to the spawning channel fence)

Upstream fry are identified by collecting a proportion of out-migrating fry and marking them with Bismarck Brown Y dye. 10 kg of fry are held in a bath containing Bismarck Brawn Y (BBY) dye for 2-3 hours before being placed into a live box in the channel (See *Marking Fish*) Fry will be marked during low migration periods (early and late migration)

Following release of Bismarck Brown Y marked fry, and for the ensuing three days, the number recaptured will provide an estimate of the number of fry that represent natural spawning in the river

Incline plane traps are used to collect out-migrating fry as they cross the fence. The downstream gear used at the main fence is located at the Hub 280 fence for enumerating river fry and collecting chum fry for the marking program. A separate trap is installed at the downstream end of the spawning channel for that enumeration. Fry are not trapped at the main fence. This places all trapping gear in a convenient location adjacent to the chum marking building (hub 280) where all related equipment is stored and data is collected and recorded. Captured fry are diverted to a live box overnight and enumerated the following AM. Rate of capture is routinely checked by releasing and recapturing a known number of BBY marked fry.

1. When emergent fry are seen in the channel, install the incline plane traps at the downstream end of channel when fry are observed anywhere in the channel
2. Incline plane traps are installed on each gate on the fence
    - each is approximately 4” wide and will capture approximately 4% of the water
3. The fry are dewatered as they pass through the incline plane trap and the fry are directed into a live box
4. Each morning, collect the fish from the live box and place them into a bucket containing water
5. Transport the fry into the marking hut and perform a bulk sample on them (see *Individual Length/Weight and Bulk Weight Sampling Protocols*)
6. Fry are anaesthetized with TMS (see *TMS Anaesthesia:*) A stock solution of 100 g/L is made up and diluted to a working concentration of 40-50 ppm in the anaesthetic bath

7. Sort fish by species, identify marks and make observations on condition of fry and number of BBY marked fry
    - During low migration periods, count and check all fry
    - During peak migration periods, perform 100 g subsamples and count and check these
8. Record information in data sheets
9. When the check of each fry is complete, place it into the drain trough such that they are directed out to the recovery box in the channel
10. The anaesthetic bath is released to the river following use
11. At the end of the day, the recovery box is opened to release the fry into the river

Forms and Records

Salmon fry weight to numbers conversions
Rotary trap enumeration sheet
Downstream enumeration form


Downstream.xls

References*:*

TMS Anaesthesia:
Individual Length/Weight and Bulk Weight Sampling Protocols
Marking Fish


Ewingetal.pdf

Ewing, R.R., B. P. McPherson, and T. D. Satterthwaite. 1990. Effects of varied rearing temperatures and feeding regimes on retention of Bismarck Brown Y stain in alevins of Chinook salmon. The Progressive Fish-Culturist. 52: 231-236.


GainesMartin.pdf

Gaines, P.C. and C.D. Martin. 2004. Feasibility of dual marking age-0 Chinook salmon for mark–recapture studies. North American Journal of Fisheries Management. 24:1456.1459


WardVerhoeven.pdf

Ward, F.J. and L. A. Verhoeven. 1963. Two biological stains as markers for sockeye salmon fry. Transactions of the American Fisheries Society. 92:379-383

Mortalities and Responses

4.22 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:

Adult mortalities are collected by gaff and are removed from the ponds on a daily basis. Mortalities are placed into a carcass pile or removed to surplus depending on timing and carcass condition. Mortalities are generally removed to a land based mort pile away from the rearing areas. Carcasses are mixed with sawdust and turned regularly to generate compost.

Juveniles are also picked for mortalities on a daily basis. Following feeding, juvenile mortalities are collected by small dedicated dipnets and placed into dedicated mort buckets. Because nets are dedicated for mortality picking, they are not cleaned following mort picks. Each enclosure has its own mort pick net that is labelled to ensure it is not used for other purposes. Juvenile mortalities are disposed of to the mort pile for composting.

Most mortalities in the earthen channels are generally carried downstream by the current (10-15 cfs) to the outflow screen from where they are removed on a daily basis.

Mortalities in the rearing ponds are generally collected while vacuuming the ponds. These mortalities are counted as they are taken up by the vacuum. These mortalities are pulverized by the pump which discharges the effluent back into the river.

Forms & Records
Daily mort and feed sheets
Tracking sheet for adults
Juvenile mortality records

References:

Outbreak Response

Outbreak – Disinfection Protocols
Mortality Collection and Disposal
Mortality Classification
Euthanasia
Site and staff disinfection and biosecurity

4.23 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)
Handling/transport (losses related to handling or transport)
Matures (fish that have matured and died)
Predators (fish killed or injured by predators)
Culls/Quality Control/Poor Performers (fish intentionally removed from the population

Details of the Operating Procedure:

No formal classification of mortalities is used. However, anomalies in expected mortalities are noted and greater than normal mortalities result in notification of the person in charge of the individual programs and the facility managers

Fish culture staff examine mortalities daily and report anomalies to the Operations manager who in turn re-examines mortalities/moribund fish. If and when a serious disease outbreak is anticipated, samples are delivered to PBS for diagnosis (treatment may or may not be prescribed depending on the severity of outbreak).

All related disease records are kept on file with the specific brood report. In addition, even minor anomalies (such as low incidence of parasites, myxobacteria, or rare cases of furunculosis) which do not result in excessive losses are noted on the raw data sheets and eventually transferred to the brood report.

Forms & Records:
Raw data sheets
Brood records

4.24 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.

4.24.1 *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.

4.24.2 ***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.

4.24.3 ***Outbreak – Disinfection Protocols***

4.24.3.1 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.

4.24.3.2 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:

If an abnormal increase in mortality rates/levels is noted, samples are collected and forwarded to PBS

Flow may be increased to the system to reduce the water temperatures and feed may be decreased. If feed is suspected, an alternate feed supply may be used. Two

Cleaning frequency will be increased if mortalities escalate. Frequency of mort picking will also be increased

While it is virtually impossible to isolate fish from each other on this facility due to water seepage between areas, an attempt may be made to isolate fish by dividing personnel to work in different areas to try and reduce any potential cross contamination

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

4.25 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:

4.25.1 *Securing the Site*

Affected hatcheries should be quarantined/isolated; facilities locked down. Gates to the facility should be closed and only essential personnel admitted. 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. Disinfection procedures should be followed for movements into and out of the facility.

4.25.2 *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.

4.25.3 *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. 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.

References:

Outbreak Response
Outbreak – Disinfection Protocols

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

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

Details of the Operating Procedure:

4.26.1 *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 protozoans *Ichthyobodo*

(Costia) and *Trichodina*. It is also a standard disinfectant used in hatcheries for the prevention and treatment of egg fungal infections (see *Egg Fungal Treatments*).

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

Cautions:

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

Formalin should not be used if :

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

Parasite-S is used on cutthroat trout if they are found to be infested with *Gyrodactylus* or *Trichodina*. Treatment will only be used on fish that are rearing in the tubs.

1. Fish are treated with a concentration of 170 ppm
2. Set the tub water flow to 200 L/min
3. Set the pump speed at 200 mL/min (measure and time a known volume)
4. Make a solution of Parasite-S equalling 0.17 mL Parasite-S to each 1 L water
    i. 200 L/min x 0.17 mL = 34 mL
    ii. 60 minute treatment x 34 mL/min = 2.04 L Parasite-S
    iii. 200 mL/min x 60 minute treatment = 12L of solution
    iv. Therefore the stock solution will be made up as 2 L Parasite-S = 10 L water
5. Make up the stock solution into a 20 gallon garbage pail and place it on a cart or onto the golf cart
6. Place the pump near the enclosure to be treated
7. Prime and start the varistaltic pump
8. Monitor the pump flow to ensure it is flowing freely
9. Monitor fish behaviour and duration of exposure constantly during exposure
10. Return flow/pond depth to normal rearing requirement after completion of treatment
11. Repeat treatment on subsequent days as prescribed by vet.
12. Flush pump and hose with fresh water for 1 hour post treatment
13. Drain hoses and pump and store appropriately until next use

4.26.1.1 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 air stones. 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.

Forms & Records:

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

4.27 Top-Coating Medicated Feed

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

Details of Procedure:

Medicated feed may be purchased directly from feed suppliers or it may be mixed on site.

Feed mixed at this site is prepared using a cement mixer.

1. Staff must wear personal protective equipment (gloves and a dust mask) when working with antibiotics to protect themselves
2. Feed is placed into the cement mixer
3. Slowly add a small amount of the powdered antibiotic into the mixer along with the feed and run the mixer for a period to distribute it evenly. The antibiotic may adhere to the feed without the addition of oils
4. Continue to add the antibiotic until it has adhered fully to the feed
5. If the antibiotic is not adhering evenly vegetable oil may be added
6. Using a spritzer, spray a small volume of vegetable oil onto the feed while the mixer is running
7. Continue to add oil in small amounts until the antibiotic evenly coats the feed

Notes:

The use of vegetable oil tends to plug up the automatic feeders so if using oil it is preferable to prepare feed 24 hours prior to use to allow the oil to soak into the feed well

Medicated feed is fed out first thing each day when the fish are more accepting of feed due to overnight fasting

If fish are refusing feed, krill powder is added to the feed at a ratio of 250 mL fine krill powder to each 20 kg bag of feed. However, it is preferable to avoid using krill powder for any duration as gill damage has been associated with the shell fines

Feed is delivered with a scoop

Medicated feed buckets are washed after use

One person is responsible for medicating fish. Buckets with medicated feed are not labelled as such – one person is assigned to feed fish on any given day and this person will be aware of which feed was medicated

The cement mixer is cleaned between uses by running it while containing a bucketful of fine gravel until any residue is ground loose. The mixer is then cleaned with a household cleanser (i.e. dish soap) and rinsed well and allowed to dry.

Forms & Records

References:

4.28 Medicated Feed: Storage, Handling, and Feeding

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

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

General Principles:

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

Medicated feed 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.

Details of the Operating Procedure:

Medicated feed is stored in the cooler. If feed is a commercially prepared medicated feed, it is purchased in well labelled bags.

Medicated feed mixed on site is placed into 20L barrels and labelled as medicated with date and time to ensure it is used in sequence.

MSDS labelling is not currently applied, and smaller feed buckets are not labelled

Water quality is not monitored differently during medication. Observations regarding turbidity, DO, temperature etc are noted. If turbidity occurs, feeding may be cut back or halted until the water clears up

Forms & Records:
Feed requirement calculation
Feeding record
Juvenile feed/mortality record
Feed requirement calculation form

References:

4.29 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.

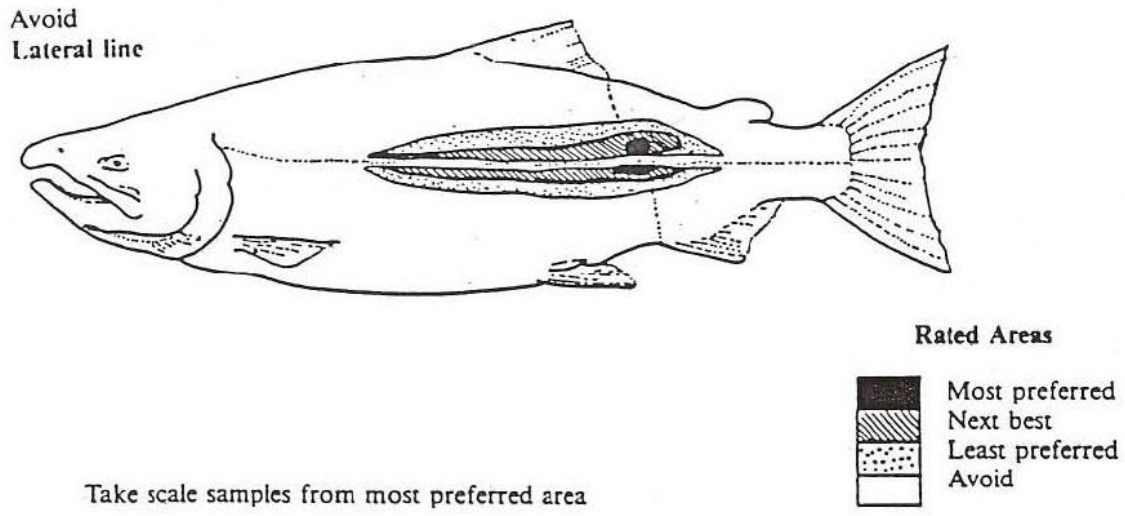
Samples may be collected for parasitology, bacteriology, virology or histology.

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.

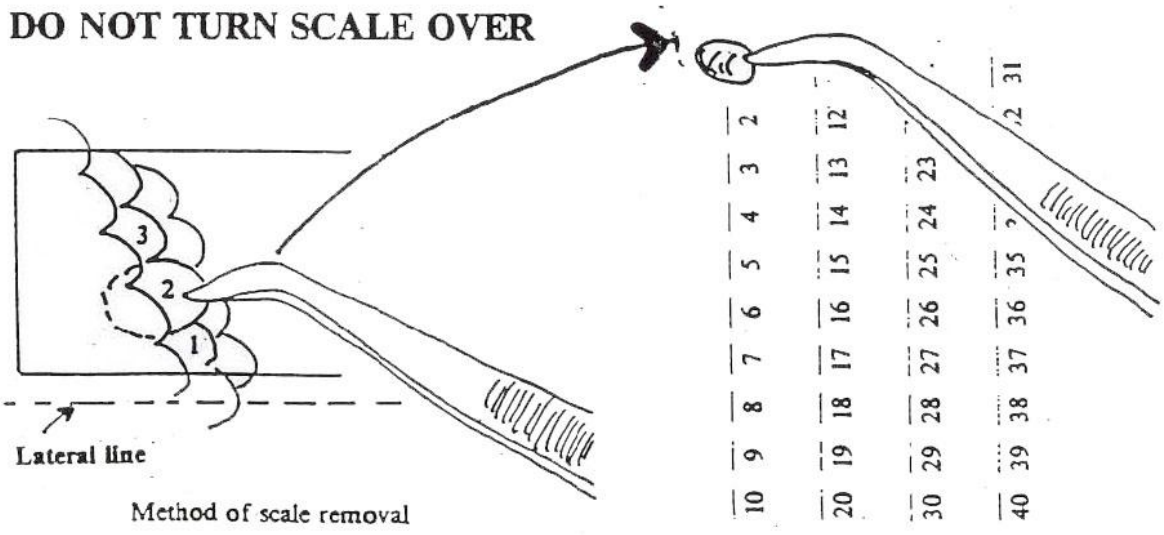
Details of the Operating Procedure:

4.29.1 ***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.



Method of scale removal

Forms:

ADBIOSAM.xls — Adult biosampling form

ADSAMPLE.XLS — Adult sampling form (scales and POH length)

References:

Euthanasia

Fish Sampling Guide — FishSamplingGuide

4.30 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:

4.30.1 ***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.

4.30.2 ***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. The diagnostic lab may also request a sample of apparently healthy fish from the population.

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

Fry are collected from the back of the diffuser. Moribund fish easiest to locate and collect from the area immediately upstream of the diffusers.

4.30.3 ***Shipping live fish:***

1. Call ahead to the laboratory at PBS to ensure they are aware that fish are to be delivered
2. Fill a large garbage can containing 10 to 20 L (depending on sample size) of fresh water
3. Place selected sample of fish into the garbage can
4. If required, attach a portable 12V air pump to the side of the garbage can.
    a. Alternatively, the garbage pail may be lined with heavy plastic bags and compressed air may be injected into the bags prior to sealing them
    b. On a particularly hot day, the fish may be placed into bag in a cooler
5. Place the lid on the pail
6. Place the garbage pail in the truck and secure it well
7. Drive to the Pacific Biological Station and deliver to the pathology laboratory

Use separate, labelled containers for moribund and apparently healthy fish.

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

4.30.4 ***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. Fish should not come in direct contact with the ice or freezer packs.

4.30.5 ***Following Transport:***

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

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

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

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

Forms & Records
Sample submission form
History of sample sent to PBS form

References:
Diagnostic Sampling protocols

Chemicals & Disinfectants

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

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

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

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

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

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

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

Veterinary Chemicals Available through Emergency Drug Release (EDR)

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

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

For more information, contact:

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

4.31 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.

> ***Note: Markers contracted by Big Qualicum have found that wearing gloves interferes with the handling of fish and results in substantial increases in time required for marking – in addition, mark quality suffers. They have therefore refused to wear gloves or other personal protective equipment.***

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.

Air stones may be placed in the anaesthetic solution, with the airflow regulated for small bubbles to optimize oxygen exchange.

Note: Oxygen levels are maintained at ambient river levels

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. One person is appointed as anaesthesiologist and is responsible for this aspect only (does not clip or tag). Three separate anaesthetic baths are maintained and fish are cycled through each of these every 2.5 to 3 minutes.

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.

Notes:

- In order to achieve desired growth/size uniformity within a group, Big Qualicum does not usually starve Chinook for more than a few hours prior to marking

Details of the Operating Procedure:

4.31.1 ***Aquacalm™ (Marinil) sedation:***

Aquacalm is also known as Marinil or Metomidate hydrochloride

Aquacalm is used when marking chum salmon fry

Note: as Aquacalm has no established withdrawal time, its use is only appropriate for brood fish and research fish, with carcasses incinerated or disposed to landfill, not for fish to be released.

Equipment List

Anaesthetic stock solution or pre-weighed amount of drug to be used
Oxygen
Tubing and air stones
Thermometer
Dissolved oxygen meter
Personal protective equipment

The dose of Aquacalm™ used for sedation at Big Qualicum Hatchery is 0.25 – 1.0 mg/L. 5.0 – 10.0 mg/L is used for anaesthesia

1. Calculate the appropriate amount of drug for the volume of water to be treated.
2. Prepare a stock solution
    a. A stock solution of 5 g Aquacalm/L is prepared in a plastic bottle and labelled with WHMIS labels
    b. The stock solution is stored in the refrigerator
3. A recirculating anaesthetic tub is situated under the marking sinks in the chum marking hut
4. Turn on the aeration system
5. Turn on the chiller unit
6. Monitor the DO and the temperature during the procedure
7. Dilute the stock solution into the anaesthetic bath in the chum building
    a. Specific details are posted in the chum building for doses and volumes for one or two sinks
    b. 60 mLs of stock solution is used for a single anaesthetic sink
    c. This may be refreshed with a further 10 mLs of stock solution at coffee break
    d. Change the anaesthetic bath completely at noon and flush the system at 4 pm
8. Bring fish into the marking hut and place them into the live tank
9. Net a small number out of the live tank and place them into a marquisette net set into the flow through anaesthetic sink to test the dose and ensure that the calculation/dilution has been correctly performed

10. Fish should reach a stage at which they are easily handled within 2- 4 minutes and recover in 4-5 minutes
11. If the dose is correct, it is safe to anaesthetize a greater number of fish and begin the procedure
12. When fish are easily handled, markers dip them out of the anaesthetic sink and place them in their clipping net
13. Fish are clipped under a magnifying glass and placed into a flowing drain trough that directs them into a recovery tub. When the fish have recovered the standpipe is removed and the fry are sent to an aluminum live box set in the river.
14. After dark the live box is opened and the fry are allowed to migrate out of the system

Anaesthetic baths are disposed of by draining to the channels

Sedated fish may not show any abnormal behaviour. However, once disturbed, they should display a lower startle reflex and should not struggle on dipnet capture. *Note: If fish lose equilibrium altogether, they have gone beyond sedation into anaesthesia, and should be processed and recovered ASAP, the sedative bath calculations should be redone and a fresh bath prepared.*

Withdrawal Time: There is no established withdrawal time for Aquacalm™. Fish treated with this drug should not be consumed by humans; carcasses should be disposed of to landfill.

Note: Aquacalm™ may be safely used at concentration of 5 – 10 ppm for anaesthesia, however, exposure to the higher concentration should be limited to less than 60 minutes.

4.31.1.1 MSDS Information:

Aquacalm is not for use in fish intended for human consumption.

When handling Aquacalm powder, protect eyes from contact. Do not inhale dry powder. If ingested, contact physician immediately.

4.31.2 ***TMS Anaesthesia:***

Equipment List

Plastic tubs of appropriate size
Anaesthetic stock solution or pre-weighed amount of drug to be used
Supplemental air; tubing and air stones
Thermometer
Dissolved oxygen meter
Personal protective equipment

The standard dose for TMS anaesthesia is 40 – 50 ppm.

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

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

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

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

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

The 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.

1. Prepare a stock solution of TMS at 100 g TMS/L water
2. Use this at a dose of 0.5 mL stock solution per L hatchery water for anaesthesia
    a. If the system contains approximately 80 L of water, an initial concentration of 50 mg/L will be achieved with 40 mL of the stock solution dissolved into the 80L of hatchery water
3. A recirculating anaesthetic tub is situated under the marking sinks in the marking trailer. The anaesthetic bath is chilled, oxygenated and recirculated through the system during the marking procedure.
4. Turn on the aeration system
5. Turn on the chiller unit
6. Monitor the DO and the temperature during the procedure
7. Dilute the stock solution into the anaesthetic bath in the chum building
    a. Specific details are posted in the chum building for doses and volumes for one or two sinks
    b. 0.5 mL of stock solution is used for a single anaesthetic sink
    c. This may be refreshed with a further 10-20 mL of stock solution at coffee break depending on how fish are res[ponding, or 10 mL may be added every hour
    d. Change the anaesthetic bath completely at noon and flush the system at 4 pm
8. Bring fish into the marking trailer and place them into the live tank
9. Net a small number out of the live tank and place them into a marquisette net set into the flow through anaesthetic sink to test the dose and ensure that the calculation/dilution has been correctly performed

10. Fish should reach a stage at which they are easily handled within 2- 3 minutes and recover in 3-4 minutes
11. If the dose is correct, it is safe to anaesthetize a greater number of fish and begin the procedure
12. When fish are easily handled, markers dip them out of the anaesthetic sink and place them into the clipping net at their station
13. Fish are marked as outlined in the *Marking Fish*

Anaesthetic baths are disposed of by draining to the river

4.31.2.1 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.

4.31.3 ***Carbon Dioxide:***

Equipment List
CO_2 cylinder
Pressure regulator
Porous tubing (or other means of dispersing the gas in water)

This is not a veterinary approved anaesthetic drug.

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

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

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

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

4.31.4 *Adult Sorting Tank*

Adult salmon are crowded into clam and brailer system at downstream end of pond three. From there they are mechanically lifted into a 500 gallon tank where they are immersed for approximately three minutes in a solution of CO_2, oxygen and water.

In order to reduce ice build-up in regulator, both heaters should be operating and warmed up before opening CO_2 valve.

1. Fill anaesthetic tank with freshwater
2. Fill the anaesthetic tank to ¾ full
3. Open main regulator valve and set the CO_2 regulator to deliver 70 L/min to the anaesthetic tank
4. Check the anaesthetic tank for bubbles rising from the diffuser
5. Charge the anaesthetic tank for 35 minutes
6. Add keg of sodium bicarbonate to the anaesthetic bath
7. Reduce the CO_2 delivery to 40 L/min
8. Set the regulator on the O_2 cylinder to 4 L/min and deliver to the anaesthetic bath continuously during anaesthesia
9. **Brailer operator must observe sorting table activity, adjust CO_2 flow rate, soaking periods, and fish loads as required. Maintain fish in semi-conscious state and do not overload the system or sorting personnel.**
10. Drain the anaesthetic bath at midday and recharge the system for the afternoon sort. If the sort is a small one, the bath may not require changing
11. Fish are crowded towards the brailer using the automatic crowder

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

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

12. When an appropriate number of fish have been crowded into the brailer (20 – 30 chinook, no more than 15-20) the brailer basket is lifted and the fish are transferred into the anaesthetic bath
13. Fish are observed carefully while they are in the anaesthetic bath
14. Fish are left in the bath for 2.5 – 3 minutes until they are easily handled (fish go out faster when the bath is fresh)
15. If necessary, the CO_2 delivery may be increased after an hour if the fish are going down too slowly. The CO_2 levels are not monitored continuously, so careful observation of fish is required.

Notes:

- A large cylinder of CO_2 should last a minimum of 12 hours
- Secure the spare cylinder adjacent to cabinet
- During heavy sorts, change anaesthetic every 4 hours
- During sorts, brailer operator must also monitor oxygen levels in pond downstream of crowder
- Anaesthetic baths are disposed of by draining to the river

OBSERVE "NO OPEN FLAME "WARNING AT CO2 / OXYGEN CABINET.

4.31.5 *CO_2 for Mass Marking Program*

This system is temporarily set up in the feed storage room when in use

When charging the anaesthetic tank, please follow these procedures closely

Anaesthetic bath should be changed at each rest period (3 times daily)

1. Fill anaesthetic tank with fresh water
2. Open valves at CO_2 and oxygen bottles
3. Set CO_2 initially at between 15 and 20 psi
4. Set the oxygen regulator so that just a very fine mist is evident at the diffuser
5. Check both air stones for uniform bubbling
6. Start the circulating pump, chiller and all monitoring devices
7. monitor ph until reading is about 6.0 (10 minutes approx) If CO_2 levels are to be measured, this is the time to do so
8. Optimum actual CO_2 level required is 325 to 375
9. Once satisfied with CO_2/pH levels, decrease CO_2 flow to 8 to 10 psi
10. Add 500 ml. Sodium bicarbonate and mix. (ph should now read between 7.0 and 7.25, but actual CO_2 levels will be unchanged from before adding soda
11. Maintain pH at between 6.5 and 7.25, depending on how the fish react. Fish should be fully unconscious in five minutes and fully conscious again in less than seven minutes

Overdose due to either high CO_2 levels or prolonged exposure will result in symptoms such as pale gills and/or haemorrhaging at the base of fins

Maintain safe CO_2 levels by adjusting flow rate; do not add more sodium bicarbonate to adjust pH. Observe fish behaviour closely. Oxygen can be left at original setting all day but do not exceed 20 ppm

Remember; low pH indicates high CO_2, high pH indicates low CO_2

Shut down procedures

1. Turn off chiller, circulating pump and all meters; CO_2 and oxygen must be shut off at day's end
2. Drain and flush dope tank (stones must not be submerged overnight or they will clog up

4.31.5.1 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.

Forms & Records:

References:

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

4.32 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.

Methods of euthanizing fish at this facility include:

- Adults may be suffocated in totes during sorting and male gamete stripping
- Fry are euthanized by bucket suffocation suffocated
- A sharp blow to the head for larger fish held out of the water.

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.

Forms & Records:

References:
Anaesthesia
Fish Handling Procedures

4.33 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:

4.33.1 ***Aquacalm***

Aquacalm is the trade name for Metomidate Hydrochloride. It is used for anaesthesia or sedation of fish for tagging, weight sampling, spawning, transportation, experimentation, photography in aquaria and surgery. Aquacalm is also used for sedation of fish, often during transport, to reduce stress levels. Consult your veterinarian or health care professional.

Aquacalm powder is very stable when kept cool and dry in a tightly closed container. Aquacalm may be stored for extended periods at room temperature (20-30°C), if kept dry and away from direct sunlight. Stock solutions made with distilled water and kept cool and out of direct sunlight may retain full potency for about four weeks.

When handling Aquacalm powder, protect the eyes from contact. Do not inhale the powder. If ingested, contact a physician immediately.

Aquacalm powder is Stored in the fridge in the fish culture building in the dry lab. Containers are appropriately labelled with MSDS labels. Stock solutions are labelled and kept in the marking location building

4.33.1.1 MSDS Information:

Aquacalm is not for use in fish intended for human consumption.

When handling Aquacalm powder, protect eyes from contact. Do not inhale dry powder. If ingested, contact physician immediately.

4.33.2 ***Compressed Gas Cylinders Storage***

Compressed gas cylinders must be stored in a clearly identified, dry, well-ventilated storage area away from doorways, aisles, elevators, and stairs. “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 at the chum marking hut – chained at the live tank – inside the building (O_2) and at the marking trailer – stored outside (O_2 and CO_2) chained and secured. CO_2 is also stored in a locked cabinet at the brailer. The main storage when cylinders are not in use, or of extra cylinders, is in the chain link compound outside the storage building

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 CO_2 on hand

Cylinders are moved on a cylinder dolly with chain to secure

Cylinders are cracked prior to attaching to the regulator to blow off any debris (cobwebs, bugs etc)

4.33.2.1 MSDS Information:

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

4.33.3 ***Parasite-S***

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

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

Parasite-S is stored in the walk in cooler at the lower site and also in the incubation facility. At the incubation facility it is stored in a spill containment box that has a capacity in excess of the drum volume.

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

4.33.3.1 Parasite-S MSDS information:

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

Parasite-S contains methanol which inhibits the formation of paraformaldehyde, a white precipitate that is extremely toxic to fish. Even so, formalin should be stored in the dark above 10

^{o}C and not allowed to freeze. If Parasite-S is allowed to freeze, it should be discarded due to the rapid formation of paraformaldehyde.

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

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

4.33.4 ***Oxyvet (Oxytetracycline)***

OXYVET® 200 LA is a sterile, long-acting, stable, aqueous solution containing oxytetracycline dihydrate equivalent to 200 mg oxytetracycline base per mL. It is an injectable solution used in various cultured animals including fish.

Treated animals must not be slaughtered for use as food for at least 21 days after the last treatment with this drug.

All prescription drugs are labelled and stored in the cooler room.

4.33.5 ***TMS***

TMS is a chemical used to provide anaesthesia to fish, thereby reducing the degree of stress associated with many fish culture procedures.

TMS powder is stored in the fridge in the fish culture building. Stock solutions are only present when actively marking and these are stored in the marking trailer

4.33.5.1 <u>MSDS information:</u>

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.

4.33.6 ***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 labelled clearly and is stored under the counter in the fish culture building

4.33.6.1 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.

4.33.7 ***Purell hand sanitizer***

Purell hand sanitizers are located in the marking trailer and in the chum marking building

4.33.8 ***Isopropyl alcohol***

Isopropyl alcohol is used for sterilizing sampling instruments in the laboratory.

It is stored in the fish culture building (lab) when it is on site

4.33.8.1 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 (incoordination) 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.

4.33.9 ***Ethanol***

70 – 95% ethanol (also known as ethyl alcohol or EtOH) may be used as surface disinfectant for instruments (i.e. spawning knives, egg picking tweezers, dissection equipment, etc.) or lab benches. Note: 70% is commonly used due to the rate of evaporation at higher concentrations.

Ethanol can be stored in sealable glass or plastic containers when not in use, and poured into a small beaker for instrument tip disinfection when required.

For lab bench surfaces, 70% ethanol may be transferred into a plastic spray bottle for use. It should be sprayed to coat the desired area of a clean bench top, left for roughly one minute contact time, then the excess may be wiped off with a paper towel.

Ethanol is stored in the fish culture building (lab) when it is on site

4.33.9.1 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.

4.33.10 ***Methyl hydrate***

Methyl hydrate is used for cleaning the tag injectors in the trailer. It is stored in the marking trailer in a labelled container

4.33.11 ***Bismarck Brown Y marking dye***

Bismarck Brown is a stain that has been used to colour fry to differentiate them for enumeration purposes. It is also known by the names Basic Brown 1 and CI 21000.

Bismarck Brown Y powder is stored in the marking shed.

4.33.11.1 Bismarck Brown Y MSDS information

The compound is an irritant in its powdered form and appropriate precautions should be taken.

On inhalation, slight irritation may occur. Remove from exposure. If symptoms persist or are severe, seek medical attention.

Toxicity following ingestion appears to be low. Irritation may occur. Wash mouth out with plenty of water and give water to drink. Seek medical attention.

Eye contact may result in a slight irritation. Flush with plenty of water. Seek medical attention.

BBY is a mild skin allergen. If skin contact occurs, wash with plenty of soap and water. If symptoms persist or are severe, seek medical attention.

Forms:

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*

4.34 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:

4.34.1 ***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.

4.34.2 ***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.

4.34.3 ***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.

Details of Operating Procedures:

The majority of equipment at the Big Qualicum hatchery is cleaned by washing and drying only

4.34.4 ***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.

Tagging needles are cleaned with methyl hydrate and all working parts of tag injector are cleaned with methyl hydrate once a week

4.34.5 ***Tank and Pond Disinfection Protocol:***

Concrete raceways are pressure washed and dried between life stage uses if time and sun permit

Tanks are rinsed of debris, cleaned with soap and water, disinfected, rinsed with fresh, clean water, and allowed to dry after the removal of fish and prior to the introduction of new fish. Transport tanks

may be disinfected if using tank to move other stocks (such as the Cultus stock from Rosewall – see Rosewall FHMP)

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).

Disinfectant is also sprayed onto any tank-associated equipment (inlet pipes, tank rims, stand pipes, etc).

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

4.34.6 ***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.

4.34.7 ***Ovadine™***

For use as a **general disinfectant** for dips for equipment or footbaths, a 250 ppm available iodine solution is made by diluting 25 mLs of Ovadine™ to 1 litre of clean water.

A change in the solution colour from dark brown to light yellow indicates a loss of activity.

For use as an **egg disinfectant**, a 100 ppm available iodine solution is made by diluting 10 mLs of Ovadine™ to 1 litre of clean water. (see Egg Disinfection SOP)

Ovadine™ may be stored at room temperature (20 – 30 °C) for periods greater than two years if containers are kept tightly sealed and away from direct sunlight.

The Tagging trailer is thoroughly disinfected between tagging programs. Once per week a disinfectant solution (250 ppm) of Ovadine is used in the recirculation chiller and is flushed through the system for a 1-2 hours. The floors and all sinks are also disinfected with Ovadine (250 ppm) once per week.

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*

General Practices and Procedures

4.35 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:

4.35.1 *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.

Predation may lead to an increase in mortalities. When predators are attacking fish observations may include partially consumed fish and obviously physically damaged fish.

A perimeter fence is in place around the rearing compound. This is a chain link fence with barbed wire at the top section. Self closing gates are present in some locations while other gates must be manually locked, locked gates elsewhere.

Net canopies are draped over the earthen rearing channels and these are constructed with side curtains that reach to the ground

4.35.2 ***Procedures***

Facilities should be checked daily for signs of predators. Any damage to holding units is to be repaired as soon as possible.

Feed should be stored and distributed in a manner that does not increase attraction to scavengers and predators. (See *Feed, Feed Storage, & Feeding Practices*) Spilled feed is cleaned up immediately.

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

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

If signs of predation are observed, examine the periphery of the facility and watch for fence damage and/or trails and pathways that may be used for trapping purposes.

4.35.3 ***Contingency plan***

When exclusion methods have failed and all other options have been exhausted, a conservation officer should be called and permits must be obtained in order to trap and relocate or terminate predators. Predator destruction must be done in as humane a manner as possible. The predator population must not be put at undue risk.

Members of the facility staff currently possess a trapping permit. Larger predators may be live trapped relocated by professionals

Forms & Records

SealObserve.xls

Seal Observation Form

References:

Feed, Feed Storage, & Feeding Practices
Mortality Classification

4.36 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:

4.36.1 ***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.

4.36.2 ***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 should be directed to either contact head office to arrange a guided tour; or where available, self guided tours are available with interpretive stations.

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)

4.36.3 ***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.

4.36.4 ***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.

4.36.5 ***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 should be maintained by visual inspection and regular scheduled renewal of the product.

Disinfectants should be disposed of according to manufacturer directions and following the requirements of waste management regulations.

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

Error! Reference source not found.

4.37 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:

4.37.1 *Temperature*

Temperature of the Horne Lake reservoir (at the surface and at 60 feet below the water line) is measured continuously on the computer in the office. There is a temperature probe present at 100 feet, but it is not currently functional. Temperature is also recorded at the incubation site.

The temperature probe in the pump house represents the temperature in all of the rearing units at the lower site. Historical temperatures have been monitored at the earthen channels and they do not differ significantly from the pump house

At 15 degrees furunculosis tends to materialize in the coho at this facility so do temperature is controlled using the lake draw at depth to reduce temperatures by 2-3 degrees when it rises to 15 ^{o}C. This seems to alleviate the problems.

4.37.2 ***Dissolved oxygen***

Dissolved oxygen is measured whenever there is concern about the density of the fish. When oxygen is measured, a handheld Oxyguard meter is used

During incubation, total gas pressures are historically monitored. Currently the digital readout is malfunctioning so the facility is not getting a total gas reading. Currently, only O2 is measured (using a portable handheld meter). O2 measurements are taken at the bottom of a heath tray stack and not as a routine measurement, only when there is a concern and the alevins are looking oxygen starved.

4.37.3 ***Channel Cleaning***

The channel is cleaned bi-annually. During cleaning, the flow to the channel is temporarily shut off and a front end loader is used to remove sludge from the settling basin. The flow is started again and a D7 cat and excavator turn the gravel over and create wind rows with the blade to flush the system. Following flushing, the D7 cat is used to level the gravel out again. The process is carried out from the top end of the channel towards the bottom.

The water flows into the main lower facility and through the rearing enclosures. This, unfortunately, must be done during the period that the juveniles are rearing. Feeding will be performed prior to this cleaning starting so that the water turbidity is avoided during feeding. The water is generally cleared by early afternoon.

Form & Records:

VNotchWeir-90.xls

V-notch Weir flow calculation spreadsheet

References:

Water quality contingency plan

4.38 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.

Details of the Operating Procedure:

A water quality monitoring program must be in place (see *Water quality monitoring*).

4.38.1 *Alarms*

Tanks are equipped with alarms to address water flow rates, water level in header tanks and possibly critical water quality parameters like dissolved oxygen levels. Alarm systems vary with the type of water supply. A designated staff member is on standby to respond to alarms 24/7.

Alarms are triggered by:

- High and low water levels
- High and low levels in any of the rearing containers
- High and low levels in the incubation head tanks

Lake levels and flow rates are monitored by a computer in the office which continuously records monitoring data. Flows are adjusted from the office on a routine, daily (up to several times per day) basis.

Weather patterns are monitored and water flows/lake levels are adjusted according to predicted rainfall

Tubs and Burroughs ponds receive water pumped via an aeration tower that is equipped with a water level alarm. A pump failure will result in low water in the tower as well as the tubs and this will trigger an alarm

Ponds are equipped with low water alarms and high water alarms

4.38.2 *Water Source*

All water at this facility is surface water and is derived from Horne Lake. Flows of between 50 – 800 cfs are available. All water is gravity fed flow and temperature control is via drawing water from different levels at the lake

The average temperature range for the facility is between 4-16 ^{o}C

No wells are present at this facility

Fish are monitored multiple times daily. A disease outbreak will initially have visible effects on susceptible, individual fish while overall the population may appear normal. However, in the event of a water quality failure, all fish on that water source will be similarly affected.

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

The incubation facility is continuously powered by two water turbines. Additional power, if and when required (during peak power demands such as pressure washing) is supplied by a diesel generator

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.

Hunts Creek is adjacent to the road and water from this system may be accessed using large submersible pumps to pump it over and into the channels. While this has been done when cleaning the spawning channel it requires a great deal of time to set up and does not represent a viable emergency option.

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 (see
Outbreak Response
).

4.38.3 *Power Outage Emergency Procedures for Coho Rearing Tubs – pumped water only*

When power outage occurs:

1. Respond immediately - time is crucial to survival of fish. No power means no water, no oxygen.
2. Start up auxiliary pump. Volume being pumped should be preset.

3. Insert emergency line into tub. Valve is under cover beside inflow line; valve handle is stored in the fish culture building.

4. Observe to make sure water flow is adequate.

Forms & Records

River flow control – operation log
Valve house operation log
Bypass log
River flow adjustments

References:

Outbreak Response

Euthanasia
Water quality monitoring

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 1 cm wide x 1 cm 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 Sample submission form

Fish Pathology Laboratory
Pacific Biological Station
Nanaimo, B.C., V9T 6N7
Tel: (250) 756-7057 Fax: (250) 756-7053

DATE: _____ HATCHERY OR SAMPLE SITE:_____

SUBMITTED BY:	MAILING ADDRESS:
_____	_____
PHONE:_____	_____
FAX:_____	_____

SAMPLE INFORMATION

BROODSTOCK CODE: _____ LAB CASE NUMBER:_____

SPECIES:_____ SAMPLE SIZE: _____

SAMPLE TYPE (√):

RANDOM		MORTS		SICK		NORMAL	

REARING CONTAINER I.D.:_____(TROUGH/TANK/POND)

AGE (FROM HATCH): _____AVERAGE WEIGHT (gm):_____

DIET:_____

WATER SOURCE: (√)

SALT		RIVER		LAKE		WELL		SPRING		MIXED		CITY	

TEMPERATURE:_____ºC OXYGEN (AVERAGE):_____ PPM

NUMBER OF FISH IN REARING CONTAINER: _____

LOSS RECORDS (PLEASE INCLUDE DATE):

TODAY:_____PAST 10 DAYS:_____

REASON FOR SUBMISSION:_____

_____

DESCRIPTION OF FISH BEHAVIOUR , APPEARANCE, AND OTHER PERTINENT INFORMATION:

_____

_____

5.3 Guidelines for in-Stream Placement of Salmon Carcasses for Nutrient Enrichment

Introduction

Historically, large numbers of salmonid carcasses provided entire watersheds with abundant nutrients and organic matter derived from the ocean. Recent research strongly supports the hypothesis that salmon carcasses play a key role in maintaining the productivity of salmonid systems and benefiting the aquatic and terrestrial ecosystem as a whole. Rearing juveniles consume salmon eggs, feed directly on spawned-out carcasses, and benefit from increased abundance of invertebrates and algal growth. The presence of carcasses in streams has been related to increased juvenile density, growth rate, body size, improved fish condition, improved over wintering survival and ultimately increased marine survival.

These guidelines have been developed to regulate the in-stream placement of hatchery salmon carcasses from Fisheries and Oceans Canada enhancement facilities where there is a desire and the capacity to distribute carcasses. The guidelines are not intended to enforce the distribution of carcasses, nor to replace harvest under an Excess Salmon to Spawning Requirements (ESSR) authorization.

These guidelines are meant to increase the overall benefits from carcass placement by minimizing disease risks and other concerns, providing general management strategies for carcass placement, and highlighting the interagency process to avoid conflicts with potentially affected groups and agencies. Numerous factors affect the benefits of carcass placement in streams. These include ambient nutrient content in treatment streams, abundance of native salmon spawners, presence of fish disease agents in carcasses, retention and distribution of carcasses in waterways, water temperatures, flow levels, light penetration, and predator / scavenger activity on carcasses by insects, fish, birds and mammals. These factors have been considered in the development of the guidelines The guidelines were developed utilizing current relevant literature, input from DFO fish health specialists and ecological research scientists, and guidelines prepared by the Washington Department of Fish and Wildlife.

Planning, Review, And Awareness

Carcass placement plans must be reviewed by a DFO member of the Introductions and Transfers committee. Projects that meet the terms of the carcass placement guidelines will be issued a letter from the Department allowing the transport and deposition of carcasses. This letter must accompany all carcass movements. Carcass placement plans should be discussed with all relevant groups and agencies. These groups will include DFO local area staff in stock assessment, habitat, and resource management, and Conservation and Protection (Fishery Officers), as well as local First Nations, stewardship groups, affected landowners or any other affected groups. It is also important to contact the regional Ministry of Environment office to ensure that carcass placement is coordinated with inorganic nutrient enrichment projects. The Ministry of Environment should also be contacted if placement is considered in non-anadromous waters.

Under the Water Act, downstream water users (primarily local municipalities), must be advised of activities that may potentially impact water quality of their withdrawals. Accordingly, Water Licensees on treatment streams should be advised prior to placement programs. Carcasses should be distributed in such a way so as to avoid or minimize impacts on domestic and other types of intakes or water

supplies. Background material and signage may be provided to advise members of the public of carcass placement activity and its benefits.

Carcass Management and Condition

The placement of salmon carcasses in streams may pose a risk of disease transmission if carcasses of infected fish are used, if carcasses are moved to areas within the watershed that are normally not accessible to salmon, or if carcasses are moved to streams outside the watershed. Streams that receive carcasses are referred to as "treatment" streams and those that provide carcasses are referred to as "donor" streams. In general, no carcasses may be moved outside their natal stream because of concerns regarding disease transmission. However, in specific circumstances, movement of carcasses from the watershed to nearby streams may be considered if all of the following conditions are met: donor and treatment streams are geographically proximate and, treatment stream is within the zone of influence of the donor stock (i.e. adults may be straying from donor to treatment stream), and current disease history is available. If sufficient information is not available, health testing of fish in the donor stream and treatment stream may need to be undertaken. Historical information can be obtained by searching the Pacific Biological Station (PBS) Fish Health Database; the Fish Pathology Program may be contacted at (250) 756-7057. Please note that wild fish surveys have not been conducted in many locations in recent years so that information contained in the database does not include current disease status for many salmon stocks.

Only those fish killed with CO2 or blunt trauma that show no visible evidence of serious disease should be used for carcass placement. Carcasses of recently dead salmon from managed spawning channels may also be considered for placement.

Because of drug clearance times, and the length of holding, fish previously treated with an antibiotic or chemical anaesthetic (i.e. TMS™, Aquacalm™) must not be used for carcass placement. However, fish treated with external chemicals that do not require a withdrawal period (e.g. Parasite-S™ or Chloramine-T) are considered safe for placement. If in doubt, contact the Fish Pathology Program. Carcasses may be frozen for later use. However, as freezing will not significantly reduce disease organism loads, it should not be considered a disease management tool.

Carcass Loading Density

All salmonid carcasses are considered equal from a nutrient content basis. That is, required placement load may be calculated as biomass and then converted to fish numbers of the available species. For example, Chinook carcasses may be substituted for coho, and vice versa. Where system-specific weight data are not available, the following average weights for returning B.C. salmon are provided for weight conversion.

<u>Suggested Average Weights for B.C. salmon *</u>
Pink 1.5 kg
Steelhead 4.0 kg
Sockeye 2.5 kg
Chum 4.5 kg
Coho 3.0 kg
Chinook 8.5 kg
* Data sources: mean weights from B.C. catch statistics (J. Bateman, pers. comm.)

The maximum carcass placement within a stream segment (including the areas into which carcasses drift from the distribution point), over the course of a spawning season should be 1.9 kg/m² based on Wipfli et al. (2003) and WDFW (2002). In treatment streams with continuous escapement records, the carcass numbers may be reduced by the recent 10 year average for natural escapement to the treatment reach.

For determining total carcass deposition maximums for streams used by more than one salmon species, the area historically available to each salmon species should be used to calculate the loading rate. Spawning timing should be factored into distribution schedules.

Maximum loading densities may be adjusted to reflect the stream's carcass retention properties. Carcass retention in streams is affected by predator / scavenger activity, carcass transport during high flows, and abundance of in-stream structures to catch and retain carcasses. Accordingly, for streams with expected good carcass retention, maximum carcass densities may be reduced by the current spawner densities. For streams with expected poor carcass retention (high gradient, high flows, few pools and few in-stream structures), carcass loading densities need not be adjusted for current spawner densities.

Carcass Distribution

The temporal and spatial distribution of carcasses should reflect the historic spawn timing and abundance of salmon in the treatment reach. Carcasses should be placed in stream areas that are normally (or recently historically) accessible to salmon, (i.e., not above barriers). Carcass placement into inaccessible stream segments may be permitted where juvenile salmon of the same stock and species have been previously out planted (e.g., colonized upper areas above impassable barriers) but consultation with regional Ministry of Environment staff is necessary.

Placement in the riparian zone is not necessary and often results in increased numbers of blowflies. (Reimchen et al, 2003.). Natural predators will remove carcasses from the treatment stream and distribute them in riparian zones.

For streams with poor access (and low public use), a few accessible sites may be used for regular carcass placement. These sites should be inspected periodically to ensure adequate natural dispersion of carcasses. Where dispersal is poor, carcass loading should be reduced.

Carcasses should be distributed in stable stream areas, where possible. This will help avoid rapid downstream transport of carcasses. Optimal sites include shallow backwater pools, side-channels, small headwater tributaries, areas with abundant woody debris and beaver-dam complexes. However, note that placing excessive numbers of carcasses in side pools with sluggish or intermittent water exchange may cause de-oxygenation (E.A. MacIsaac, pers. comm.). Carcass placement should be avoided or delayed during high flow events, especially where anchoring and/or riparian placement is not feasible. Carcass distribution schedule should consider anticipated problems of poor stream accessibility due to snow, high water, and other constraints.

Timing of carcass placement is also important as nutrients should be made available to young salmon upon their emergence from the gravel. Placement timing may be early, mid or late, and may be used to

influence the ecological response to loading within watersheds. For example, the use of carcasses from later runs of native salmon (fall and winter) may benefit the next growing season, provided that some nutrients are stored through the winter (Wipfli et al. 1999). Also, the use of carcasses from several species, each with a different run timing (e.g., early sockeye, mid-chum, late coho), will provide a longer nutrient pulse in the treatment stream than if only one or two species were used, each with a brief spawning period.

If a treatment stream has a late natural spawning timing, carcasses from earlier runs to the treatment stream may be frozen and stored for later placement. The use of frozen carcasses is also convenient for long-distance transport.

Carcass Anchoring/Mutilation

Carcasses may be tethered or anchored in place, especially in unstable, higher-flow areas in order to improve carcass retention. Where carcass anchoring is desirable, natural anchors (e.g., large woody debris, logjams,
beaver-dams) or bio-degradable tethers such as natural-weave ropes, should be used where possible. External identification tags should be removed from carcasses prior to their placement. Non-bio-degradable tethers should be collected and removed from the stream after carcass decomposition. Where frozen carcasses are used, they should be tethered in place (frozen carcasses float and may be readily transported downstream). Where tethering is not possible, it is preferred to thaw out at least one fourth of the frozen carcasses before distributing them in order to enhance carcass retention at the point of access.

Where escapement enumeration programs will be conducted on treatment streams, carcasses should be cut in half or otherwise mutilated at placement, as directed by area stock assessment staff. This is crucial in order to avoid double-counting and ensure that enumeration programs are not affected.

Records of Carcass Placement

Records of numbers and species of carcasses placed in treatment streams should be maintained in annual data summaries, including areas and dates of placement. Summaries should be provided to the contact member of the Introductions and Transfers Committee.

References and Background Literature

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5.4 National Aquatic Animal Health Program

The following excerpt explaining the functions of the NAAHP are extracted from: http://www.dfo-mpo.gc.ca/Aquaculture/health-sante_e.htm

The NAAHP is a science-based regulatory program for aquatic animal diseases which have been designated reportable or notifiable in Canada because of their potential impact on trade and our economy. The program consists of measures needed to prevent, control and/or eradicate aquatic animal diseases of concern. The NAAHP is modeled after Canada's internationally recognized terrestrial animal health program, and will respect the health measures of the Aquatic Animal Health Code of the World Organization for Animal Health (OIE).

The NAAHP is comprised of the following key elements for listed diseases of concern:

- Listing of aquatic animal diseases meeting international and national criteria for mandatory reporting
- Legislation, regulations and policies
- Surveillance (early detection), monitoring and reporting
- Zonation (regionalization)
- Disease databases
- Laboratory diagnostic testing and capacity building
- Quality Assurance/Quality Control
- Scientific research and technology development
- Import controls
- Export certification
- International relationships (influencing setting of standards, trade negotiations)
- Contingency planning
- Disease control and eradication (containment standards and quarantine, disease preparedness and response etc.)
- Education and training
- Risk analysis
- Awareness
- Animal welfare
- Record keeping (tracking and tracing)
- Codes of practice
- Hatchery Program

As a member of the OIE and the World Trade Organization, Canada is obliged to implement OIE standards for trade purposes, including trade in aquatic and terrestrial animals. In addition, Canada is a member of the Food and Agriculture Organization (FAO) and signatory to the Code of Conduct for Responsible Fisheries aimed at conservation of resources for sustainable economic productivity. Canada's major trading partners are adopting regulatory frameworks for their own aquatic animal health programs to meet these international scientific standards. Canada may be required to attest, for export purposes that aquatic animals and their products originate from regions, farms or sites that are free of reportable or notifiable diseases.

The Minister of Agriculture and Agri-Food, who is responsible for the CFIA, and the Minister of Fisheries and Oceans are jointly implementing the federal responsibilities for the NAAHP. This collaboration between Canada's veterinary services and fisheries authority will greatly facilitate Canada's capacity to meet international obligations for aquatic animal health management.

The CFIA provides the overall program lead for the NAAHP under the legislative authority of the Health of Animals Act and Regulations. The Agency is responsible for the disease surveillance/monitoring protocols and control measures for reportable diseases. DFO delivers and oversees the National Aquatic Animal Health Laboratory System (NAAHLS).

Since the management of the wild and aquaculture industries is a shared responsibility in Canada, the NAAHP is designed to respect federal and provincial/territorial jurisdictions. Expertise and collaboration from provinces/territories and industry will continue to be sought to minimize duplication or gaps in an effort to ensure that all aquatic animal diseases are well managed by government and industry.

The Aquatic Animal Health Committee (AAHC) has members which include the Canadian Aquaculture Industry Alliance (CAIA), the Fisheries Council of Canada (FCC), the Aboriginal Aquaculture Association, the Canadian Veterinary Medical Association (CVMA), provincial representatives, Fisheries and Oceans Canada and the Canadian Food Inspection Agency. The AAHC advises the CFIA and DFO on matters relating to the development and implementation of the NAAHP. Information will be shared extensively with all stakeholders as major components of the NAAHP evolve. This approach will ensure a comprehensive and coordinated aquatic animal health management program for Canada.